Section 1
GENERAL

SECTION I. GENERAL

MAINTENANCE OF THE CEMB BINDER

There is a common tendency to "force" the locks at each end of the binder by depressing them too firmly. It is advised that these locks may be operated correctly with the lightest pressure. The handles are not supposed to go all the way down, but are to be depressed only enough to cause a light grip. A simple trial will demonstrate the amount of depression required of the handles in order to lock the binder sufficiently to prevent its falling apart.

In case any binder is forced to the extent that it finally does not lock, a repair may be effected by squeezing the guide lips slightly with pliers.

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CATALOGUE OF ELECTRON TUBE TYPES

A publication entitled "Catalogue of Electron Tube Types in Use by the Navy" (NAVSHIPS 900,075) has been published and distributed to all ships and shore stations concerned with electronic equipment.

This pamphlet lists vacuum tubes by their approved designations. To be sure you get the tube you want, *use the approved designation.*

If you don't have a copy of this publication, you can get one by writing the Bureau of Ships.

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TREATMENT OF STORED TUBES

When tubes are removed from storage for installation in equipment, it is suggested that contact pins and caps be cleaned with fine (00 or 000) sandpaper. This procedure removes all traces of dirt or oxide which may have collected on the pins and produces a clean but slightly rough surface thus assuring good contact in the sockets.

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CARE OF MERCURY VAPOR TUBES

Certain equipments such as the LR frequency meter and the TBM and TBM–2 transmitters employ mercury vapor rectifier tubes such as types 872, 866, 82, 83, etc. When these equipments are turned on after a period of disuse there may be violent arcing inside the tube due to the collection of metallic mercury on the filament and walls of the tube. This may damage associated transformers as well as ruin the rectifier tube.

This condition may be avoided and the life of mercury vapor rectifier tubes considerably increased by adherence to the following suggestions:

(1) Before putting a tube in service, always wipe the bulb clean to avoid surface leakage and the resultant heating effects.

(2) Maintain the filament voltage at its rated value to provide the proper amount of barium at the surface of the cathode.

(3) In tropical climates or under high temperature conditions, forced ventilation may be necessary to obtain the specified ambient temperatures as recommended by the manufacturer for certain mercury vapor tube types. The temperature of the condensed mercury in the base of any mercury vapor tube should be kept within the specified limits to insure proper vapor pressure for optimum operation. Low condensed mercury temperature decreases the mercury vapor pressure and raises the potential at which the tube starts to conduct. This causes deterioration of the filament because of the higher voltage drop across the tube. On the other hand, high condensed mercury temperature reduces the peak inverse voltage that the tube can stand and may cause arc-backs with consequent destruction of the tube. Either condition reduces tube life. The temperature of the condensed mercury may be measured with a thermometer attached with a small amount of putty to the bottom of the glass bulb.

(4) Whenever a new mercury vapor rectifier tube is installed or when equipment is to be used after standing idle for a month or more, the tube must be conditioned. This is accomplished by running the tube for one-half hour at rated filament voltage and *without* any plate voltage applied. This procedure assures the evaporation of all mercury from the tube bulb and mount before plate voltage is applied. The reasons for this operation are:

(*a*) Liquid mercury clinging to any part of the mount may cause excessive mercury pressure at that point with resultant local arcs.

(*b*) Mercury globules that adhere to the plate may act as a pool cathode and cause arc-backs.

(*c*) Mercury condensed on the glass may cause mercury vapor streamers which can produce excessive heating of the bulb.

(5) If at all possible, plate voltage should not be applied to mercury vapor tubes until 30 seconds after filament voltage has been applied. This insures adequate time for preheating the filament to insure proper mercury vapor pressure for best operating conditions. Should plate voltage be applied too soon, the cathode will be bombarded and harmed because of the resulting high voltage drop through the tube.

REMOVAL OF TUBES FROM EQUIPMENTS

In some sets tubes are mounted very close to other parts and their removal is often very difficult. Such tubes may be removed by making a "lasso" out of a few feet of hook-up wire and slipping the noose over the tube down to the base. With assistance from one hand on the top of the tube, a slight vertical tug on the wire with the other will remove the tube. Care should be taken not to use the lasso on the glass portion of tubes as the glass may come loose from the base.

"Loktal" tubes cannot be removed by this method as they lock into the socket. They may be removed by rocking the tube circularly in its socket until its release from the socket lock is evidenced by a slight click. The tube may then be removed by a vertical pull. When being inserted in the socket they must be located in the proper position by the key on the locating plug in the center of the base, in the same manner as octal based tubes. The tube is then pressed down until locked in the socket which is evidenced by a slight click.

TESTING TYPE CWL-861 ELECTRON TUBES

Figure 1 shows the recommended method of opening the waterproof paper containers used for shipping type CWL-861 electron tubes. The Westinghouse Electric & Manufacturing Co. recommends that the bottom of the case (end opposite the handle) be opened in order to conveniently test this tube type for continuity. See figure 1.

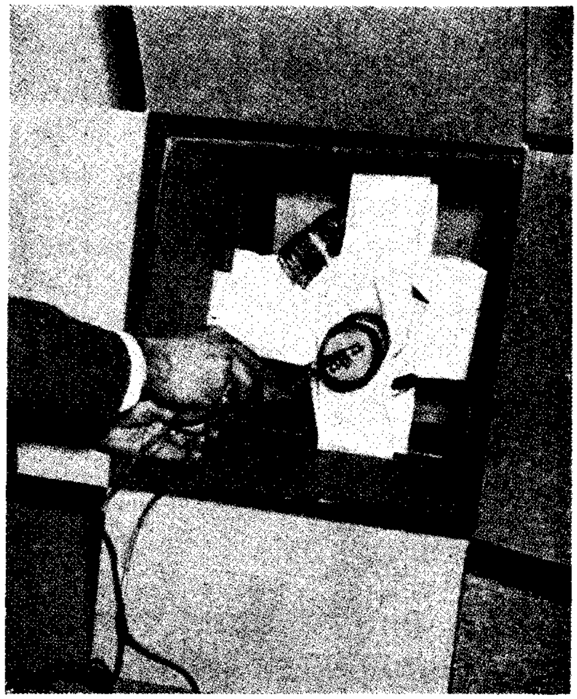

FIGURE 1.—Testing type CWL-861 tubes.

For testing in this manner, it will not be necessary to remove the tube or packing material from the container. After testing, the container should be resealed with the proper kind of tape.

they should always be inserted so that the short-tipped end rests in the mounting hole. This places the large end on the same side of the socket as the clips.

The design of the socket will not prevent the tube from being accidentally inserted *upside down*. If this should occur, the tube and probably a plate circuit resistor would burn out. With some sockets it is also possible to insert the tube *backwards*, i. e., with the two-grouped tube prongs inserted in the three-grouped socket clips and the three-grouped tube prongs inserted in the two-grouped clips.

It is obvious that there is but one correct way to mount acorn tubes in their sockets. A simple rule to remember is to *always grasp the large end of the tube* in the fingers and insert the *two-grouped* tube prongs in the *two-grouped* socket clips.

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MAINTENANCE OF TRANSMITTING VACUUM TUBE SPARES

In radio communication equipment where the transmitters are not used continuously a rotation of spares is undesirable. However, the quarterly tests as outlined in BuShips Manual 67–151 should be modified to include spare tubes and the test on shipboard should include an operational test of at least one hour, the main purpose of which is to clean up any gas present. The tube should be operated as near its maximum ratings as possible. This is particularly true of tantalum plate tubes as no clean-up is obtained unless the plate is operated at a white color in the center.

Types which should be given this operation test include the 203–A, 204–A, 211, 217–C, 803, 805, 809, 811, 812, 813, 814, 833–A, 838, 845, 849, 851, 852, 860, 861, and 38111A.

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GROUNDING OF ELECTRONIC WORKBENCHES

It has been brought to the attention of the Bureau, that ships electronic workbenches were insulated from the deck or other grounded structures. This type of installation is dangerous as well as instrumental in setting up interference to installed electronic equipment, while repairing equipment on the ungrounded bench.

Special precaution should be taken to ground workbenches by providing two or more ground straps symetrically placed at diagonally opposite corners or posts using low resistance flexible braid securely welded or bolted to steel deck or bulkhead. After completing grounding of the bench it should be tested with a low reading ohmmeter to insure positive grounding. Positive ground will be indicated by a meter reading of 0.01 ohm or less. *10/1/51*

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POWER TRANSFORMER FAILURES

The majority of power transformer failures are directly traceable to troubles originating in other components of the equipment. By means of a few simple tests much of this trouble can be avoided.

Frequent tests should be made to determine the line voltage, and in those cases where the voltage is found to exceed the rating of the equipment by more than 5 percent, steps should be taken to reduce it to within the allowable limits. For optimum results the line voltage should not vary more than ±5 percent. Modern equipments are designed to operate satisfactorily when operated within ±10% of the normal line voltage. High line voltage will cause transformers to heat excessively, causing the insulation of the windings to char. When this happens flash overs, burnouts, and shorted turns are the result.

If a watt-meter is available the equipment may be checked, and compared with the rating in the instruction book. In the absence of a watt-meter, a rough check may be made by feeling the case of the power transformer. If the transformer is so hot that a hand cannot be held on it indefinitely (the transformer will be *warm* in normal operation) there is too much current being drawn and the equipment should be turned off until the trouble can be located and corrected.

Shorted tubes, condensers, reactors and grounded terminals should ordinarily be found easily. Direct shorts can be determined quickly by removing the rectifier tube and measuring the resistance from filament or cathode (some rectifiers are indirectly heated) to ground. Reference to the instruction book will give the correct resistance. Small variations will occur, but the resistance should not vary more than 10 percent.

Frequently a piece of equipment will operate to all appearances normally, but the transformer overheats. In such cases it is well to test for tubes which partially short, condensers with high resistance leaks, resistors which ground—things causing an increased excessive drain, but not sufficient to prevent operation of the equipment. Point-to-point resistance charts furnished in the instruction books for each equipment should be used to facilitate the work and increase the efficiency of the units.

It should be borne in mind that any abnormal current drain on the secondary side of a power transformer will cause a correspondingly heavier drain on the primary side, and that heavy and abnormal current drains will heat the windings of the transformer causing eventual burnouts, shorts, etc. Defects of power transformers are rare; their failure is usually caused by some other component in the equipment.

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→ RADIO EQUIPMENT LOG

The Radio Equipment Log–NAVSHIPS 900,039–is obsolete and all copies in stock have been destroyed. The Electronic Equipment History Card–NAVSHIPS 538–the Record of Field Changes–NAVSHIPS 537–and the Tube Performance Record–NAVSHIPS 538–are to be used in its place. They are described in Chapter 6 of the BuShips manual, Paragraph 6–32(1), and in the February 1948 issue of BuShips ELECTRON, Jage 12. *1/1/52* ←

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ISSUE OF PUBLICATIONS TO INDIVIDUALS

The Bureau gets letters from time to time from individuals requesting publications for their personal use. While we appreciate the interest and enterprise of these people who are anxious to improve their understanding of radio, unfortunately it is not possible to print enough copies for personal issue. Therefore, if you find your ship or station hasn't enough copies of some publication for convenient use, ask the commanding officer to make an official request or what you need. A good policy is to *establish a library or central reference point where everyone can read and study radio publications.*

●

REVISED ELECTRONIC FAILURE REPORT NAVSHIPS 383

One of the most important links in the chain of events in the electronics maintenance program is the Electronic Failure Report, NAVSHIPS 383. This report, submitted for each and every mechanical and electronic failure of electronic equipment, furnishes valuable data for the following vital functions:

(1) Procurement of maintenance repair parts

(2) Location of design and manufacturing defects

(3) Development of field changes

(4) Contractual adjustments

(5) Preparation of maintenance data

(6) Assistance in future design.

Use of this revised form provides several features. First, copies are not required and the necessary information can be entered with pen, pencil, or typewriter. The procedure has been simplified further in that the type or failure can be entered by a check mark (√ or **x**). Also in order to facilitate stocking, pads of reports are issued instead of single copies. Detailed instructions are interleaved in each pad. Another advantage of the revised report is that one set of data blanks fulfills the requirement for reporting tubes and parts instead of having one side for tubes and the other for parts as previously used.

The report is self-explanatory, and care should be exercised in entering the data as indicated, in order that the best possible use can be made of the information. It cannot be overemphasized that the report should be complete and that only one failure should be reported on each sheet.

Figure 1 is a failure report correctly prepared. It is recommended that all maintenance personnel familiarize themselves with this sample. It is suggested that the items be completed in the following order:

(1) This space is provided for numbering the reports as found necessary.

(2) List the date on which the failure occurred.

(3) Include both the ship's number and name or the station.

(4) Specify the ship's number and name or the station which effected the repair.

(5) Specify the name and rate of the person who effected the repair.

(6) Indicate the service using the equipment.

(7) Indicate the type activity using the equipment.

CAUTION.—The information entered in items (3) through (7) *must be compatible.* Example 1, if an electronic equipment, which is installed in a plane aboard a carrier, is serviced by a technician from a tender, the plane's number should appear in item (3), the name and number of the tender in item (4), the name and rate of the person effecting the repair in item (5), block 1, NAVY, should be checked in item (6), and block 4, AIR-BORNE, should be checked in item (7).

Example 2: If an electronic equipment which is installed in a jeep carried aboard a ship is serviced by personnel at a Naval Shipyard, the jeep's designation should appear in item (3), the name of the yard in item (4), the name and rate of the person effecting the repair in item (5), block 1, NAVY, of item (6) should be checked, and block 3, AMPHIBIOUS, in item (7) should be checked.

U. S. NAVY ELECTRONIC FAILURE REPORT
NAVSHIPS 383 (REV. 4-49)

NOTICE: 1. Read instructions interleaved in this pad prior to preparing report.
2. Report all failures (Electronic, electrical, and mechanical).
3. Use separate sheet to report each part failure.

REPORT—SHIPS-84

(1) REPORT NO.

(2) DATE OF FAILURE 25 JAN. 1950

EQUIPMENT INSTALLED IN (*Number and name of ship or station*)	REPAIRS MADE BY (*Number and name of ship, yard, tender, etc.*)	LEAVE BLANK	REPAIRED BY (*Name and rate of person*)
(3) DD-999 USS EVERSAIL	(4) DD-999 USS EVERSAIL		(5) P. DOE ETI

SERVICE USING EQUIPMENT (*Check one*) (6)	TYPE ACTIVITY USING EQUIPMENT (*Check one*) (7)	EQUIPMENT CATEGORY (*Check one*) (8)
1 [X] NAVY 2 [ ] USCG 3 [ ] USMC 4 [ ] ARMY 5 [ ] AIR FORCE	1 [X] SHIP 2 [ ] SHORE 3 [ ] AMPHIBIOUS 4 [ ] AIR-BORNE 5 [ ] OTHER (*Specify*)	1 [X] RADIO 2 [ ] RADAR 3 [ ] SONAR 4 [ ] TEST 5 [ ] ORDNANCE 6 [ ] NANCY AND RADIAC 8 [ ] POWER 9 OTHER (*Specify*)

NAME PLATE DATA

EQUIPMENT				MAJOR UNIT INVOLVED
MODEL DESIGNATION (9) XXX-5	SERIAL NO. (10) 1745	NAME OF CONTRACTOR (11) RADIO CO.		TYPE NO. AND NAME (14) -46080 RECEIVER
LEAVE BLANK	CONTRACT NO. (12) NXs-99999	DATE INSTALLED (13) 25 JAN. 1949		SERIAL NO. (15) 1762

PART FAILURE DATA (*Check one*)

(16)	COMPLETE TUBE TYPE, OR NAME AND NAVY TYPE NO. OF PART	STANDARD NAVY STOCK NO. (*See note 10*)	SYMBOL DESIGNATION (*V-101, R-201, etc.*)	FAILED IN (*Check one*) (20)
[ ] TUBE	(17) POTENTIOMETER -63757	(18)	(19) R-136	1 [X] OPERATION 2 [ ] FAULTY PACKAGING 3 [ ] HANDLING 4 OTHER (*Specify*)
[X] OTHER	APPROXIMATE LIFE (*Hours*) (21) 420 — LEAVE BLANK	MANUFACTURER'S NAME (22) RESISTOR CORP	SERIAL NO. OF TUBE OR PART (23) — ARMY STOCK NO. (*USMC only*) (24)	MFRS' DATA (*See note 18*) (25)

CHECK TYPE OF FAILURE (26)

002 [ ] AIRLEAK	130 [ ] CHANGE OF VALUE	300 [ ] GROUNDED	360 [ ] INTERMITTENT OPERATION	225 [ ] MFR'S DEFECT	003 [ ] OPEN FILAMENT	540 [ ] PUNCTURED	620 [ ] SHORTED TO PRIMARY
007 [ ] ARCING	170 [ ] CORRODED	310 [ ] HANDLING IMPROPER	380 [ ] LEAKAGE	009 [ ] MICROPHONIC	460 [ ] OPEN PRIMARY	011 [ ] SCREEN DEFECTS	630 [ ] SHORTED TO SECONDARY
070 [ ] BROKEN	190 [ ] CRACKED	320 [ ] HIGH VOLTAGE BREAK-DOWN	013 [ ] LOOSE BASE	008 [ ] NOISY	470 [ ] OPEN SECONDARY	005 [ ] SHORTED INTERMITTENT	020 [ ] UNSTABLE OPERATION
014 [ ] BROKEN BASE	330 [ ] EXCESSIVE HUM	340 [ ] INSTALLED IMPROPERLY	012 [ ] LOOSE ELEMENTS	022 [ ] NO OSCIL-LATION	480 [ ] OVERHEATED	006 [ ] SHORTED PERMANENT	[ ] OTHER (*Specify in remarks*)
015 [ ] BROKEN GLASS	001 [ ] GASSY	350 [ ] INSULATION BREAK-DOWN	004 [ ] LOW EMISSION	440 [ ] OLD AGE (*Specify in remarks*)	021 [ ] OVERLOADED	600 [ ] SHORTED TO CASE	
080 [ ] BURNED OUT	016 [ ] GLASS STRAIN		040 [ ] MECHANICAL BINDING	450 [X] OPEN	010 [ ] POOR FOCUS	610 [ ] SHORTED TO FRAME	GPO 16—58703-1

(27) REMARKS: INCLUDE CAUSE OF FAILURE AND SUGGESTED CHANGES (*Continue remarks on reverse side*) — LEAVE BLANK

OPEN ON HIGH SIDE, BELEIVED DUE TO HEAT, 2nd SUCH FAILURE IN YEAR

Example 3: If an electronic equipment such as the Ground Control Approach equipment, AN/MPN-1A located at an air station adjacent to a Naval Shore Station is serviced by technical personnel from the shore station, the name of the air station should be entered in item (3), the name of the shore station should be entered in item (4), the name and rate of the person effecting the repair should be entered in item (5), and block 1, NAVY, of item (6), and block 2, SHORE, of item (7) should be checked.

(8) Indicate the proper category of the equipment in which the failure occurred (as shown in NAVSHIPS 900, 135 for shipboard use).

Entries (9) through (12) are obtained from the main name plate of the equipment:

(9) Include the model designation (letter and numeral) of the complete equipment, for example TBI-5, -49545, AN/FMQ-2, AM-215/U.

(10) Include the serial number of the complete equipment. This number usually follows the model designation.

(11) Include the name of the contractor of the complete equipment.

(12) Include the contract number. This is very essential.

(13) Indicate the date that the complete equipment was installed. This information

should be available on the Electronic Equipment History Card NAVSHIPS 536 as used aboard ship. If the exact date is not available, the approximate date should be listed.

Entries (14) and (15) are obtained from the nameplate of the component (unit) in which the failure occurred.

(14) Include the type number and name, such as CNA–46080 receiver, AS–389/FMK–2 antenna.

(15) Include the serial number which usually follows the component (unit) type number.

(16) Indicate whether a tube or part failed.

(17) If a tube failed, give the complete tube type such as 6SN7GT, 807 W, etc. If a part failed, indicate the name and Navy type number such as resistor –63758, switch –24003, or the name and JAN number such as capacitor CV11A070.

(18) Enter the "Standard Navy Stock Number". If the SNSN is not known, omit this entry.

(19) Include the correct symbol designation of the part or tube that failed as marked on the unit or chassis and shown in the instruction book (V–303, T–101, etc.).

(20) Indicate properly whether failure occurred in operation or handling or was due to faulty packing. NOTE: If failure was noted when the maintenance part or tube had just been taken from the shelf or from stock, specify the exact condition by inserting the word "stock" in number 4 of item (20). Indicate the approximate shelf life in item (21) (example: 6 months-shelf) and check the type of failure properly, item (26). Elaborate as necessary under remarks, item (27).

(21) State the life of the part or tube in hours. If the exact life is not known, list the approximate number of hours of life.

(22) The name of the manufacturer of the part or tube that failed should be entered in this space. For the majority of parts, this name can be obtained from the instruction book or handbook. For tubes, this name can usually be obtained from the body or base of the tube or from the carton.

(23) Include the serial number of the tube which can be obtained from the body or base of the tube. Several individual parts also have serial numbers identifying year of manufacture, series, etc. This should always be stated.

(24) Enter the Army Stock Number. This space applies particularly to the U. S. Marine Corps.

(25) Include the manufacturer's identification data such as drawing number, part number, etc., if the equipment model, symbol designation, SNSN, etc., are not known.

(26) Indicate the type of failure. Where more than one type is involved, explain under "Remarks."

(27) Include the contract number and guaranteed life hours of guaranteed electron tubes. State the cause of failure of parts and tubes, and enter any suggested changes, comments, or recommendations to improve equipment operation.

It is recommended that Failure Reports be submitted immediately following repair or replacement of the defective part. Simultaneously, the Electronic Equipment History card, NAVSHIPS 536, or Tube Performance Record, NAVSHIPS 538, whichever is applicable for shipboard, should be maintained. Records which are kept up to date provide a valuable reference and aid in maintenance and repair of electronic equipment.

Additional pads of the Electronic Failure Report are available from the nearest District Publications and Printing Office.

Don't delay—Submit your reports. The link must not be broken. *4/1/50*

SUBMISSION OF QUARTZ CRYSTAL RECORDS

Several destroyers have recently submitted to the Bureau of Ships record sheets of radio crystals and crystal holders on DesAt form No. 91 (c). In accordance with the program for the elimination of forms no longer necessary for Bureau purposes, these quartz crystal records no longer need be submitted to the Bureau of Ships.

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SUBMISSION OF TRANSMITTER TUNING RECORDS

As transmitter tuning records are still being received in the Bureau from the field, attention is directed to BuShips letter serial no. 340 (925B) over EN28/A2-11 dated 5 January 1944 addressed to all Navy ships and several other Naval activities. This letter is reprinted here for the information of all cognizant activities:

"Subject: Radio—Transmitter Tuning Records.
Ref: (a) Manual of Engineering Instructions, Chapter 31 (mimeograph form).
(b) Form NBS-342 Transmitter Tuning Records.

1. Reference (a), paragraphs 31-225 to 31-229, inclusive requires preparation and submission to the Bureau of Ships of Transmitter Tuning Record Form NBS-342.
2. In the interest of reduction in paper work, addressees are advised that preparation and submission of transmitter tuning records is no longer required.
3. Each ship and station shall maintain sufficient transmitter tuning data to permit competent personnel inexperienced with the particular station to adjust any transmitter, and to serve as a guide to the expected performance of the transmitter installation."

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SPARE PARTS FOR NONSTANDARD TYPES OF RADIO EQUIPMENT

By previous correspondence, the Chief of Naval Operations established allowances for VHF equipment. The standard Navy type for this is known as the TDQ transmitter and RCK receiver. Pending the availability of the TDQ/RCK, the Bureau of Ships procured the Army types BC-639/BC-640 as "stop-gap" equipment. The delivery rate of the BC-639/BC-640 was not sufficient to meet urgent needs and such deliveries as were made were without spare parts for ten months after initial deliveries. Observing that the supply of BC-639/BC-640 would not meet vital requirements, the Bureau obtained, through the Bureau of Aeronautics, approximately 500 sets of the Army type SCR-274N as additional "stop-gap" equipment. This equipment could be obtained only in an incomplete condition and without spare parts, but the immediate need was so urgent that it was accepted and distributed to the forces afloat in an effort to give the forces afloat everything which was available as quickly as possible. It was never intended that the 274N would serve other than as a temporary substitute to be replaced at the earliest opportunity by the TDQ/RCK. Spares could not be obtained and are still not available. Inasmuch as the TDQ/RCK production has begun the Bureau is taking no further action to obtain spare parts for the SCR-274N.

By numerous requests to the Bureau for spare parts for miscellaneous types of equipment, it is apparent that many sets of the types SCR-522, SCR-624 and WE-233A have been installed by the forces afloat. This material was obtained, not through the Bureau, but from the Army or other activities in the operating areas. Inasmuch as the Bureau was not advised to anticipate spares for this equipment, no action has been taken to have such spares made available to the Bureau. The only source of such spares is from the activity which originally furnished the material to the ship.

Recently Army types SCR-508, 608, 609, 610, 619 and the BuAer type WE-233A have been authorized as part of the allowance for certain ships. The Bureau is procuring this equipment and will distribute it to the various installation activities in the same manner as standard Navy types of equipment. In order to clarify the procurement and distribution of spare parts for Army equipments, the Bureau has sent out a pilot letter which is reproduced here for the information and guidance of all concerned:

NAVY DEPARTMENT
BUREAU OF SHIPS
Washington 25, D.C.

Serial No. 1028(970)
EN28/A2-11

29 May 1944

To: Commandant, Navy Yard:
New York, N. Y. Navy #128
Mare Island, Calif.
Supply Officer in Command, Naval Supply Depot, Mechanicsburg, Pa.
Supply Officer in Command, Naval Supply Depot, Clearfield, Utah.
Commander Service Force, Seventh Fleet, c/o Fleet Post Office, San Francisco, Calif. (Att: RMO)
Commander, Eleventh Amphibious Force, c/o Fleet Post Office, New York, N. Y. (Att: RMO)

Subj: Radio—Maintenance Material for Servicing Army Type Radio Equipment in Use by the Navy.

1. The Navy will, in the immediate future, start receiving maintenance material for servicing Army type radio sets in use by the Navy. This material is being delivered to the Navy in two forms, i. e., "Depot" and "Third (3rd) Echelon" maintenance.

2. With the exception of Naval Supply Depot, Mechanicsburg, action addressees should, on receipt of "Depot" spares, place this material in bins by stock number, and issue as required to fill requisitions. Stock is to be maintained by requisition on the Bureau of Ships. Naval Supply Depot, Mechanicsburg, is to retain "Depot" maintenance intact for future distribution as directed by the Bureau of Ships.

3. Third (3rd) echelon maintenance corresponds to Navy tender spares, however, it must be repackaged for adaption to the Navy's needs. Naval Supply Depot, Clearfield, has been designated as the repackaging center. All third (3rd) echelon maintenance as received from the Army will be sent to Clearfield for repackaging after which it will be distributed as directed by the Bureau of Ships. The repackaged third (3rd) echelon sets are not to be broken open but are to be retained intact for further distribution as directed by the Bureau.

4. It must be kept in mind that there is no single list of "Depot" maintenance for a complete equipment but several lists, determined by the number of components comprising the complete equipment.

For example:

Army type SCR-608 consists of:

BC-683 (receiver)
DM-34 (dynamotor)
RM-20 (control unit)
A-83 (antenna) etc.

It is also to be kept in mind that all the components will not necessarily come from the same Army Supply Depot. Therefore, it is to be expected that the components making up a set of "Depot" spares will be received as separate shipments, from several sources, at different times. It is not anticipated that this will present any difficulty since the material all goes into the stock bins.

5. The Ground Maintenance Activities (G. M. A.) lists covering this material are being reproduced and will be distributed as rapidly as they become available.

E. L. FRYBERGER,
By direction of
Chief of Bureau.

CC:
CINCLANT
COMSERVLANT
CINCPAC
COMSERVPAC
COMNAVEU
COMNAVNAW
COM 11th PHIB
COMSERVRON 3rd Flt.
COMAIRCENTPAC (RMO)
COM 7th Flt.
RMO, NYBoston
RMO, NYNYK
RMO, NYPHILA
RMO, NYNOR
RMO, NY Charleston
RMO, NYPuget Sound
RMO, NY Mare Island
RMO, NYPEARL
RMO, INDMAN 7th N. D.
RMO, INDMAN 11
RMO, INDMAN 17
RMO, INDMAN 8

→INSTRUCTIONS FOR OBTAINING CLASS 16 MATERIAL

Numerous requests from forces afloat addressed for action to the Bureau of Ships indicate that many activities are unfamiliar with the proper procedure for obtaining Class 16 material. Such action burdens the Naval Communication facilities and places an unnecessary work load on personnel clearing these requests. More important, though, is the inherent delay incident to rerouting the requests to the appropriate activity.

The following information is published as a guide for all activities, and wide dissemmination is encouraged in order to clarify the situation:

Electronic equipment and components (major units) are issued to vessels and shore stations to fill allowances. Vessels allowances are published in the Electronic Equipment Type Allowance Book, NAVSHIPS 900,115, and shore station allowances are promulgated individually by letter from the Chief of Naval Operations. Electronic equipment and components cannot be obtained by the submission of a routine requisition. These equipments and components are procured by the Bureau of Ships and usually stocked in Naval Shipyards and at Naval Supply Depots. They are issued to vessels and shore stations to fill established allowances upon the recommendation of the Shipyard or Industrial Manager's Electronics Officer, acting as the representative of the Bureau of Ships.

In new construction vessels the allowance lists constitute authority to issue the equipments listed. Additional equipments may not be installed in any type of vessel, regardless of the class it belongs to, without prior Bureau of Ships approval, except in the case of a definite emergency; in the latter case the Bureau shall be notified immediately.

In the case of vessels in the maintenance category, the allowance lists alone are not to be taken as authority for accomplishing changes in existing installations. Alterations to electronic installations in these vessels can be accomplished only when they are specifically authorized by the Bureau of Ships in the form of ShipAlts or Bureau of Ships letter.

The allowance lists are authority for issuing to ships the items listed in fitting-out and tender allowances.

If a vessel wishes to obtain a new electronic equipment which is on its approved allowance, or an authorized replacement for an equipment already installed, application should be made through the proper maintenance activity afloat for approval and further transmittal to the proper Electronics Officer who will utimately be responsible for the approval of issue of the equipment. This applies where no installation costs are involved or where an approved ShipAlt has been issued and funds have been made available for its accomplishment. Shore stations will apply to the cognizant Electronics Officer for equipment and components to fill authorized allowances.

It will generally be the policy of the Chief of Naval Operations and the Bureau of Ships to establish and keep up-to-date allowance lists for electronic equipment, and it is considered that only in very rare instances should a vessel or shore station find occasion to request that an allowance for a piece of electronic equipment be established. In the event a vessel desires to make such a request, a letter should be forwarded through the cognizant type and fleet commanders to the Chief of Naval Operations. Shore station requests should be forwarded through the District Commandant to the Chief of Naval Operations. Such requests should be very specific and lucid in regard to the need for the establishment of the allowance.

If an equipment is worn or damaged beyond the point of economical repair, and a replacement is desired, a formal survey should be held in accordance with Article 1906, Navy Regulations, 1920. In all instances, the indicated disposition shall be to turn over the item to the nearest Electronics Officer for possible repair or cannibalization. After the survey is approved, application may be made in the normal manner for a replacement equipment to fill the allowance.

Requests for complete sets of spares or a field change to an installed equipment are handled in the same manner as for complete equipments.

In correspondence, identification of equipments or their components (major units), shall be either by Naval model letter, Army-Navy nomenclature, Navy type number, or a Signal Corps model designation, whichever is applicable. In the isolated case where no identification by model is available, the equipment or component requested should be completely identified by the appropriate description pattern in the Joint Army-Navy Manual of Standard Descriptions for Electronic Equipment and Material (JAN-109), which may be obtained from registered publication offices.

Attention is called to the fact that fire-control radar equipment is under the technical control of the Bureau of Ordnance, and is to be handled in accordance with the directives of that Bureau.

It is obvious, also, that various spare parts will be consumed from time to time. The proper procedure to obtain a part which is missing from a set of spare parts (due to expenditure, etc.) is to submit a requisition to the nearest electronics stocking point. If the material is not available, the Supply Officer at the stocking point will order the necessary parts from the Naval Supply Center, Oakland, Calif. or Pearl Harbor (for the Pacific area). If these wholesale points do not have the parts requested, the request will be forwarded to the Electronics Supply Office, Great Lakes, Ill., which will then purchase the parts from commercial sources.

The Supply Officer of the electronics stocking point will attempt to obtain and furnish the material before the vessel leaves his vicinity. If he is unable to obtain the material prior to the vessel's departure, he will return the unfilled portion of the requisition to the ship and advise the commanding officer that no further action will be taken by him to forward the missing items to the vessel, and that the unfilled portion should be cancelled. The commanding officer will then submit a new requisition on his next arrival in port or next contact with an electronics stocking point. This is to prevent the situation of having many items following the ships; in many cases the items will never be delivered—resulting in waste of shipping space, loss of material, increasing paper work, and adding to the burden of shipping personnel.

In all cases as complete an identification as is possible of the part requested should be furnished. The following information, in addition to a brief description of the part, is available to ships and should be furnished:

(1) Navy type letter designation or JAN designation.

(2) Model letters of the equipment for which the part is required. Circuit symbol number of the part in the model letter equipment.

(3) Manufacturer's (or contractor's) name and part number. *4/1/48*←

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CORRESPONDENCE CONCERNING DISTRIBUTION AND ALLOCATION OF MATERIAL

It has been noted that occasionally communications are received from the forces afloat concerning requests for the allocation of certain electronic material. These requests should normally have been received from the local EO as representative of the Electronics Division, Bureau of Ships and should have been evaluated by that officer so that the Electronics Division would have the benefit of his experience and his first-hand knowledge of the situation.

It is not desirable that such requests be returned for resubmittal, as this procedure would result in a considerable delay and in many cases a worthy request would be delayed to such an extent that compliance becomes difficult if not impossible.

However it is considered desirable that in all such cases, communications be addressed to the nearest EO in order that he, as the Electronics Division's representative may be kept informed of all such transactions, and that we may have the benefit of his first-hand knowledge. The above policy includes, where circumstances dictate, communication with the service force commanders concerned as well.

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IMPORTANCE OF PROPER DESCRIPTION ON REQUISITIONS FOR CLASS 16 MATERIAL

To insure prompt delivery of Class 16 replacement parts on requisition, it is imperative that all items be clearly identified. Many instances have been reported where supply activities have been unable to furnish items requested because of insufficient part descriptions.

When ordering Class 16 replacement part as much of the following information should be given as pertains:

(1) Federal standard stock number, if any.

(2) Navy type number of the part itself; if not available, the equipment manufacturer's part or drawing number, together with the

names of the manufacturer of the equipment and the part.

(3) Navy model letter of the equipment in which used, and circuit symbol describing it; or if not a Navy model, the manufacturer's type number on the whole equipment and the name of the manufacturer.

(4) A description of the part itself including its capacity, resistance, rating, power supply or other characteristics.

(5) If an equivalent item instead of an exact replacement is satisfactory, state so and indicate whether the supplied part should be equivalent as to size, weight, capacity, function, rating, or some other characteristics. This information is extremely helpful in deciding whether an available part is sufficiently close to the desired characteristics to justify sending it.

(6) Whether in equipment, tender or stock spares.

(7) Electron tubes should be ordered in accordance with the approved Navy designations as set forth in *Armed Forces Cross Index of Electron Tube Types, Section 16–820 of Catalog of Navy Material, Bureau of Ships Section, Part II*, and published by the Electronic Supply Office, Great Lakes, Illinois (copies are available on request).

Requests will specify the quantity required for immediate delivery and also the additional quantity required for stock. If part of the order must be delivered by a certain date, or directly to another supply activity, this fact will be stated.

DATE MARKINGS ON ELECTRONIC EQUIPMENT

During the war the Joint Security Control directed that all forms of date markings, such as date of contract, date of manufacture, date of acceptance, etc., should be omitted from all electronic equipment for security reasons. This directive was later modified several times to permit coded dates, dates on components, dates on tubes, dates on commercial units, etc., to satisfy unforseen conditions arising when the original directive was applied.

The Joint Security Control has recently amended its policy on the date marking of electronic equipment, and the following is quoted from letter JSC/L21–3, dated 19 November 1946, and received via the Chief of Naval Operations:

"a. No markings which indicate date of manufacture, either coded or uncoded, shall be permitted on any electronic systems, equipments, units or removable assemblies, except as provided in paragraphs b and c below.

"b. Appropriate date markings shall be permitted on component parts of electronic equipment when necessary for quality control, production or maintenance purposes.

"c. Service agencies shall be permitted to affix appropriate date markings on electronic equipment when required in connection with servicing, overhaul and preventive maintenance work.

"NOTE.—It is to be understood that the above policy does not prohibit the use of code designations for the fiscal year of purchase order on nameplates of equipment."

It should be noted that the above policy *permits* the application of uncoded dates in connection with servicing, overhaul and maintenance work on equipments. Such dates are very desirable, and sometimes essential, in the proper accomplishment of routine overhaul on certain types of electronic equipment. It is frequently necessary or desirable to know the date when an equipment was last overhauled, when last inspected, etc., without referring to logs or records, which may or may not be available.

The particular form the information may take and the method of application will vary considerably to suit the specific equipments and units involved; therefore, a uniform procedure or method cannot be specified here. The marking, however, should be legible, prominent, and of sufficient permanence to insure easy readability during the expected period of usefulness. *1/1/48*

REDUCTION IN NUMBER OF LOUDSPEAKERS

In order to eliminate a portion of the confusing noise in the pilot house, combat information center, and other spaces aboard ship, the Bureau of Ships plans in future installations to limit the number of communications loudspeakers to a maximum of four in any one station. This total will not include intercommunications speakers, or speakers built into remote control units or equipment such as the Type–23270 TCS remote control units, or that of the MBF.

In order to gain maximum flexibility with a minimum number of loudspeakers, selective monitoring should be provided. This may be accomplished by two methods, illustrated in Figure 1, as follows:

(1) When six or more voice circuits are utilized, by connecting one Type JA2C (30) rotary switch (Bureau drawing 9000–S6503–73437) between each speaker-amplifier (Type–49546 loudspeaker and Type AM–215/U amplifier) and each voice remote-control unit or radiotelephone receptacle. Additional circuits may also be connected directly to the receiver transfer-panel in the radio room.

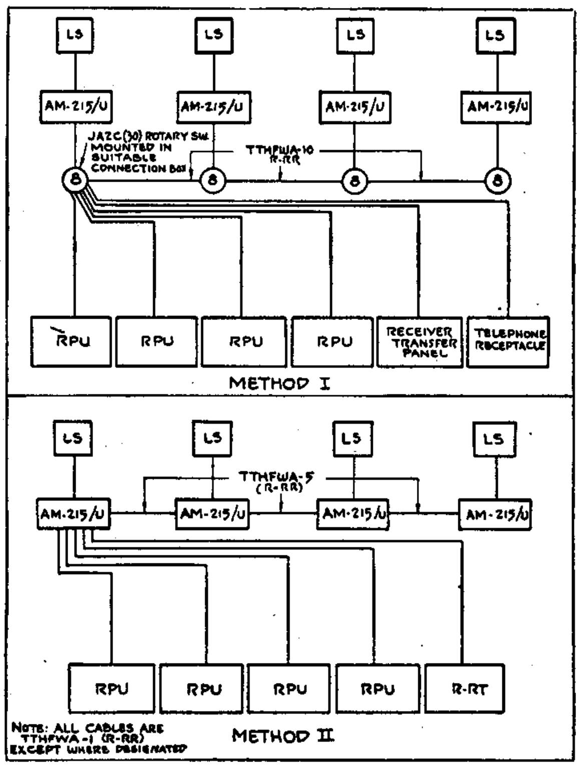

FIGURE 1.—Two methods of accomplishing selective monitoring, one for six or more voice circuits, and one for five or less.

(2) When five or fewer voice circuits are utilized, by employing the selector switch in the Type AM–215/U amplifier unit in lieu of the Type JA2C (30) rotary switch. This arrangement will permit selection of any desired receiving circuit at the loudspeaker.

The JA2C (30) switch is not supplied in any containing box or enclosure, so a suitable one must be provided. Where operational requirements permit doing so, switches may be installed for greater convenience in a single box in groups of four or less. *1/1/48*

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VERY-HIGH-FREQUENCY MEASUREMENT METHODS

Standard Navy radio equipment now in operation, such as the models TDQ, TDT, RCO and RCH etc., have carrier output frequencies beyond the normal usable range of the Navy models LM and LR frequency measuring equipments. The fundamental frequency of the crystals employed in the crystal oscillators of these receivers and transmitters are, normally, never in excess of 17 megacycles.

Satisfactory transmitter measurements above 17 megacycles can be obtained by first turning on only the oscillator of the transmitter. The output frequency of the oscillator may then be readily identified and measured directly on the Navy models LM or LR equipments. The LR is accurate to within 0.003 percent and the LM is accurate to within 0.01 percent. The actual carrier frequency can then be found by the equation $f_m \times n$ where f_m is equal to the fundamental frequency of the crystal which has been determined by measurement with either the LM or LR equipment, and "n" is equal to the frequency multiplication in the transmitter. The frequency multiplier or buffer amplifier stages may sometimes drag or shift the crystal frequency by a small amount. Where this difficulty is encountered, it may be overcome by checking the oscillator frequency of the transmitter when only the oscillator is on; then turning on the entire transmitter, completing any necessary tuning of the various stages, and rechecking the crystal frequency with all of the transmitter stages running. Since the heterodyne frequency meter has been set up on the first measurement, changes of the original setting would be small and the correct signal should be identified easily and quickly.

Satisfactory receiver measurements, greater than 17 megacycles, may also be obtained by following the general method outlined in the preceding paragraph. Each receiver of a different type is in itself a special problem. First, if the harmonic or fundamental frequency output (dependent on whether the LR or LM equipment is used as the testing medium) is sufficient to drive through the i-f stages of the receiver, maximum i-f output may be shown by connection of an output meter or oscilloscope to the output of the RCO, for the purpose of measuring variations in output signal strength; or by observing an upward indication of the "input" meter located on the front panel of the RCK. In either the RCO or the RCK, maximum output will occur when true IF is being passed. This frequency meter reading should be recorded. Second, the crystal oscillator frequency should be measured after all multiplier and buffer stages have been tuned. This frequency meter reading should also be recorded. Third, use the oscillator and i-f values obtained above to calculate two frequency response points. This can be done by inserting these values in the formula: local oscillator frequency × frequency multiplier ± i-f frequency. Fourth, through the use of the highest available fundamental frequency band obtainable on the LM or LR equipments, ascertain dial settings of either equipment which will produce a harmonic first at the high and then at the low response point previously calculated. Maximum response of the receiver will enable the operator to determine whether the local oscillator is above or below the incoming signal frequency, and, therefore, which response point is the actual received frequency.

Frequency meters TS–173/UR and TS–186/UP are now available operating in the range of 90 to 450 mc and 100 to 10,000 mc, respectively.

CLASSIFICATION OF RADIO FREQUENCIES

A new classification of radio frequencies, divided into seven major bands, is announced by the FCC to become effective immediately. As a result of the Commissions action, Section 2.5 of the FCC General Rules and Regulations on the "Useful radio spectrum" means the total number of frequencies or wavelengths which may be used for the transmission of energy, communications, or signals by radio.

At the present development of the art the useful radio spectrum is considered to extend from 10 kc to 30,000 mc or from 30,000 meters to 0.01 meter. These frequencies are classified into bands with designations and abbreviations as follows:

Frequency	*Designation*	*Abbreviation*
10 to 30 kc	Very-low	VLF
30 to 300 kc	Low	LF
300 to 3,000 kc	Medium	MF
3,000 to 30,000 kc	High	HF
30 to 300 mc	Very-high	VHF
300 to 3,000 mc	Ultra-high	UHF
3,000 to 30,000 mc	Super-high	SHF

CALIBRATION AND COMPENSATION OF MEDIUM-FREQUENCY DIRECTION-FINDING EQUIPMENT

Under proper conditions of installation and calibration it has been demonstrated conclusively that very good results can be obtained with medium-frequency direction finders. Optimum location of the crossed loop assembly is not always possible but large values of deviation can be greatly reduced by installation and proper adjustment of compensation loops.

Maximum permissible deviation hereafter shall be that deviation which exists when the deviation at 300 kc has been reduced, by means of required correction, to not more than two degrees. Normally, a calibration of direction-finding equipment without application and adjustment of compensation is not considered to be satisfactory. The DAK series direction finders can and will give excellent results when properly installed and calibrated.

Each individual installation must be treated as a "tailor-made" job and compensation must be applied and adjusted for optimum performance regardless of plans. Compensation loops should, in general, be as small as possible consistent with proper operation of equipment in order that they will not act as absorption loops which adversely affect the efficiency of transmitting and receiving antennas. However, if the loop is made too small, overcoupling may result which will produce a severe reduction of sensitivity in the instrument.

Curves received by the Bureau of Ships indicate that a very common cause of poor operation is over-compensation. This not only results in an unsatisfactory calibration, but also reduces the voltage pickup of the loop and leads to a generally unstable condition. Over-compensation is caused by coupling the compensating loop and the direction finder loop too closely. This applies more correction than is necessary for zero deviation. This condition can be recognized by the deviation in the first and third quadrants being negative instead of positive or by the entire curve being negative in sign, increasing in value as the curve approaches 90 degrees, then decreasing until 180 degrees is reached. It can usually be assumed that the sign in the first and third quadrants will be the same. Where considerable deviation exists over the bow, however, this may not always be true and it is advisable to make a check. Figure 1–A indicates the first condition and Figure 1–B the second.

An expedient method of placing the corrector in the proper location must therefore be found to provide an indication of what may be expected in the way of deviation throughout the frequency range of the receiver. Approximately, the deviation will increase in proportion to the square root of the frequency change. The following procedure should be followed:

(1) Without the compensation loop in place a curve should be made with the receiver on 300 kc, and the point of maximum deviation noted. The compensation loop should then be placed in a position that will result in a minimum of coupling and bearings taken through maximum points of deviation in the first, second and third quadrants.

(2) By the process of trial and error and checking the points of deviation after each adjustment the coupling of the compensation loop should be adjusted until not more than a two-degree deviation exists at 300 kc. The calibration may then be carried out on the higher frequencies.

From the study of results on file at the Bureau of Ships, it has been found that at certain frequencies (varying with the type of vessel on which the equipment is installed, but usually somewhere between 800 and 1200 kc) the deviation suddenly departs from the expected proportionate increase and may reach a value as high as five times that normally expected. It has been the practice on many vessels to adjust the compensation loop at this point, a procedure which, though it reduced the deviation, also reduced the sensitivity at lower frequencies to such a degree that at these frequencies the receiver was useless. This method of compensation should be discontinued and the procedure outlined above should be followed.

Extreme care must be exercised in securing and bonding compensation loops to the ship's structure. It is believed that too little attention is now being given to this important factor in the calibration procedure. The following methods, listed in order of preference, are considered most satisfactory:

(1) Cable brazed directly to the ship's structure.

(2) With lugs soldered to each end of the cable, secure to a clean flange welded to the ship's structure by means of a 3/8″ brass machine bolt, using a double nut for securing. A brass washer should be placed on top of each lug and on the opposite side of the flange, tightened as much as possible and then coated with Glyptol.

The practice of welding steel buttons to the ship's structure to be used in conjunction with iron screws for securing the lugs is not approved, since rust and corrosion eventually set in, changing the overall resistance of the loop. The practice of using resistors of any type in the compensating circuit is not approved and should be discontinued.

In addition, certain precautions must be observed to insure accuracy of the equipment both before and after calibration. The models DAK–1, DAK–2 and DAK–3 sense amplifier and directional amplifier input channels must be properly aligned. The balanced modulator tubes must be properly adjusted to insure tracking of the ABI and the matched line system of the DAK–1 and DAK–2. To a certain degree, unbalance is caused by the use of the set in "search" position for long periods of time. In this position only one of the tubes is operative, and therefore use of the equipment in this position over too long a period should be avoided.

In the interest of simplification of the detail work involved in calibrations, the Bureau requests that no further copies of calibration data be sent to the Bureau except those which:

(1) Reflect unusual deviations, lack of symmetry, inverted deviations, erratic performance, etc.

(2) Are calibrations of pilot installations.

(3) Are calibrations specifically requested by the Bureau.

When calibration data are submitted which cover one or more of these items, the letter of transmittal should contain complete and competent comment by the officer in charge of the calibration.

In the past, "half scale" calibration has been specified as the standard method of calibration for all Navy direction finders. This system provides some distinct advantages for equipments such as the DP series and the DAE series direction finders which operate on the principle of manual rotation of the loop to a null position.

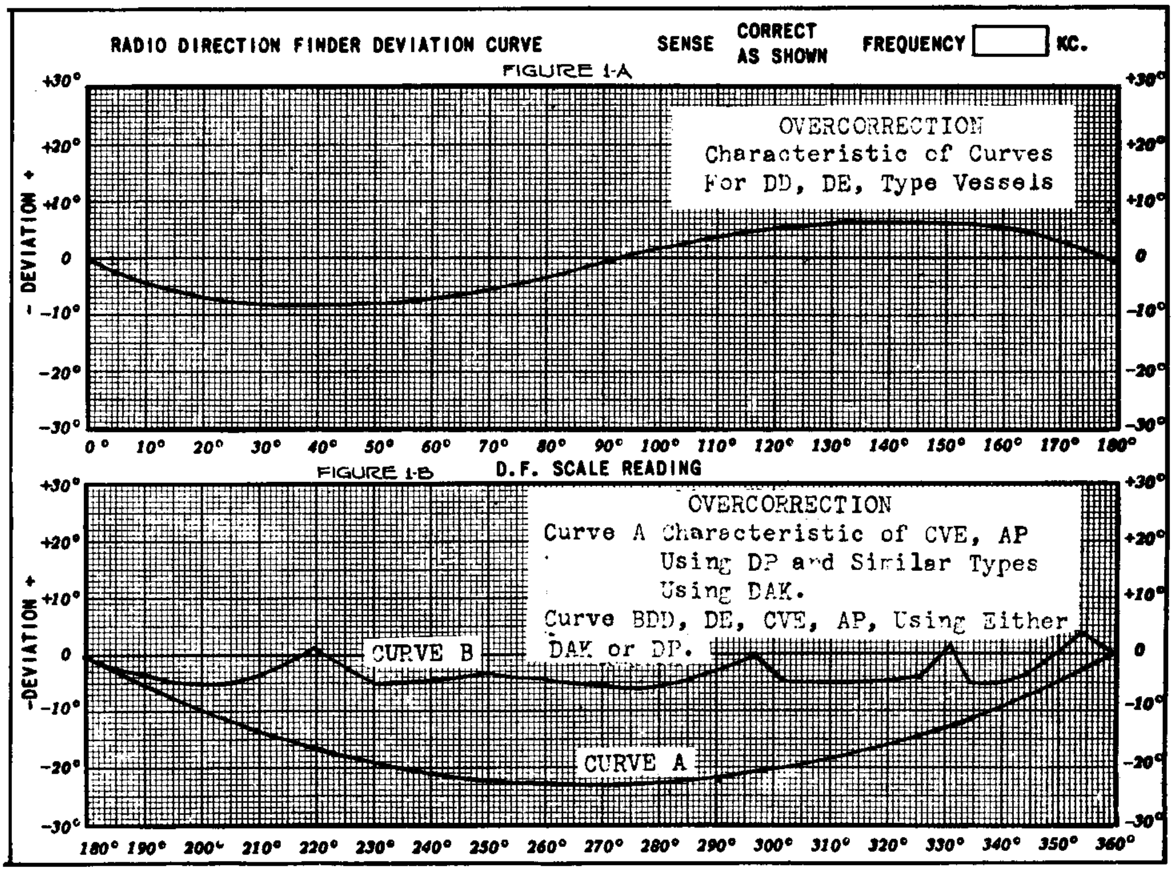

Figure 1.—Calibration curves for direction-finding equipments.

However, half scale calibration is of no benefit or advantage for fixed loop direction finders which have the goniometer marked for direct indication of bilateral bearings. Some equipments now under procurement, such as the DBD series MF/DF, give direct reading unilateral bearings, and these equipments cannot be calibrated by the half scale method.

In the future, the following procedure shall be followed in the calibration of direction finding equipments:

(1) All direction-finding equipments with manually rotated loops (such as the DP series, the DAE series, commercial direction finders, etc.), shall be calibrated by the half scale method. Calibration data should be plotted on form NBS 329.

(2) All direction-finding equipments with fixed loops or automatically rotated loops which give automatic or semi-automatic bearing determinations (such as the DAK series, the DAQ series, the DAU series, the DBD series, etc.), shall be calibrated by the *full scale* method. Calibration data should be plotted on form NBS 331.

QUICK NEUTRALIZING TESTS

Transmitters that are on the air for long periods of time, or continuous 24-hour operation, can be checked for neutralization while operating. This is accomplished by tuning the plate controls slightly off resonance and observing the action of the grid meters. This procedure is based on the assumption that the circuit is operating as a pure amplifier, with the deviation from normal readings indicating some irregularity. It also assumes that the Q of the circuit is constant over the tuning range. Theoretically the Q is constant for only one frequency in a given circuit; however, for the small tuning change the Q is virtually the same.

Figure 1 illustrates the condition under investigation while tuning the r-f amplifier. At "A" is a block diagram of a neutralized amplifier, the r-f input to the grid circuit alone being used to obtain the power output. Almost the same condition exists at "B" of the same figure, an r-f oscillator. It is merely an r-f amplifier with some of its own plate power fed back, usually in the neighborhood of 5 percent of the output and in the proper phase for sustained oscillations. Thus in the grid circuits of "A" and "B" only one r-f current flows to vary the bias voltage. In "C" of Figure 1, we have the case of the unneutralized amplifier, where r-f is fed from a preceding stage, but some r-f is also fed back from a spurious frequency in the plate circuit. This is really a combination of an r-f amplifier and an oscillator that results not only in poor efficiency but also produces undesirable frequencies.

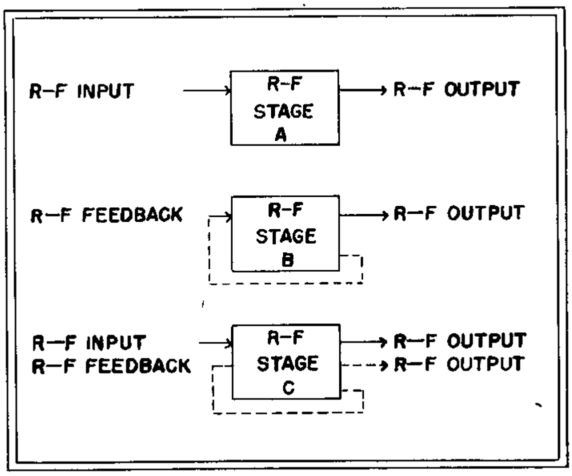

FIGURE 1.—Typical conditions of operation of an r-f amplifier stage in a transmitter.

In the cases illustrated at "A" and "B," an ammeter in the grid circuit will show the current flowing during resonance, and this current will fall off in about the same degree either side of resonance, as illustrated by curve "AA" of Figure 2.

Some operators prefer to watch the plate and

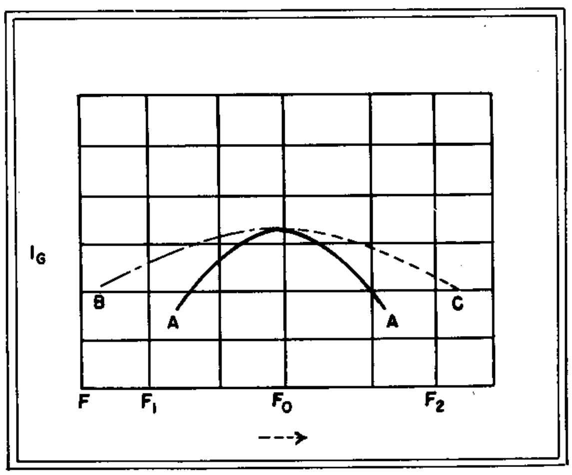

FIGURE 2.—Graph showing the possible changes in the grid current of an r-f amplifier when the plate tank circuit is tuned through resonance.

grid ammeters at the same time, the one rising and the other falling about the same degree either side of resonance. However, in tightly coupled circuits, especially at high frequencies, these two relationships may not hold even though the amplifier is perfectly neutralized.

When another current is present in the grid circuit due to extraneous oscillations, the current will not fall off at the same angle, but one side will have a steeper dip than the other. Thus, if in tuning from F_0 to F_1 and F_2, the curve "AC" results, it may be an indication of unbalance, possibly caused by bad neutralization. Curve "AC" might indicate instability at frequencies above resonance, which would call for reduction of inductance (in inductance neutralization). Curve "BA" would show possible instability below resonance, requiring more inductance or capacitance in the neutralization circuit.

While this system may indicate an unbalance in the tank circuit, it is not to be used to obtain neutralization. Even if an unbalance is noticed, it is no assurance that the circuit is not neutralized. Furthermore, only operators thoroughly familiar with their transmitters should use this method, since off-resonance operation can raise the plate current to the point where the over-load circuits would operate. It would then be difficult to bring controls back to normal to get the transmitter back on the air. Observing the grid ammeters should be used only to determine normal conditions, with any unusual changes warning the operator of some kind of irregularity.

Another way of checking neutralization rapidly is by cutting off excitation. (This may require recording a carrier break in the transmitter log.) This is done by shutting off the auxiliary oscillator's plate supply and then switching the oscillator transfer switch to the dead oscillator, killing the r-f supply to all succeeding tubes. If the tubes are all biased to cut-off or beyond, the grid and plate ammeters should all drop to zero in a perfectly neutralized transmitter and the carrier should go off the air. Any flow of plate and grid current will indicate possible oscillation in the earliest stage and should be checked through the regular neutralization procedures.

This process of checking takes only a couple of seconds, long enough for the technician to observe that the particular ammeters read zero, while plate and grid voltmeters remain at normal readings. Amplifiers with self-bias are so biased that, with all excitation removed, a safe amount of plate current flows. Such a stage would seem to have regeneration or oscillation, but the skilled technician will be familiar with his circuits.

Where plate current flows with excitation off, the difficulty may be traced not only to improper neutralization but to spurious oscillations, caused generally by similar r-f chokes resonating in the plate and grid circuits at some far removed low frequency. Parasitics of high frequency due to long r-f leads may also cause irregular operation and may show up with this check.

If the operator has more time available and his transmitter is off the air he has two other easy ways of checking roughly for neutralization. With the filament of the amplifier tube lit, but the plate voltage off, r-f voltage is fed to the amplifier. While observing the grid current meter, the plate tank tuning capacitor is rotated through resonance (with no plate voltage). In a perfectly neutralized stage, the grid ammeter reading should remain steady, since the plate circuit is supposed to have no reaction upon the grid circuit.

In a badly neutralized stage, there will be a violent dip of the grid meter while tuning through resonance. There will generally be some slight reaction on the meter, especially on the higher frequencies, even though the amplifier is neutralized, but the operator will easily recognize this flutter of the needle from the more pronounced dip caused by poor neutralization.

Another quick check is good for all but the final stage. This requires that two stages have no plate voltage while checking, although the filaments remain on. With a preceding stage tuned to resonance (but no plate voltage) the succeeding amplifier is likewise tuned to resonance and its plate meter observed for current. The presence of current will be a fairly sure sign of RF leaking through the preceding amplifier tube and being rectified in the succeeding stage.

Obviously the final stage cannot be checked in this manner since there is no following stage in which to detect the presence of RF. At higher frequencies or due to stray couplings, some RF may still feed through but the engineer is conscious of these peculiarities.

It must be stressed that the technician must be fully acquainted with the circuits he tests by these methods, to avoid damage and trouble. These checks should serve to indicate that everything is operating normally, any deviations from usual readings only warning the operator that more careful checking is needed. Even after these tests have been completed, there may be extraneous oscillations due to shock excitation, transients, or other strays developed by long operation of circuits, which will escape notice. Such special conditions require treatment with extensive and elaborate equipment.

—Reprinted from *Electronics*

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NEW NAME AND NAVY MODEL DESIGNATION FOR RADIO-COMMUNICATION CONTROL LINKS

These communication control links consist of Navy model TDG transmitters, RBQ receivers and a large variety of 42A1 carrier telegraph equipments. The 42A1 carrier telegraph and telephone equipments have never had a Navy model designation and, therefore, the following has been assigned for the system:

NAVY MODEL UN
CARRIER CONTROL SYSTEM

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REVISED SYSTEM OF CABLE AND WIRE MARKING

An amendment to General Specifications for Machinery S28-2, "Designating and Marking Electrical Installations," has been initiated to provide a new and standardized method of designating cable and wire marking in electronic installations. This amendment will cover cable marking standardization of wire terminal marking, and the use of synthetic sleeving for identification purposes.

Cable Marking

All shipboard electronic installations are to be marked as follows:

Radio Communications (R–R)

R–RA	Transmitting and receiving antenna (radio-frequency)
R–RB	Broadcast distribution (audio-frequency)
R–RF	Frequency meter extension (radio-frequency)
R–RP	Power (between distribution panels and equipments and between units of equipments)
R–RR	Receiver output (audio-frequency)
R–RT	Transmitter, keying and controls
R–RV	Radiophone (audio-frequency and control)

Radar (R–ER)

R–ER	Repeaters
1R–ER	Air search
2R–ER	Surface search
3R–ER	IFF equipment
4R–ER	Main battery fire control
5R–ER	Secondary battery fire control
6R–ER	Auxiliary anti-aircraft battery
7R–ER	Heavy machine gun battery
8R–ER	Torpedo director circuits
9R–ER	Beacon circuits

Sonar (R–S)

R–SA	Attack aids
R–SD	Depth determination
R-SL	Listening
R–SR	Ranging
R–SS	Sounding
R–ST	Shipboard anti-sub attack teacher

Countermeasures (R–C)

R–CA	Antennas
R–CC	Control circuits
R–CM	Modulators
R–CP	Power circuits
R–CT	Trigger circuits

Where more than one unit of a particular type is installed, an additional number is added following the general specification letters as listed above, to represent such additional units. For example, for four radio transmitters the designations would be R–RT1, R–RT2, R–RT3 and R–RT4. Where only one unit is involved, the "1" after the classification letter may be omitted.

Numbers designating the various equipments are to be selected in accordance with the section of the General Specification S28-2-D.

Following the general designation and classification numbers just described, additional numbers will be added to indicate the particular cable in the classification. Particular cables will be numbered consecutively. Some examples of this are:

1R–ER–14	Electronics—Radar—Air search no. 1 unit (starboard forward) cable no. 14.
R–RV12–70	Electronics—Radio—Voice control no. 12 unit (port) cable no. 70.
R–SR2–3	Electronics—Sonar—Ranging no. 2 unit (port) cable no. 3.
R–CA3–3	Electronics—Countermeasures antenna no. 3 antenna (starboard) cable no. 3.

Terminals

Wire terminals (lugs) shall be marked or tagged to correspond to the marking of the terminal board terminals to which they are to be attached.

The stamping of the wire marking on the tongue of the terminal is the preferred method of designation. Where this is impractical, due to the size of the terminal, either fibre tags or branded synthetic sleeving may be used for material under the cognizance of the Bureau of Ships.

In all cases where wires or cables are fanned out a distance of 6 inches or more from the wire terminals, fibre tags or synthetic sleeving shall be used and marked to indicate the cable designation as well as the terminal designation—the terminal designation following the cable designation.

Pending reprinting of the specification or the issue of a supplement, the instructions above are to be considered in effect. It is important that all installation, maintenance and training activities concerned with these changes be made familiar with them.

COLOR CODE FOR TRANSFER PANEL PATCHCORDS

The standard types of receiver, transmitter and radiophone transfer panels are supplied with from five to forty-five patchcords, depending upon the size and type of panel. For purposes of applying the following color code and for standardization among identical panels, the patchcords with each panel are arbitrarily assigned numbers beginning with number one. This means that the cords of a five-cord panel would be assumed to be numbered 1 to 5; of a ten-cord panel, 1 to 10; etc. In case the patchcords for any one type of panel have been graduated in length by ship's force the shortest cord should be considered as number 1 and the balance consecutively numbered according to length. With the assumed numbering system (no actual numbers are applied to the cords) established, the following color coding can be applied to patchcords by any activity or ship's force with reasonable assurance that all panels of a type throughout the service will be color-coded alike.

The standard Bureau authorized color code for "RR", "RT" and "RV" patchcords is as follows:

Patchcord Color Code

Cord No.	*Color*	*Cord No.*	*Color*
1	Black	24	Brown & black
2	White	25	Blue & orange
3	Gray	26	Blue & green
4	Red	27	Blue & red
5	Green	28	Blue & gray
6	Orange	29	Blue & white
7	Blue	30	Blue & black
8	Brown	31	Orange & green
9	Yellow	32	Orange & red
10	Yellow & brown	33	Orange & gray
11	Yellow & blue	34	Orange & white
12	Yellow & orange	35	Orange & black
13	Yellow & green	36	Green & red
14	Yellow & red	37	Green & gray
15	Yellow & gray	38	Green & white
16	Yellow & white	39	Green & black
17	Yellow & black	40	Red & gray
18	Brown & blue	41	Red & white
19	Brown & orange	42	Red & black
20	Brown & green	43	Gray & white
21	Brown & red	44	Gray & black
22	Brown & gray	45	White & black
23	Brown & white		

The paints should be of good quality and the colors brilliant. Such paints are usually carried aboard vessels for marking piping and flag gear. The paints should be applied to the knurled, cable-securing gland of each plug and *not* on the rubber cable. The paint will not adhere satisfactorily to the rubber and there is also a possibility of a deteriorative effect. The single colors identifying cords #1 to #9 shall be applied to the entire external surface of the gland nuts of both plugs as indicated in Figure 1. Each color

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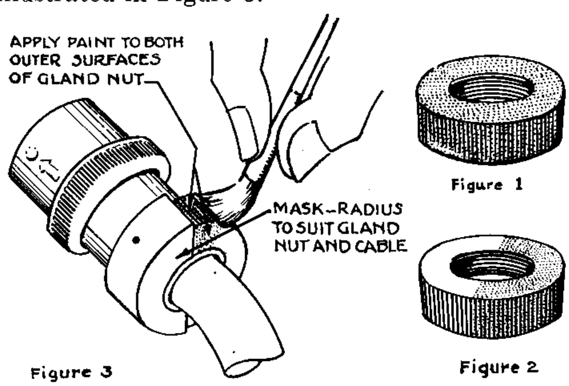
of the dual colors identifying cords #10 to #45 shall be applied to one half of the external surface of both plugs as indicated by Figure 2. The separation of the two colors should be accurate and neat. This can be facilitated by the use of a small half-circular metal masking template, as illustrated in Figure 3.



FIGURES 1, 2, and 3.—Methods of painting gland nuts.

The foregoing color coding may be applied to existing equipment by forces afloat as requirements dictate.

CONNECTION OF RECORD PLAYERS TO SHIPBOARD BROADCAST RECEPTION SYSTEMS

The Bureau of Personnel is procuring and furnishing to the Service a number of portable (suitcase type) record players for training and entertainment purposes. These units are primarily for shore-based personnel, but a number of them are finding their way aboard vessels of the fleets. Once aboard a vessel it is natural that they be utilized in a manner whereby they will serve the greatest number of personnel; this immediately dictates that the output of the record players be connected to the vessel's radio broadcast distribution system. This is entirely permissible and feasible due to the fact that from two to four spare channels were provided in the original design of the distribution system just for such anticipated purposes. However, the two types of record players being distributed by BuPers at the present time were not designed with this particular use in mind and, therefore, are not provided with exactly the proper output circuit for coupling into one of the broadcast distribution channels. This fact has resulted in a number of unsatisfactory lash-ups, and in an attempt to improve conditions, inexperienced personnel will unnecessarily modify or mutilate either the record players or the distribution system or both. On the other hand, if the very simple interconnections between the record player units and distribution channels are accomplished as indicated herein, the results will be very satisfactory and the normal functions of neither the phono units nor the broadcast system will be adversely affected.

The two record player units being furnished by BuPers are identified as Sandwick model MC–364 and Birch "Flagship" model. Both units are very similar and both give excellent results. The internal wiring diagrams of both types are reproduced herein as Figures 1 and 2 respectively. Both have dual speed (33⅓ and 78 RPM) motors and will accommodate any size or style of disc.

The interconnections between the record players and the standard shipboard model RBO broadcast distribution system should be accomplished as indicated in Figure 3. It should be noted that the connections are to be made to the low impedance output circuit of the amplifier, to which the speaker is normally connected, and not to the high impedance PHONO OUTPUT jack located on the front panel. The latter connection will not produce satisfactory results. A 4-prong plug should be used for the connections to the record player if it is desired to retain the portability feature of the unit; otherwise, the connections can be made internally in a permanent manner. It is preferable to install a double throw switch adjacent to the record player unit and connect this switch in a manner that will permit instant change-over from the distribution system to the record player's speaker and vice versa. Particular note should be made of the fact that the two record player manufacturers utilize different terminals of the 4-prong connectors. The output of the Sandwick model is connected to terminals No. 1 and No. 3; whereas, the output of the Birch model utilizes terminals No. 1 and No. 4. One side of the secondary winding of the output transformer is grounded in the early models of both types of record players, as indicated in Figures 1 and 2. If this ground connection exists in any record player being connected to the RBO distribution system, it must be removed before the record player is operated with the system. The ground connection within the unit is made in such a manner that it can be easily removed. Unless this ground is removed from the output winding, the reproduction will not be satisfactory as the completed circuit results in one-half of the center-tapped speaker-amplifier input being grounded. The Bureau understands that this ground connection has been omitted on both types of record players of recent manufacture.

Connection to the distribution system should be made to channel No. 5 in the standard 10-wire connection box located near the model RBO

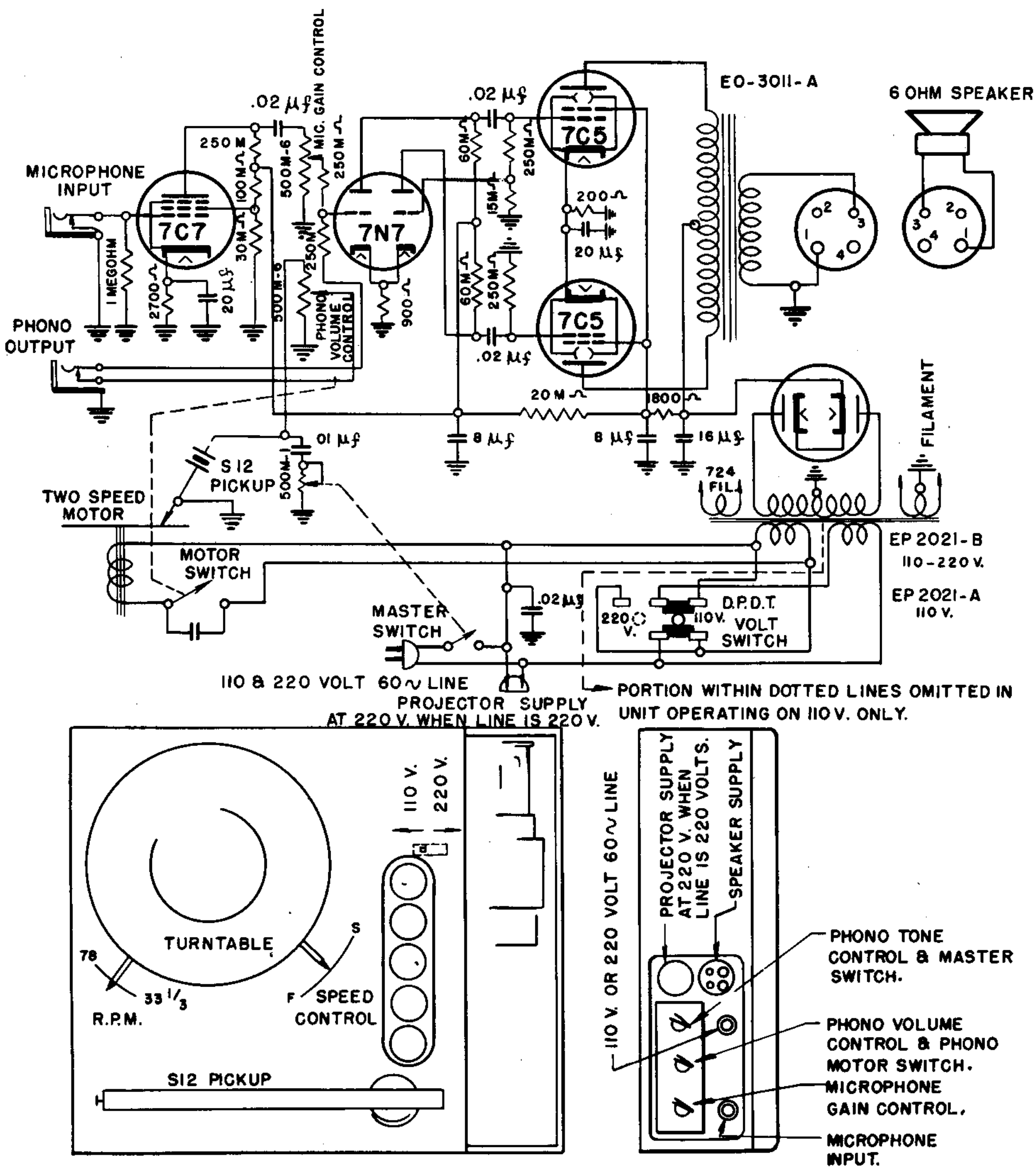


FIGURE 1.—Sandwick model MC-364 reproducing equipment.

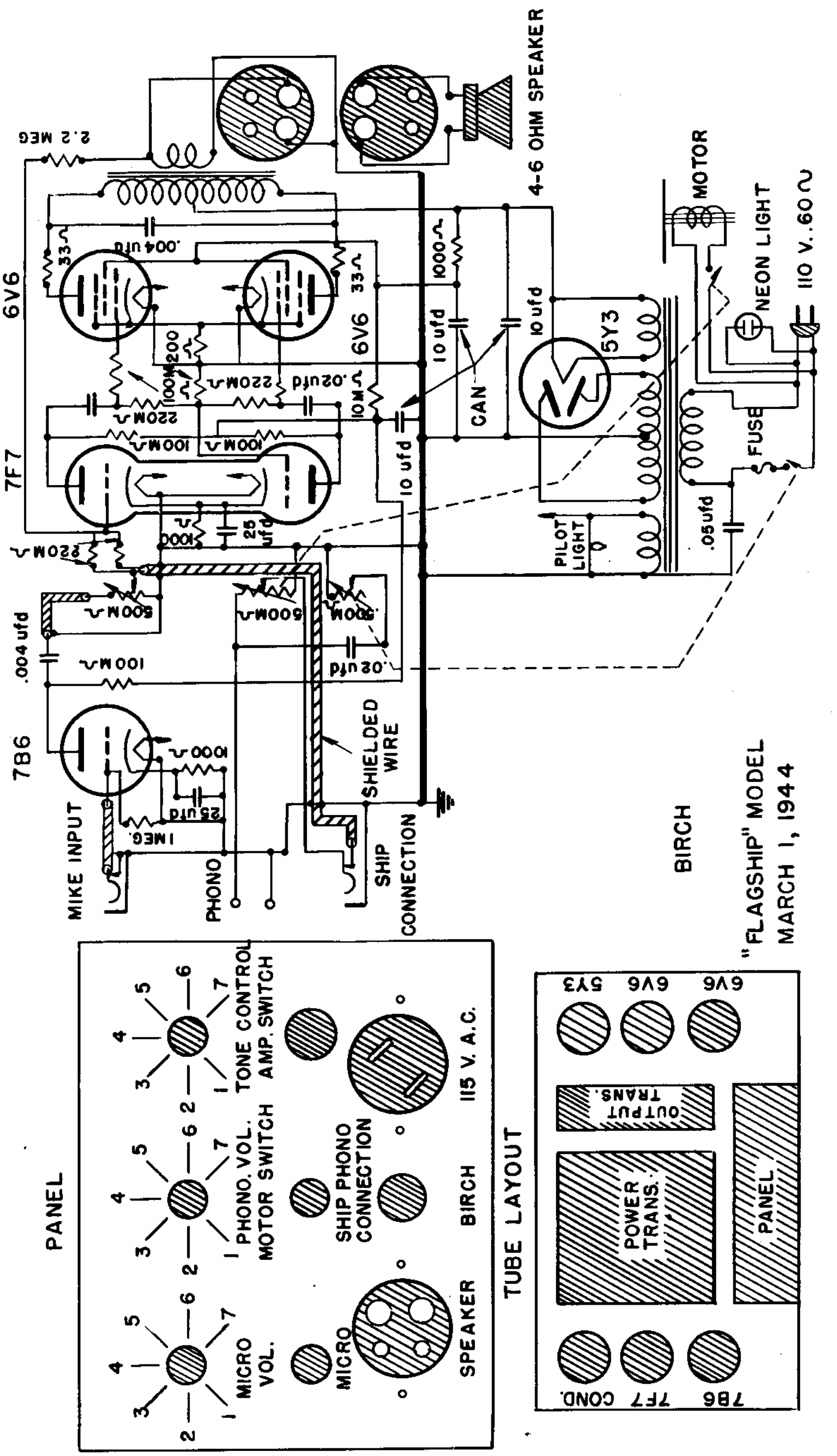


Figure 2.—Birch "Flagship" model reproducing equipment.

receivers, as indicated in Figure 3. However, if the record player unit is to be located in a space removed from the receivers, as is frequently the case, the connection may be made to the same channel (No. 5) at the terminal block in any speaker-amplifier unit along the line. If two record players are installed and connected to the RBO system, the second unit should be connected to channel No. 4.

The 10-ohm 10-watt loading resistor indicated in Figure 3 should be used in all such installations. Any resistor possessing the specified characteristics may be used in lieu of the specific type indicated in the diagram.

If "stops" have been installed on the channel selector switches of the type 49131 series speaker-amplifier units of the distribution system to blank-off spare channels, it will be necessary to remove them from all units before placing the system in operation.

Record players (either the above types or any others which may find their way aboard Naval vessels) shall not be connected to any model RBO series receiver or the associated distribution channel. A phono connection is provided in these receivers but shall not be used in shipboard installations as separate channels are provided for such purposes in the distribution system. When record players are connected through a receiver unit, it deprives personnel of the broadcast reception normally available on that particular channel.

Some operating notes for these record players are:

(1) The equipment is turned on by rotating the tone control in a clockwise direction.

(2) Volume is controlled by the control marked "Phonograph".

(3) After allowing the tubes to heat for 30–45 seconds, run the ball of the thumb gently across the point of the needle. A clicking or rasping sound indicates that the equipment is ready for operation.

(4) Ordinary commercial phonograph records are played at 78.26 RPM and the groove runs from the outside toward the center. Transcriptions are played at 33⅓ RPM and may begin either at the inside or outside. The label on the transcription will indicate the correct starting point.

(5) Motor speed may be changed by gently moving the RPM arm from 78 to 33⅓ or vice versa while the motor is running. Caution: Do not force or jam the arm or the motor will be

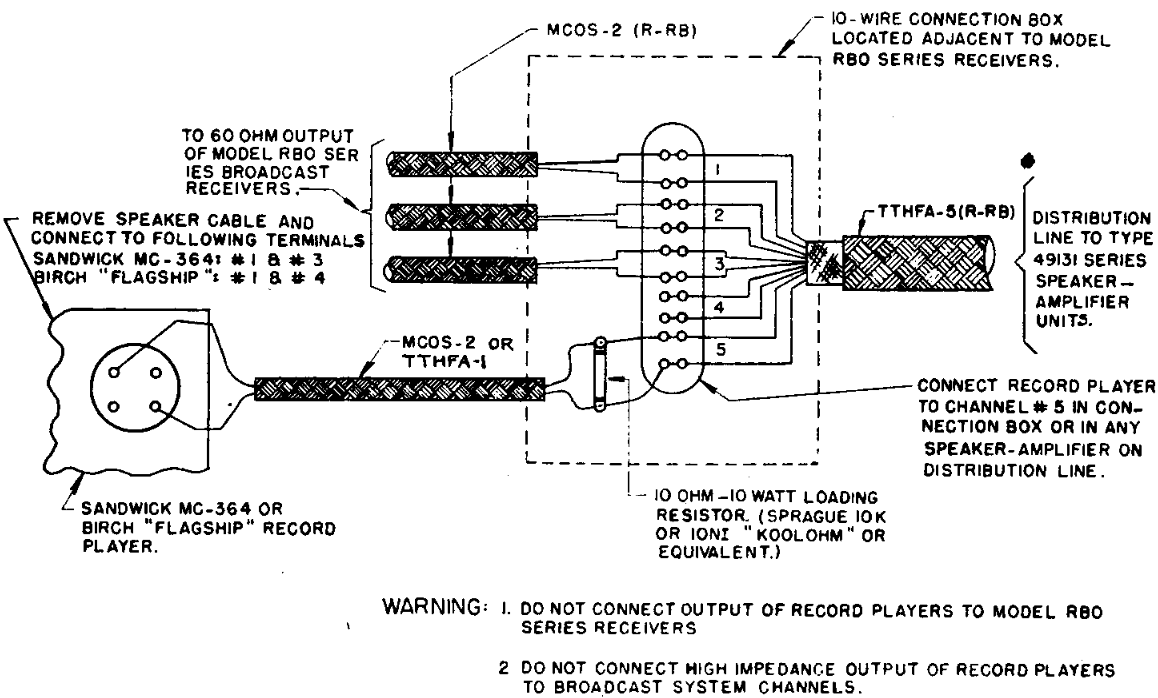


Figure 3.—Connections between record players and model RBO distribution system.

locked with consequent damage. Never changed speeds unless the motor is running.

(6) Keep the microphone control set at zero unless it is in use as considerable hum will be produced otherwise.

(7) Make sure that the needle is secure in the needle chuck. It should be tightened with thumb and forefinger only—NEVER with pliers or other tools. Type 36N535 steel needles are recommended. These are available in packets of 100 for 15¢ at most recreational supply activities. If a permanent needle is used, it should never be removed or turned until it is ready for replacement.

Some maintenance notes for these record players are:

(1) The following spare parts are furnished with each unit:

Two crystal cartridges
Three fuses
One set of tubes
Five packages of needles
One pilot lamp (Birch record player only)

(2) The phonograph motor should be lubricated every 60 days. Navy oil symbol 2075 is recommended.

(3) The speed of the turntable may be adjusted by moving the lever arm marked "speed control." It should be adjusted to run at 78.26 RPM or 33⅓ RPM and should be checked with the stroboscope and neon lamp which are supplied with the instrument. A stroboscope disc is being published in this bulletin for use in the event that the original disc becomes lost or damaged.

(4) *Important*—An Astatic type S–12 crystal pickup is supplied with the unit. Two replacement crystal cartridges are supplied as spares. Crystal microphones, headphones and phonograph pickups are easily and quickly damaged by exposure to excessive heat. Under NO circumstances should the pickup itself or the replacement cartridges be subjected to temperatures of 120° F. or above. Should there be any question of the ambient temperature exceeding this level, a thermometer should be placed alongside the pick-up and if 120° F. or above is reached, immediate steps should be taken to cool the unit. Should it become necessary to replace the crystal cartridge or connecting wires, a minimum of heat should be used when soldering connections at the cartridge. Cool the joint with a swab of cotton dipped in alcohol immediately after removing the soldering iron. Heavy-handed sweating in of soldered joints at the cartridge terminals is practically certain to ruin the crystal. Quick soldering with minimum heat, a clean iron, low-melting-point solder and immediate cooling of the joint is absolutely safe. Should extra crystal cartridges be required, the proper unit is Astatic type B–2 replacement cartridge.

INSTRUCTIONS FOR USING A STROBOSCOPE DISC

The stroboscope disc reproduced herewith as Figure 1 may be used to check the speed of any phonograph recording or reproducing turntable at either 78.26 or 33⅓ RPM, which are the correct operating speeds.

Carefully cut out the disc and mount it on stiff cardboard or on a 10-inch phonograph record using rubber cement or any other adhesive that will not shrink or stretch the paper. *Do not use ordinary paste.* Extreme care should be taken not to distort the drawing. If the disc is mounted on a phonograph record, make sure that the drawing is truly centered over the record spindle hole; if it is off center it will affect the accuracy of the stroboscope disc, resulting in a backward and forward movement of the segments even though the turntable speed may be constant. By the same token, care must be exercised in punching or cutting out the center hole in the stroboscope disc. The white dot is the exact center; the small black area the part to be removed. A sharp-pointed scriber compass will do the job nicely.

With the turntable in motion and the stroboscope disc in place, cast the light from a neon lamp directly on to the rotating disc segments, shielding the disc from extraneous light. The neon lamp must be energized from a 60-cycle a-c supply. If the turntable is operating at the correct speed, one set of the segments will appear stationary—the inner set for 78.26 RPM and the outer set for 33⅓ RPM. It should be pointed out that the accuracy of the device is dependent upon the exactness with which the frequency of the a-c supply is kept at 60 cycles per second. A backward or forward motion of the segments indicates that the turntable is running below or above the correct speed and its speed should be

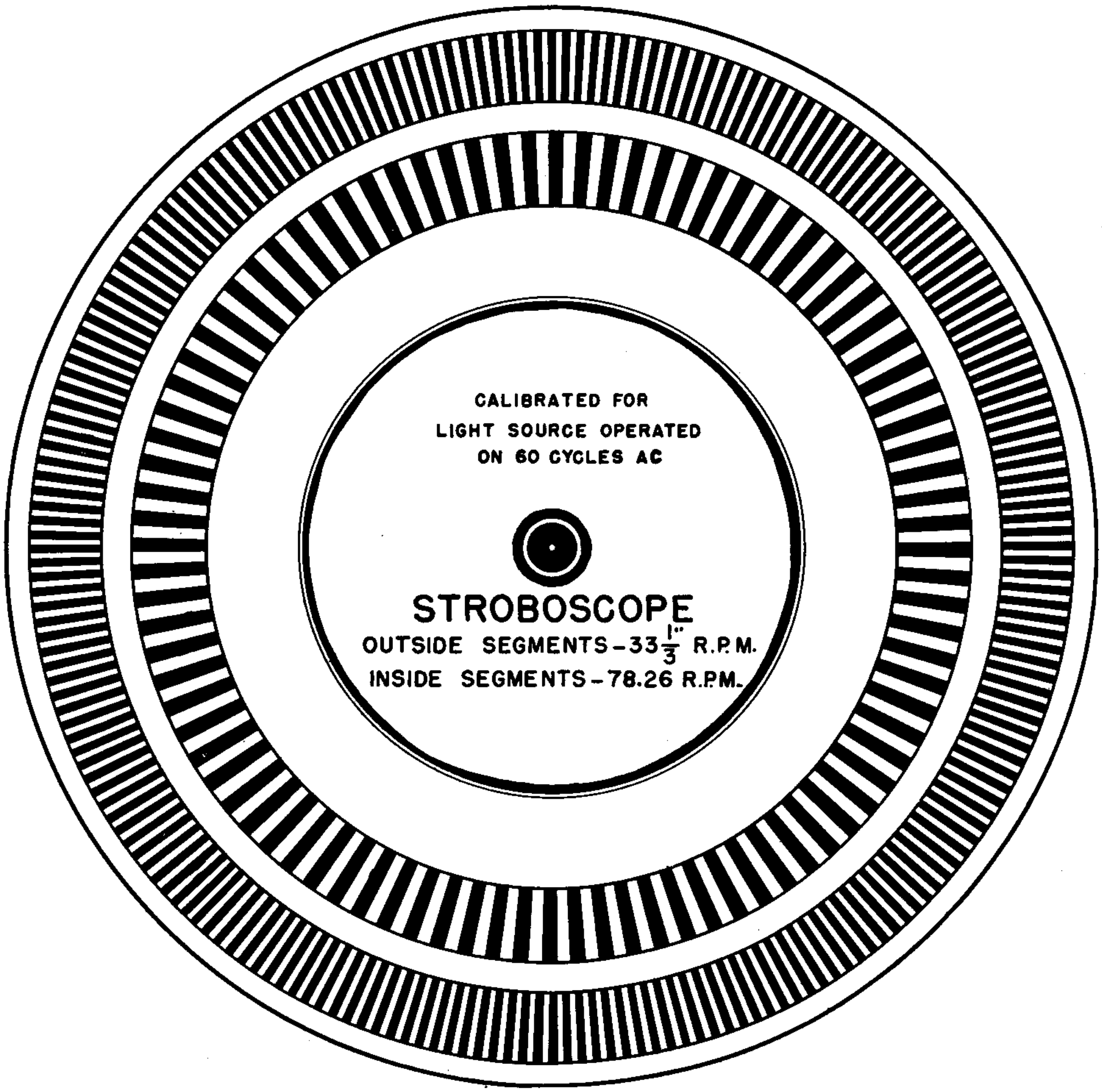


FIGURE 1.—Stroboscope disc.

adjusted until the proper set of segments appear stationary.

In using the stroboscope, it is preferable to simulate actual operating conditions by checking the turntable speed with a normal load. This may be accomplished by checking the speed with the pickup traversing the outer grooves of a 10-inch record placed on the turntable underneath the stroboscope disc—or the outer grooves of the record on which the stroboscope disc is mounted as the case may be.

In an emergency an ordinary incandescent lamp may be used in lieu of a neon lamp. However, the incandescent lamp is not nearly as satisfactory due to the thermal inertia of the filament preventing it from cooling below the temperature of incandescence during each cycle of AC. This effect causes the segments to appear blurred although their movement is easily observed. When viewed with light from a neon lamp, the segments appear sharp due to the lack of thermal inertia in a neon lamp, the light flashing off and on 120 times a second. A single fluorescent lamp operated on a 60-cycle a-c line also makes a satisfactory light source for viewing the stroboscope.

●

NON-SHATTERABLE NITROGEN FLASKS

Maintenance activities should check all available vessels to determine if the nitrogen flasks used in conjunction with the receiving antenna transmission line systems are of the non-shatterable type. All flasks which do not meet these specifications should be replaced with the approved non-shatterable type.

●

COLLECTION OF EXPLOSIVE GASES FROM BATTERIES

The Federal Communications Commission has been informed by the U. S. Coast Guard of an explosion of a portable lifeboat radio transmitter aboard a merchant vessel when an attempt was made to test it. In this instance, it appeared that an explosive gas had accumulated inside the airtight case and that it was ignited by an electric spark after the cover had been removed and the set placed in operation. It has been reported also that portable lifeboat transmitters stored in warehouses have exploded owing to the presence of gases generated by recently charged batteries.

The danger of explosions can be eliminated if proper precautions are taken. It is suggested that batteries be removed from the portable radio equipment containers for charging and that the batteries be allowed to stop gassing before being placed in the radio sets after charging. If the electrolyte has accidently leaked into the container from the battery, the case should be cleaned. It should also be left open to the air for an adequate period after removing the cover, before proceeding to test the equipment.

●

PROLONGING THE LIFE OF DRY BATTERIES

Many dry batteries are arranged so that contact with the negative terminal is made by a brass or copper spring pressing against a portion of the zinc case of one of the cells which make up the battery. Since current flows through this contact while the battery circuit is closed, there is opportunity for electrolytic action to occur at the contact surface. Such electrolytic action is greatly increased by large amounts of moisture in the air. A slight drop in temperature causes the moisture to condense to water, and the wet contact acts exactly like an electrolytic cell. Two damaging conditions result:

(1) The electrolytic action causes the zinc to oxidize, forming zinc oxide. This is indicated by a white coating on the zinc surface, powdery when dry, and wet and sticky when damp. The layer of zinc oxide acts as an insulator, and reduces the current which can be drawn from the battery.

(2) If the battery is still operated while the layer of zinc oxide is damp, holes will be eaten in the zinc and the battery ruined.

When the battery output falls off, as evidenced by the effects noted in (1) above, the battery is usually condemned and thrown away, although it may actually have more hours of serviceable life remaining. These service hours can be obtained by cleaning the contact as follows:

(1) Scrape the zinc surface with a knife to remove the layer of white material, being careful not to gouge into and remove scraps of the zinc metal itself.

(2) Polish the scrape surface with fine sand-paper until it is bright.

(3) Wipe dry the batteries, the contact springs, and the inside of the battery compartment.

Dry batteries should be examined daily, paying particular attention to the contacts, and cleaned as necessary. This precaution will increase the service obtained from batteries, and will in many cases prevent unexpected failures of communication equipment. The presence of white powder, soggy white deposits, and corroded spots on the zinc shells of batteries is evidence of electrolytic action. It calls for immediate cleaning and drying.

—*Signal Corps*

RADIO BATTERY CHARGING FACILITIES IN LANDING CRAFT

The following are excerpts from a BuShips (Codes 660–819) letter which may be of general interest to all radio installation and maintenance activities concerned with landing craft:

"Landing craft will receive models TCS, SCR–610, SCR–508, and SCR–608 transmitting and receiving radio equipment. The Bureau is purchasing individual motor-generator sets to be used with each SCR radio and eventually all newly installed SCR equipment will be provided with these motor-generator sets which will operate from the ship's service system. However, due to production difficulties, a number of installations of SCR radios will be made without the motor-generator sets. For such installations, when the proper voltage is not available on board the vessel, it will be necessary to supply batteries as a source of power.

SCR radio equipment as installed will in most cases be suitable for 12-volt operation although there may be some cases where 24-volt equipment is installed. Insofar as battery operation is concerned, when 12-volt battery-operated SCR radios are installed, the following equipment should likewise be provided:

(1) For the SCR–610:

(*a*) Two complete sets of 12-volt SBM 100-ampere-hour batteries, each set to consist of two 6-volt SBM 100-ampere-hour trays. One complete set of 12-volt batteries is for normal use and the other complete set is for standby use.

(*b*) One two-pole double-throw transfer switch, 10-ampere, 9–S–5191–L, type SS–2.

(*c*) One 7- to 14-ampere battery charging panel, Bureau plan No. S6201–649406, Contract Nos. NObs–16164 and 16782.

(2) For the SCR–508:

(*a*) Two complete sets of 12-volt SBM 200-ampere-hour batteries, each set of batteries consisting of two 6-volt SBM 200-ampere-hour trays. One complete set of 12-volt batteries is for normal use and the other set is for standby use.

(*b*) One transfer switch, two-pole double-throw, 30-ampere, Plan No. 9000/S6202/70350, type XXVI–1S.

(*c*) One 15- to 30-ampere battery charging panel Bureau plan No. S6201–649405, Contract Nos. NObs–16164 and NObs–17497.

(3) For the SCR–608:

(*a*) The same equipment is to be supplied for SCR–608 as indicated above for SCR–508.

It is to be noted that the above listing of material is on the basis of a 12-volt SCR radio installation. If 24-volt SCR radios are installed, it will be necessary to double the number of batteries furnished. The transfer switches and the battery charging panels listed will be satisfactory for either 12 or 24 volts.

The transfer switch is to be used to transfer the SCR radio from the normal set of batteries to the standby set and vice versa. The battery charging panel is of the bulkhead mounted type with 30 feet of flexible cable and clips for charging the battery which is not being used by the radio.

In regard to TCS radios, where adequate charging facilities have not previously been provided, the same charging panel provided for the SCR radio batteries, as listed herein, should also be used to charge the TCS radio batteries."

RELAY MAINTENANCE

Relays should be carefully inspected regularly. They should be cleaned periodically with carbon tetrachloride and the contacts dried immediately. A small piece of chamois leather mounted on a thin strip of bakelite makes a convenient cleaning and drying tool. Do not use paper, cloth or other fuzzy materials. Films forming on the contact surfaces cause the greatest amount of trouble. Films will form through the action of air and various other gases on the contact metal, but most troubles of this type are due to grease films. Carbon formations due to the burning of grease and other substances can be troublesome. The carbon will form rings on contacts, eventually building up the rings so that the contacts will be held open.

When current always flows in one direction through a relay, the contacts may "cone and crater". The crater is formed by the metal being transferred to the other contact and deposited there in the form of a cone. When filing contacts to remove carbon, cones, or craters, it is not desirable to polish them too smoothly. The slight roughness left after filing with a good file helps to break through any films that form. It should be remembered that most files will be greasy. Therefore, after filing, the contacts should be cleaned with carbon tetrachloride. When ball-shaped contacts are found, they should not be flattened. In many applications ball-shaped contacts are better than flat ones, since dust does not collect on them so readily and the ball points break through film more easily.

For a more complete article on relay maintenance, the reader is referred to the "Radio and Sound Bulletin No. 17".

RMA PREFERRED VALUES FOR RESISTORS

The RMA standard list of preferred values for resistors has been adopted by the majority of the leading manufacturers of radio and electronic equipment. The primary purpose of the list is to limit the number of different types of resistors to be manufactured. The basic values increase nearly logarithmically and are multiplied by powers of ten; for example: $1.8 \times 10^4 = 18{,}000$ ohms, $4.7 \times 10^5 = 470{,}000$ ohms, $5.6 \times 10^6 = 5.6$ megohms, etc. Where values such as 20,000, 50,000 or 75,000 ohms would normally be encountered in circuits, probably 22,000, 47,000 or 82,000 ohms would be found instead.

The basic list of RMA preferred values for resistors follows:

1.0×10^x ohms	2.2×10^x ohms
1.2×10^x ohms	2.7×10^x ohms
1.5×10^x ohms	3.3×10^x ohms
1.8×10^x ohms	3.9×10^x ohms
4.7×10^x ohms	8.2×10^x ohms
5.6×10^x ohms	10.0×10^x ohms
6.8×10^x ohms	

SENSE DETERMINATION IN DIRECTION-FINDING EQUIPMENTS

When making "sense" determinations with a direction finder it is of extreme importance that the correct procedure for that particular model be followed as outlined in the instruction book. On ships having commercial direction finders, such as the Radiomarine AR–8700 series or the corresponding Mackay equivalent, a bearing in the correct sense is one in which the signal level increases when the loop is rotated 90° toward lower scale readings. It should also be noted that this "Pullman car rule" of "the higher the lower" also applies to the Navy model DAE direction finder, prior to its modification as described below.

On Navy standard models such as the model DP series, a bearing in the correct sense is one in which the signal level increases when the loop is rotated 90° toward higher scale readings.

It should be pointed out that some model DAE direction finders have been modified in order to make the sense determination procedure conform to Navy standard practice. This modification is accomplished by removing the scale from the bottom of the loop mounting and reinstalling it after rotating it 180°.

It is suggested that instructions for correct sense determination be posted near the direction finder for ready reference by personnel operating the instrument who are not thoroughly familiar with the correct method for the instrument.

PROTECTION OF WIRING DIAGRAMS ON RADIO EQUIPMENT

It has been reported that considerable damage is being done by insects to wiring diagrams on radio equipment. The following method for protecting wiring diagrams is recommended.

As part of the moisture-proofing kit (Army type 68Q5) being supplied to Advanced Bases, there is included a quantity of G.E. Glyptol type No. 1200–F. This is a clear resinous varnish having adhesive properties. In order to secure and protect wiring diagrams, the Glyptol should first be sprayed or brushed on the clean metal surface. Then place the wiring diagram on the wet surface. After the diagram has been attached to the varnished surface it should be sprayed over completely with Glyptol thereby protecting the diagram from moisture and insects.

FUNGUS GROWTHS

Mildew molds and bacteria that cause decay develop rapidly on textiles and wax in impregnated wire insulations and on fibrous insulating materials such as vulcanized fiber under suitable conditions of temperature and humidity. They will also form on phenolic materials although not as readily, which is believed to be due to some antiseptic action of the phenol compounds. Polished surfaces of phenolic materials are not attacked to the same extent as sawed or punched edges where fibers are exposed. It has even been observed that fungus will form on porcelain or glass and will in time etch the surface. The start of a fungus growth on surfaces of this character is explained by the prior accumulation of a thin film of organic matter on which the fungus feeds. The presence of fungus on insulating surfaces will often reduce the insulation resistance to prohibitively low values. The surface resistance of porcelain is reduced, resulting in flash-overs in radio equipment employing high frequencies and potentials. In an atmosphere near saturation and under other favorable tropical conditions, fungus will start to form in a day or two. Experience has shown that once such a growth begins, even though the insulator is immediately and thoroughly dried, growth will continue more rapidly as soon as the high humidity reappears. This indicates that where heaters are provided in enclosed equipments for drying purposes, it is advisable to operate them continuously rather than intermittently.

For the removal of fungus growths, wiping the surface with a cloth saturated with a 50 percent to 70 percent volumetric mixture of ethyl alcohol and fresh water has been found to be effective. The cloth should preferably be of chamois, continuous-filament artificial silk, or other lint-free material. (This treatment, however, should not be applied to textile insulating materials.) Considerable experience with wire having plasticized cellulose acetate coated insulation in damp locations within the United States and in the laboratory, has indicated that this type of insulation has definite fungus-inhibiting qualities.

FAILURE OF LOW-FREQUENCY A-C AND D-C TRANSMITTER METERS

Transmitter meters frequently are shunted by a small condenser to protect them from high r-f currents. In case of burnout, test this condenser before replacing the meter and replace the condenser if it is found to be faulty. It may be well to replace this condenser with one of a higher voltage rating if the original has failed and it may be helpful to substitute one of higher capacitance if the original is still good, but of insufficient capacitance to protect the meter.

WIPING-CONTACTS ON TUNING CONDENSERS

After long periods of use, wiping-contact fingers used for making connection to variable condenser rotors sometimes loose their springiness and make poor contact. When this condition is encountered, the wiping-contact should be replaced with a bonding connection securely soldered to the rotor and to the frame of the condenser. Suitable "pigtail" material for bonds is phosphor bronze dial cable. One turn should be placed around the shaft so as to allow the rotor to turn freely. When cutting phosphor bronze dial cable the strands often have a tendency to unravel. This may be prevented by tinning the cable with a drop of solder for a short distance in the vicinity of the point at which the cable is to be cut. The cable should then be cut through the tinned portion.

ERRATIC PERFORMANCE OF VHF EQUIPMENT

One cause of erratic performance in VHF equipment has been rain entering the microphone. A thin rubber cover has proven satisfactory for keeping the microphone dry, and does not interfere with normal operation of the equipment.

SUMMARY OF NAVY TYPE LOUDSPEAKERS

Navy designation	Mfg.	Used with	Audio power (watts)	Input impedance (ohms)	Type magnet	Shape and description	Model or mounting	Description of loudspeaker
49061	....	TBM, TBN, General use.	....	600	PM	Height 13″, Width 10″, Depth 8″, (maximum).	Bulkhead	Includes an amplifier. Operates from 115 volts AC or DC, ±6 volts. Volume control. Jensen PM6C Marine type speaker. 6″ cone, splash-proof and blast-proof. Speaker output 10 bars. RE 13A 563A.
49091	CRD	V.H.F., CXAC.	....	600	PM	Top 9$\frac{3}{16}$″, Base 3$\frac{9}{16}$.	Bulkhead	Complete with volume control and transformer for operation from 600 ohm line.
49092	CNA	RAO	2	20,000	PM, dynamic.	Standard relay rack panel, 19″ x 7″.	Rack	Speaker is standard Jensen PM dynamic type with a 6″ cone. Fitted with a 20,000-ohm input transformer to match the speaker output of the RAO receiver.
49101	CRV	TBS-3	4 (normal), 20 (maximum).	700	PM	Cylindrical	Bulkhead	20-watt speaker, limited by "L" pad to 4 watts. Transformer primary impedance 700 ohms minimum at 3 volts, 60 cycle AC and 0 amperes DC. Matching transformer.
49102	CMX	XAJ	....	....	....	....	....	
49105	CNA	RAS-1, RAS-2, RAS-3, RAS-4, RAS-5, RAW.	2	5000	PM	Rack panel 19″ by 8¾″.	Rack	Loudspeaker is Rola., Inc. speaker PMK8. Cone diameter is 8″. Fitted with a 5000-ohm coupling transformer to match receiver output. Voice coil impedance 2.8 ohms.
49106	CNA	RAO, RAS, general use.	2	5000	PM	Cabinet – height 9⅜″, width 10¼″, depth 7¼″.	Table	The loudspeaker chassis and matching transformer are identical with those of the Type CNA-49106. Electrical characteristics are the same. This cabinet model purchased under same contract as the Type CNA-49105 for use when table mounting is desired.
49108	CRA	DT, DY	....	....	PM	....	....	Permanent magnet, dynamic type loudspeaker with impedance matching transformer. 5″ cone diameter.
49131, 49131A, 49131B, 49131C, 49131D.	CRV, CRV, CRV, CMX, CRV.	TBT, RAQ, RBO.	1.75	600	PM	Approximately 16″ in height, 14″ in width and 8″ in depth.	Bulkhead	All models are loudspeaker-amplifier units and include an integral amplifier and a power unit for 115 volts, 60 cycle AC or 115 volts DC, supply 40 watts. Input to amplifier 6 milliwatts. These models vary as to switch, terminal board, metal construction, and minor changes.
49139	CJS	TCQ	....	....	PM	....	....	5″ permanent magnet, dynamic, Jensen type PM5D.

Navy designation	Mfg.	Used with	Audio power (watts)	Input impedance (ohms)	Type magnet	Shape and description	Model or mounting	Description of loudspeaker
49140....	CNA...	RBE.....	1.75...	600	PM......	Rack panel 19" by 8²³⁄₃₂".	Rack......	Mounts on standard relay rack. Operates from 115 volts, 50/62 cycles AC. Rated input 6 milliwatts, 600 ohms at 1000 cycles. Rated output 1.75 watts to the voice coil at 1000 cycles. Uses two 6V6GT and one 5U4G tubes in amplifier. Speaker is Jensen type PM6C. Voice coil impedance 6 ohms. 6" cone diameter. RE 13A 605A.
49141....	CJS....	RBE in connection with CNA-49140 speaker/amplifier.	....	....	PM......	Diameter of cone 6".	....	Jensen type PM6C. Voice coil impedance 6 ohms at 400 cycles. RE 13A 605A.
49149....	CHL...	RBJ, RBK.	3.....	5000	....	Overall height 9¼" width, 10¼", depth 7".	Cabinet for table mounting.	Accessory for RBJ.
49154....	CHC...	RBG.....	2.....	5000	PM......	....	Metal cabinet.	Jensen dynamic speaker having permanent magnet field, matching transformer, 8" diameter cone.
49155, 49155.	CMX, CRV.	TCS-7, TBS.	20 ...	500	PM......	Circular, metal housing approximately 10" in diameter.	Bulkhead..	Speaker proper will handle 20 watts speech. Includes transformer in case to match voice coil to 640-ohm line. Similar to CRV-49101 except is equipped with a blast plate and includes an attenuator, with maximum attenuation of 40 db continuously variable, mounted on the case. Dynamic with permanent magnet field. RE 13A 936.
49166....	CUL...	CXBO...	25....	....	PM......	....	....	Dual type, high fidelity 60 to 500 and 300 to 10,000 cycles. 50% efficient. Weather proof.
49172....	CHL...	RBK-2, RAK-8.	....	5000	PM......	....	Cabinet....	10" permanent magnet speaker. Flat response from 80 to 5000 cycles. Resistance 4.80 ohms. Transformer primary 3000 turns #36 wire, secondary 65 turns #20 wire. Matching transformer. Voice coil impedance 6 ohms. Jensen C-4065.
49175....	CUL...	MN......	12....	8	PM......	Double, re-entrant horn type bell 8", depth 7".	Special angle bracket-roof, table, bulkhead.	Weather-proof, uniform response over frequency range of 400 to 5000 cycles per second and an audio power handling capacity of 12 watts, 8 ohms impedance.

Navy designation	Mfg.	Used with	Audio power (watts)	Input impedance (ohms)	Type magnet	Shape and description	Model or mounting	Description of loudspeaker
49183	CWQ	RBF-2			PM			The unit consists of a loudspeaker mounted in an enclosure. Frequency range 600 to 10,000 cycles per second.
49186	CNA	RBT-1		7000	PM		Cabinet	8″ cone diameter. Frequency response 200 to 5000 cycles. Voice coil impedance 6 ohms at 400 cycles. Matching transformer.
49207	CJS	DAQ	2		PM	Overall diameter 5″, overall depth 2⅝″ maximum.		Cone speaker.
49228	CNR	ML-3		5.5	PM			Includes dynamic loudspeaker, volume control, and terminals mounted on a terminal strip. For remote use. Input 2.34 volts, 0.426 amperes. Frequency response within ±2 db from 100 to 4500 cycles.
49239	CJS	PD-1	6		Electromagnetic dynamic.			Electromagnetic dynamic. Completely dustproof. Rated 6 watts. Voice coil impedance 6 ohms at 400 cps. 1″ diameter field coil. DC resistance 280 ohms, wound with #30 wires.
49240	CRA	PH, PJ, mobile equipment.	2.5		PM	3½″ cone housing.	Especially suitable for mounting in portable equipment.	Completely dustproof. 5-ounce magnet, 3″ cone. Voice coil impedance 4 ohms.
49282	CJS	PE-1	5	4	Electromagnetic.			Core diameter 6″. Field coil rated 1800 ohms, 4 watts, tapped at 300 ohms.
49437	CJS	TCS-6		6	PM			Cone diameter 5″. Natural frequency of diaphragm is 275 ± 10 cps. Voice coil made up of two layers of #35 wire.
49442	RQ	OAY	8-10		PM	Cone diameter is 12″.		Speaker-amplifier unit. Operates horn 110/1/60 AC, 105 watts. Consists of a bridging power amplifier, Thordarson Electric Co. type T-31W10 and a high fidelity loudspeaker, Jensen type JCP-40. Amplifier gain is approximately 82db. Unit has bass and treble controls. Jensen type JCP-40. Voice coil impedance 6 ohms, 12″ cone.
49478		Never used.	12 (maximum).	600	PM	Bell 8″	Universal mounting provision.	8″ bell. Frequency range 200 to 3500 cps. Designed for use under adverse conditions. This Navy type loudspeaker has never been contracted for.

Navy designation	Mfg.	Used with	Audio power (watts)	Input impedance (ohms)	Type magnet	Shape and description	Model or mounting	Description of loudspeaker
49493....	CJS....	RAO-5........		600	PM......	Metal cabinet 8¼″ by 8¼″ by 4⅜″.	Table.....	Speaker unit is 6″ in diameter and has a 19 ounce permanent magnet. Impedance matching transformer, primary has terminals for connection to circuits of 20000, 10000, 5000, 2000, 600 ohms. Volume control. 5-foot input cable. Frequency range 200 to 5000 cps.
49545....	....	RBO.....	3.....	600	PM......	Height 20″, width 16″, depth 12″ maximum.	Bulkhead, table.	Speaker-amplifier. Operates from 115 volts, 50-60 cycles AC. Five channel input. Volume control. Tone control. Frequency range 100 to 5000 cps. High quality cone speaker for entertainment purposes. New. Has not been contracted for yet.
49546....	CUL...	General communication use.	10 (normal operating range will probably not exceed 2 to 4 watts.)	15	PM......	Reflex horn. Mounting base is approximately 7½″ by 3¾″, overall depth of horn and base 10¼″.	Any vertical surface or to the overhead if suitable right angle bracket is secured.	Submergence-proof and blast-proof loudspeaker for open bridge installations and other locations exposed to the weather. Includes T-pad volume control and hermetically sealed transformer with primary tapped at 600, 1200, 1800, 2400, and 3000 ohms to permit paralleling of from one to five speakers across a standard 600 ohm audio line. Frequency range 200 to 3500 cycles per second. In production at the present time.
49587....	CZC...	....	10....	....	PM......	Cabinet.......	Bulkhead..	12″ cone diameter. Matching transformer to match 6-ohm voice coil to 600-ohm line. Frequency range 300 to 5000 cycles per second.
49597....	CCI....	RCO, RDF.	....	....	PM......	Panel 19″ by 7″.	Rack......	Cone diameter 6″. Contractor's commercial model #132. Impedance matching transformer to match 500-ohm voice coil to 600-ohm line. Complete with cord and plug.
49620....	CMX..	Identical with the CMX–49131C in every respect except the loudspeaker cone in the CMX–49620 is not blast-proof. Formerly the CMX-49131E.						
49624....	....	General use.	15....	15	PM......	Double re-entrant type. Approximately 7½″ in diameter and 6″ in depth.	On or through the bulkhead.	Submergence-proof and blast-proof loudspeaker for general exterior use on small craft such as PT boats. Frequency range 500 to 5000 cycles. Complete with impedance matching transformer with the primary tapped at 600, 1200, 1800, 2400, and 3000 ohms. New. Contract to be let in the near future.

Navy designation	Mfg.	Used with	Audio power (watts)	Input impedance (ohms)	Type magnet	Shape and description	Model or mounting	Description of loudspeaker
49645	CRV	RBM	2	600, 3300, 5300.	PM		Mounted in portable case.	Monitor amplifier mounted in portable submergence-proof and blast-proof case complete with speaker. Self contained a-c operated power supply, 115 volts ±10%, and an alternate 12 volt d-c operated vibrapack. Source impedance 600 ohms; input impedance 600, 3300, and 5300 ohms. Rated output 2 watts at 400 cps and 4% distortion. Frequency range 500–4000 cps.

LITZ WIRE

Since high "Q" means in general better selectivity and greater gain, coils are usually designed to secure the highest "Q" compatible with other practical construction and circuit factors. Since "Q" is the ratio of inductive reactance to effective resistance, the "Q" may be increased by either increasing the inductance or reducing the effective resistance of the coil. The inductance of a coil is fixed by the frequency range to be covered and the maximum and minimum capitance of the circuit (assuming variable capacity tuning) so that any efforts to increase the "Q" must be directed toward a reduction in effective resistance.

It will be noted that the term "effective resistance" has been used. The term is used to denote the increase in resistance at high frequencies due to coil losses and skin effect. The effective resistance is the ratio of the power dissipation in a coil to the current squared. Alternating current at high frequencies tends to flow on the surface of conductors rather than uniformly through the cross section area of the wire as is the case with DC or power frequency AC. Since the thin outside shell has a smaller area than the wire, the current density is increased at high frequencies with a consequent increase in losses and effective resistance.

At low and medium frequencies (30 to 3000 kc) the surface area of a conductor may be increased without increasing the cross section of the copper by dividing the conductor into strands and insulating each strand from the others by a thin enamel coating. Wire in this form is known as "Litzendraht" or "Litz" wire. Litz wire consists of many strands of fine wire, each strand individually insulated with enamel and the whole group covered with a protective textile wrapping. Furthermore, the strands are so arranged that each occupies a place on the surface of the conductor an equal percentage of the time so that the radio-frequency current will divide equally among the many strands and thereby give the lowest radio-frequency resistance. Originally, the strands in Litz wire were braided so as to give this effect. Recent Litz wire is merely twisted so as to bring the different strands to the surface at different points, giving a result approaching that of braided Litz, but at far less cost. If stranded wire without twisting is used the results are inferior to those obtained with twisted Litz.

Litz wire comes in a variety of combinations of number of strands, wire gauges of individual strands and types of covering. The more commonly used combinations are 5, 6, 7, 8, 9 and 10 strands of #38, 40, 41, and 42 B & S gauge wire. The number of strands used is a rough function of frequency; in general, the higher the frequency the greater the skin effect and the greater the number of strands employed. The gauge of the strands is determined by the overall wire diameter which is dictated by winding space, coil size, etc.

When soldering Litz wire to coil terminals, it is of great importance that a *good*, permanent electrical contact be made to *each* and *every* strand of wire. Otherwise some of the strands will not be conducting their share of the current with a consequent increase in radio-frequency resistance.

Before soldering, the insulating enamel must be cleaned from each strand. This is best done by heating the end of the wire in an alcohol lamp until red hot, and then plunging the wire into a bath of alcohol. This operation completely removes the enamel insulation from the individual strands, leaving them clean and ready for soldering. A less satisfactory emergency method is to fold a scrap of 000 sandpaper between the thumb and forefinger with the abrasive inside and draw the wire through several times, rotating the wire axially after each draw. Care must be exercised not to break any strands as this is easily done. This method removes the cloth insulation as well as the enamel from the strands.

MASTER-OSCILLATORS FOR ADVANCED BASES

The Bureau is purchasing 1,000 small self-excited stabilized oscillator units capable of delivering, under continuous operating conditions, a minimum of 0.75 watts with continuous coverage of the frequency spectrum from 0.75 to 10.0 mc. inclusive. The complete equipment will include a rectifier power unit for taking power from a 115/230 volt, 50–60 cycle, single-phase supply line. The oscillator, rectifier power unit, oscillator coils, and buffer coils will be contained in a single cabinet that is capable of being mounted in a standard 19″ relay rack.

These oscillators are intended for use with such transmitters as the TCB, TCC, TCR, and TDF series to provide continuously variable operation on frequencies for which crystals are not available.

EMERGENCY FREQUENCY CONTROL

There are many occasions in field operations or at advanced base radio stations when there is a need for a stable, continuously variable means of frequency generation to drive a normally crystal-controlled radio transmitter. Changes in communication plans at the last moment will render a transmitter idle until crystals of the proper frequencies are obtained or reground to the redesignated channels. The allowance lists for advanced base stations usually contain a few Navy type LM frequency meters. Similar types such as the Army SCR–211 may also be obtainable. One of these units may be used as a variable frequency oscillator by connecting it to a fabricated exciter, the circuit of which is shown in Figure 1. This arrangement will deliver approximately eight watts output. All screen and plate resistors are ten-watt types. Key the first 6AC7 when using it as a variable frequency oscillator. Crystal control may be obtained by connecting the crystal across the second 6AC7 as shown in the diagram. Keying is then accomplished in the second 6AC7.

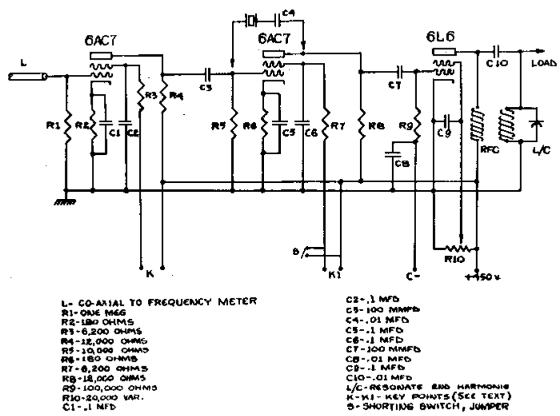


FIGURE 1.—Continuously variable master-oscillator arrangement.

The output of the exciter may be connected directly to the grid of the isolation stage or doubler. When the transmitter is equipped for a frequency-shift keyer, the output may be plugged directly into this receptacle.

HOW TO LOAD THE TRANSMITTER

The material to follow is published for the instruction of those members of ships' personnel who are not entirely familiar with the tuning of transmitters.

An antenna will not radiate all the power available from the transmitter unless the impedances of the antenna and transmitter are properly adjusted by a method of "loading". Loading generally consists of two parts: The tuning of reactances which are connected to the antenna for the purpose of changing or "transforming" the impedance of the antenna; and the adjustment of coupling reactances which are connected between the transmitter and the antenna loading reactances.

The tuning procedure almost always starts with the loosening or decreasing of the coupling in order to protect the transmitter. This is necessary because overcoupling of the tuned antenna might reduce the impedance of the final stage's tuned circuit to such an extent that the final stage tube would conduct an unsafe amount of current.

After decoupling, the final stage is tuned. This process usually involves tuning a parallel resonant circuit which is in series with the plate of the output tube. The tuned circuit is the load impedance for the output stage and is tuned to parallel resonance by rotating the condenser and observing the final plate current meter (or cathode current meter). When it reads a minimum value, the plate load impedance has been maximized and is correctly adjusted.

Next, the antenna is tuned so that it will draw a maximum amount of power from the transmitter. This is done by varying the loading reactances as described in the instruction book, meanwhile observing that the antenna ammeter indicates in a manner described in the article "What Does Antenna Current Mean," page ANT:3, with the magnitude of the current dependent upon the adjustment of reactance described in this paragraph. When the adjustment is correct, the antenna ammeter will indicate a maximum current (providing such current is readable) and the final stage plate current will also reach a maximum. In other words, the tuning apparatus is adjusted until these two meters indicate maximum value.

At this point in the adjustment schedule, the coupling apparatus is still arranged for loose coupling. The last step is therefore a tightening of the coupling, accomplished by closing the plates of a coupling condenser, or by bringing the two windings of a radio-frequency coupling transformer closer together. The proper degree of coupling is obtained when the plate current meter of the final stage indicates the rated value, or that value of current which the instruction book describes as "rated" or "normal".

If the frequency establishes enough current in the antenna standing wave at the antenna ammeter to permit an ammeter indication, then the antenna current can be observed during the coupling process. Usually, the antenna current will rise as the coupling is tightened (increased), but, of course, the operator ceases to increase the coupling when the final plate ammeter shows rated current.

Sometimes, usually at high frequencies, the instruction book mentions overcoupling. In such cases, the rated value of plate current is reduced from its usual or normal value so that the tuning may be accomplished by observing the final plate ammeter. In such cases, if the antenna current can be observed it will rise during the tightening of coupling until the plate current reaches rated value, and will then decrease if the coupling is tightened enough to draw more than rated final plate current.

Summary: Loading is almost always accomplished with these several simple steps:

(1) Decrease coupling.
(2) Tune final plate circuit to the dip in plate current.
(3) Tune antenna circuit to maximize final plate current. (Antenna ammeter will pass through a maximum reading, which reading may be too small to see.)
(4) Tighten coupling until final plate ammeter shows rated current. (Antenna ammeter will again increase, but may not be large enough to observe.)
(5) If so directed by the instruction book, the operator should loosen the coupling slightly and repeat steps (2), (3), and (4).
(6) If the coupling cannot be satisfactorily decreased for step (1), then it may help to disconnect the antenna, and reconnect it between steps (2) and (3).

The reader is referred to the article "What

Does Antenna Current Mean," page ANT:3, for further information on antenna current.

There are frequent reports of difficulties in properly loading transmitters on certain frequencies. On a few transmitting equipments the output coupling devices do not have sufficient range to load the antenna with the above procedures. The trouble can usually be cleared up by adding a controllable amount of reactance to the antenna circuit, either inductive or capacitive reactance being used as required. It has been found that a 250-mmfd. variable condenser suitably mounted and protected is usually all that is required. A type 481640 auxiliary tuner has been developed by the Bureau to eliminate tuning difficulties with the model TCE series transmitters. These tuners consist of a 250-mmfd. condenser suitably enclosed for mounting either on a bulkhead or atop the TCE, and may be secured by application to the nearest Radio Material Officer.

FAILURE OF TRANSMITTER TO LOAD

When a transmitter fails to load properly, check the antenna system for open or poor contact at the feed-through insulators. A simple trunk continuity check can be made by connecting with a jumper the antenna wire to the ship's hull outside the external feed-through insulator. Then disconnect the antenna from the transmitter and check the d-c resistance from antenna bus to ground. Zero (or very low) resistance indicates satisfactory continuity. *Be sure to remove the jumper after the test.*

—U. S. S. *Haverfield*

MAINTENANCE OF VOLUME CONTROLS

Noise in a receiver is frequently traced to a faulty volume control. If the control is suspected, it may be checked by tapping and/or rotating the shaft while listening for a change in the nature of the noise.

If the volume control is of the wire-wound type, it may be cleaned with an eraser or crocus cloth. See the article "Relay Maintenance," page GEN:28, for directions on cleaning contacts. After cleaning, the contact surface may be washed with carbon tetrachloride or alcohol and lubricated with a light coat of vaseline.

Worn out carbon resistance elements need replacement. In an emergency, they often can be repaired by smearing the contact surface with pencil lead. If no exact replacement is available, but one of higher resistance is, a replacement may often be made by utilizing the available one and shunting it with enough fixed resistance to bring the paralleled resistance down to the desired value.

EMERGENCY TREATMENT OF ARC-OVERS

Arc-overs often call for a permanent replacement of a component or insulator, or for increasing the separation between arcing points if air is the insulator, or for some other type of repair that cannot always be made during an emergency.

Although arcs are always due to the same general causes, there is enough difference in radio equipment arcs to permit several types of emergency repair. An arc between one or more sharp points might be eliminated by filing down the points (provided such points are not functional). An arcing contact calls for dressing the contact and testing any associated arc-reducing resistors or reactors. An arc along the surface of a ceramic insulator calls for cleaning and/or drying the insulator surface; such failures are most likely to appear in hot, damp climates.

Some arcs can be cured by a slight revision in the circuit. For example, in a transmission line circuit, an arc might be eliminated by moving the offending spacer to a position of lower voltage, or even temporarily removing it. Occasionally, a haywire suspension of an offending connection might permit temporary removal of a punctured insulator. In a few instances, the arc can be eliminated by shunting the impedance of the arc path with a resistor of sufficiently low impedance to reduce the potential across the arc path; although this can only be done where it is known that no deleterious overload or detuning will occur as a result of the added impedance. An example might be the failure of a modulation transformer's insulation. Temporary replacement of an arcing component can sometimes be effected by utilizing some combination of other components; for example, an arcing rheostat might be replaced by another of larger resistance, shunted by a fixed resistor of such size as to bring the combined resistance to the right value. This can only be done when there are no critical requirements of the original component such as taper, calibration, capacity to ground, etc.

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OPERATION OF START-STOP SWITCHES

Most start-stop switches of the momentary type are so connected that the depressing of both buttons simultaneously would throw a direct short across the line, and blow one or more fuses. This condition is considered normal, and it is therefore suggested that all radiomen be familiar with it, and avoid blowing fuses by irregular operation of the momentary start-stop switches.

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TREATMENT OF RADIO EQUIPMENT AFTER SALT WATER IMMERSION

The following procedure is suggested for the treatment of radio equipment after salt water immersion:

(1) Dismount transmitters, receivers, frequency indicators, direction finders, etc., removing all covers, access and mounting plates, vacuum tubes, fuse covers and fuses, and armatures from dynamotors or motor-generator sets. Disconnect and remove all meters from equipment and cases. Break the dial glass, if required, to drain off water.

(2) Flush all parts of the equipment thoroughly, using warm fresh water under slight pressure. Do not subject the internal parts of pressure-sealed units to the water treatment without first ascertaining that salt water is present inside the pressure-sealed portion; then remove the salt water from the exposed parts only. Place the equipment in a tank and soak it not less than four hours in circulating warm water. If non-circulating, change the water at intervals of one hour. As an added precaution against corrosion, if the material is available, it may be desirable to add a minute quantity of potassium dichromate to the fresh water solution in the strength of ½ oz. to every 10 gallons of water.

(3) Remove the equipment from the water and drain it. Blow out all moisture with low pressure air and place the equipment in any available oven. Dry it thoroughly for 24 hours at a temperature of approximately 150° F.

(4) If storage is required prior to overhaul, spray all exposed metal parts slightly, using light clear oil.

Experience indicates that if equipment is treated as outlined immediately after immersion, a minimum of replacement parts and overhaul work is required. It has not been found practical, however, to attempt to salvage vacuum tubes, meters or externally shielded cables (except plugs, which are removed and included with the equipment being preserved). Power transformers in transmitters, likewise, must practically always be replaced, even though megger tests after baking may show normally high insulation resistance to ground. It has likewise been found that replacement of sockets, relay contacts, etc., may be required, particularly if immersion took place before power voltages were removed from the equipment. Glass tubes having their leads coming directly out of the glass envelope without a tube socket will not need to be replaced unless proven defective. On tubes of this type, it will be necessary to remove all corrosion from the tube leads. Cathode-ray tubes can possibly be salvaged by removing the plastic base from the tube, removing all corrosion and salt water and replacing the plastic base.

Rewiring of equipment is not normally required, the criterion used being a check of circuit resistance to ground from the various terminals, using a megger, after removing normal circuit grounds or resistor shunts. An insulation resistance in excess of 50 megohms is taken as satisfactory evidence that rewiring is not required. Rewiring, replacement of parts, refinishing of cases and final testing of equipment is accomplished as with other types of overhaul procedure.

If the immersion was for a prolonged period or if the equipment has not been properly washed and preserved, it is usually found that so much corrosion of the cases and mechanical parts has taken place that it cannot be economically overhauled.

—*Airborne Coordinating Group*

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ELECTRONIC CORD AND CABLE TESTER

The electronic cord and cable tester shown in Figure 1 is said to take the guess work out of checking portable cords and cables for breaks, and

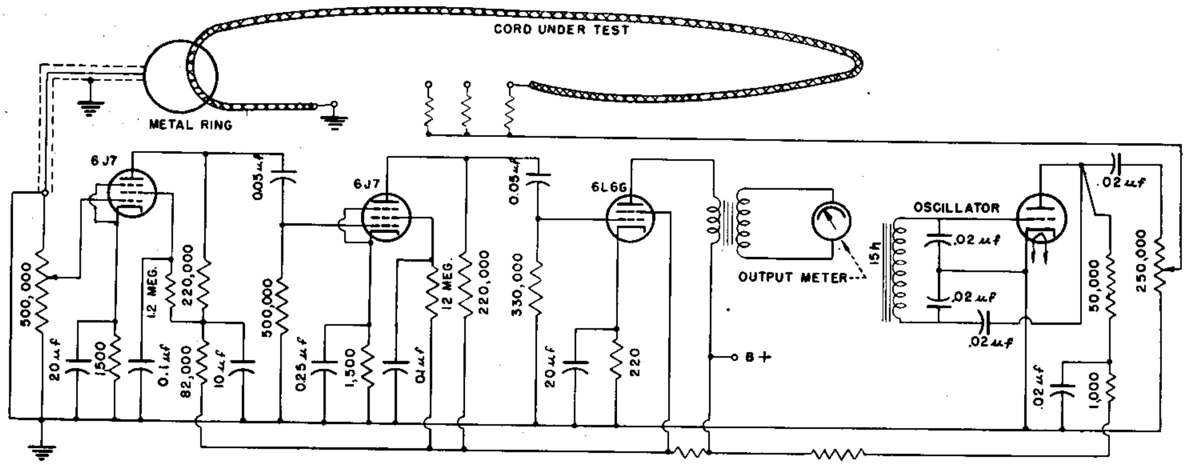

FIGURE 1.—Electronic cord and cable tester.

to save time and material. It was developed by Consolidated Vultee Aircraft Corporation and is presented here for the benefit of Naval activities who have occasion to check portable cables and who may wish to construct the device.

The circuit is shown in Figure 1. One tube is connected as a self-excited oscillator operating on a frequency of about 400 cycles. The output of the oscillator is applied to the cord.

A small amount of the signal energy is picked off the cord by a metal ring through which the cord is passed. Fed to a high-gain amplifier, the signal amplitude is increased sufficiently to operate the output meter shown. When a break in the conductor passes through the ring, a sudden change in the meter deflection occurs and the broken spot can be quickly and accurately ascertained. Thus, the necessity of cutting the cord to locate the break is eliminated.

The metal pick-up ring is mounted inside an assembly of fibre insulation material. A short shielded lead is provided for connecting the ring to the amplifier. The ring is mounted on top of the test unit. Input and output potentiometers are provided to permit adjustment of the circuit so that the meter reading occurs at a convenient portion of the scale when a good cable of the type to be tested is inserted in the ring. An additional provision for this purpose is the use of different values of resistance in the output circuit.

In addition to the output terminals shown in the diagram, the electronic tester may be modified if desired to accommodate various male and female cable and cord plug receptacles.

—*Electronics Magazine*

STARTING NUTS IN TIGHT PLACES

When the available space is too small for the use of fingers and the nut won't stick to needle nose pliers and the profanity is exhausted, try this stunt:

Place the nut on a metal plate and lay a piece of wire solder across the nut, placing the nut near the end of the solder. A hammer blow will force the solder down into the threads and cause the nut to stick to the solder. Using the solder as a handle, place the nut in position and turn the screw. As the nut travels down the screw, the solder will be forced off and an end wrench or long nose pliers will hold the nut for tightening.

CARE OF BALL BEARINGS

The production of bearings cannot keep pace with bearing requirements. Therefore, the authorized maintenance procedures for the care of bearings should be followed religiously. Some of the things that can be done to improve the situation are:

(1) Keep bearings clean. One speck of sand or grit can ruin a bearing. Watch out for dirty hands, tools, benches, rags, cleaners and lubricants.

(2) Clean bearings thoroughly. Always use a clean dry cleaning solvent, and also a brush if necessary. Place the bearing on a clean surface, such as a sheet of paper, to drain and dry. Never use compressed air to dry a ball bearing. Keep new bearings in the original wrappers until actually ready to install. All bearings, except prelubricated bearings that are sealed, must be cleaned before installation.

(3) Install bearings properly. Be sure all parts of a bearing assembly—spindles, hubs, and cups—are cleaned and free from sand and grit. Be sure the bearing itself is clean. Install, adjust and lubricate according to instructions.

(4) Lubricate bearings correctly. Bearings that are going to be grease packed, such as wheel bearings, must not be oiled before installation. Keep sand and grit out of lubricants. Lubricate bearings in accordance with the instructions in the appropriate radio equipment instruction book.

(5) Bearings that are not going to be reinstalled immediately, after they are removed and cleaned, should be oiled to prevent rusting. They must be cleaned again to remove oil and dirt before installation.

—*Signal Corps Technical Information Letter #27*, February 1944.

FAILURE OF POST TYPE FUSE HOLDERS

Considerable trouble has been experienced with post type fuse holders, such as those used with models RAO, RBH, RBO, etc. The usual trouble is failure of the spot weld between the lug on the side of the holder and the internal metal sleeve, causing loss of input power to the receiver.

As an emergency measure, broken fuse holders may be "sweat soldered," tinning the metal sleeve and carefully working solder into the hole in the soldering lug on the side of the holder. A permanent repair may be made by replacing the defective holder with one of improved construction, such as Littelfuse catalog #1075F. It should be remembered that post type fuse holders are not "built like a battleship" and hence can be easily damaged by heavy handed twisting with a screwdriver. The fuse holder should be screwed in until just tight and *no more* and secured.

SOME NOTES ON THE USE OF FUSES

A fuse is electricity's safety valve. It is placed in a circuit to protect equipment and if it "blows" it is an indication of trouble. Fuses of reliable design do not deteriorate with age. They will protect a circuit indefinitely if not overloaded or subjected to poor contact.

If a fuse has been making good contact in its clips, it will be clearly indicated by the condition of the contact terminals. If the contact has been tight, very little or no air can get to the portions that were making contact. Hence, very little or no oxidation can occur and the portions in intimate contact will be clean and bright. If, however, the contact has been poor, air gets to the contact surfaces and the heating of the fuse (due to either excessive current density in the contacts or to the voltage drop across the oxide or other agent introducing resistance between the contact surfaces) produces oxidation which is evidenced by discoloration of the contact surfaces. No matter how badly a fuse might be heated, there will be a clean, nonoxidized space if good contact has existed. If the washer or end ring on a renewable fuse is burned or partially melted, it indicates that the cap was not screwed down tightly. Charring of the fibre tube or inside fibre strip in a renewable fuse always indicates poor contact or over-fusing, i.e., installing a renewable link of greater capacity than called for. Poor contact is to be especially avoided, as the heat produced by current flowing through this contact is conducted to the fuse, melting the link prematurely or damaging the case.

When renewing the link in a renewable fuse, it is important that a link of the correct current rating be installed. Overloading a renewable fuse or a fuse block is no different than overloading anything else. If an attempt is made to make a fuse carry a current greater than that for which it was designed, the terminals and current carrying parts of the fuse will overheat, damaging the fuse case and taking the spring out of the fuse clips. Furthermore, a renewable fuse that is overfused may explode if subjected to a heavy short circuit. The pressure developed by the volatilization of the extra metal will be greater than the fuse case was designed to handle. Drilling holes in the sides of a fuse tube to keep down the temperature where a renewable fuse is over-fused makes a real hazard out of the fuse because a fuse with holes explodes more readily than a totally enclosed fuse. Pressure inside the fuse case helps to extinguish the arc and this pressure is lost when a fuse is mistreated in this manner. Such holes will also permit the expulsion of molten metal and hot vapors which may ignite inflammable material and cause serious burns.

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COLD-SOLDERED JOINTS IN EQUIPMENTS

High resistance soldered connections, especially in fuse holders, have been reported in several receiving equipments, including models RAO, RBL, RBO, RAK and RAL.

The cold-soldered connection should be reformed by the application of a hot soldering iron. Replace bakelite fuse holders if they have been damaged by an arc across a cold-soldered joint.

It is well to look for other cold-soldered joints on components such as certain types of fuse holders, components potted in tar, etc., which are so constructed that only a small amount of heating is permitted in soldering them.

—*Commander Service Force, Atlantic Fleet*

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SOLDERING

In the maintenance of radio equipment, too much emphasis cannot be laid on good soldering as an appreciable portion of equipment failures can be directly traced to poorly soldered joints, especially on shipboard where apparatus is subjected to continual shock and vibration. In this connection, attention is invited to the following suggestions on soldering:

(1) The parts to be soldered must be absolutely clean, i.e., free from oxide, corrosion and grease.

(2) The only satisfactory flux for radio and electrical work is rosin. Either a paste or thick solution of rosin in alcohol or carbon tetrachloride ("Carbona") or rosin core solder may be used. Soldering paste is satisfactory for assistance in tinning and soldering power cables to lugs, provided it is used judiciously and sparingly, and any excess is removed as soon as the joint is cool. Acid or "killed acid" flux should *never* be used except in cases of absolute necessity.

(3) All wires should be mechanically fastened to soldering terminals or each other. Solder has very little mechanical strength and should not be used for fastening purposes. Mechanical rigidity should be obtained by bending the wire into a small hook at the end, and nipping it firmly with a pair of pliers around the other part to be soldered. Wrapping or twisting of wires around lugs should be avoided as it is very difficult or impossible to satisfactorily remove connections made in this manner.

(4) The soldering iron must have its tip properly cleaned and tinned. Satisfactory soldering cannot be done with a tip that is oxidized.

(5) The work must be heated to a temperature slightly higher than the melting point of the solder. This allows the solder to penetrate to all fine crevices of the joint and form the alloy with the other metals essential to a good joint. It also causes the rosin flux to be burned out of the joint, as is evidenced by the white rosin smoke or globules of rosin floating on the solder.

(6) If possible, the iron should be held below the joint to drain off excess solder. It is a common fallacy that the strength of a soldered joint depends upon the amount of solder used. It does not. Experience shows that "piled up" joints usually have one or more layers of rosin sandwiched between the solder preventing good electrical and mechanical joining.

(7) The joint must be kept perfectly still until the solder has had time to solidify. Premature motion produces a so-called "cold" joint which has a dull "white" appearance instead of a shiny "silvery" one. Cold joints tend to have a high resistance, and the cure is to reheat the joint until the solder remelts and then allow it to cool without motion.

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CARE OF THE SOLDERING IRON

From time to time the tip should be removed from each soldering iron and the black scale removed from the tip and from inside the barrel of the iron. This procedure accomplishes two things:

(1) It provides for better heat transfer between the barrel of the iron and the tip by removing the layer of heat insulating scale.

(2) It prevents the tip from "freezing" in the iron. A frozen tip is an unfortunate circumstance as its removal is a matter of great difficulty, and, once a frozen tip has worn away through use, the iron must be discarded. A light application of penetrating oil around a frozen tip may be of assistance in its removal.

When an iron is new, or a new tip is installed, coating the inside end of the tip shank with dry flake graphite will prevent sticking or freezing. A threaded tip should not be screwed in too tightly when the tip and iron are cold.

When finished with a soldering job, wiping excess solder from the tip while it is still hot will prevent erosion and pitting, requiring less frequent filing and thereby increasing the life of the tip.

Tips with deep pits that would require considerable filing to smooth down should be removed from the iron and carefully hammered down to the desired shape and surface.

The insulation resistance of the iron should be measured when it is new and monthly thereafter; irons with low insulation resistance and grounded irons should be removed from service for repairs.

CONSTRUCTION OF A "HEAT STRIPPER" TO REMOVE COPALENE AND RUBBER INSULATION

Knife or tool stripping of tough copalene or rubber insulation has been a tedious and difficult job. Improper use of tools has resulted in nicked inner conductors (particularly single conductors) that break when vibrated or bent in operation. Such breaks cause trouble that is hard to trace and usually makes the equipment inoperative. Increased use of copalene-insulated coaxial cable and the use of added plugs, fittings, junction boxes and switches have multiplied the danger from improper stripping and the time involved in the operation.

The idea offered herewith has been used with excellent results at Mare Island. An edged "V" (with a 1/8" wire slot in the bottom of the "V") is fashioned on the end of a piece of copper strip and secured around the heating portion of an ordinary soldering iron. (See Figure 1.) The cable insulation to be stripped is laid in the "V" and rotated. The "heat stripper" rapidly melts a clean break that permits the end insulation to be easily removed with a slight pull. This method

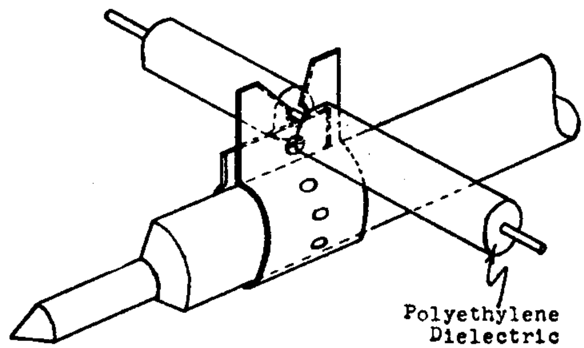

FIGURE 1.—A method of stripping tough insulation.

can be used for lateral cuts on thinner external layers as well, and can also save time on rubber insulation such as Tyrex.

—*Navy Yard, Mare Island*

NOTES ON THE CARE OF HAND TOOLS

Pliers.—Good pliers are forged of high grade steel, tempered to provide the proper spring in the handle, with knives sharpened to assure a smooth clean cut. If properly used they will give years of satisfactory service. Like any tempered tool they can be quickly ruined by being placed in a flame or near excessive heat. The practice of using pliers to hold objects in a blowtorch flame is almost certain to draw the temper from the pliers. An old cheap pair of pliers should be retained for this use exclusively.

Another common form of abuse is using pliers as a hammer. Pliers may be easily cracked or broken under such treatment and there is the added danger of nicking the blades, making the pliers unfit for cutting. The few seconds necessary to pick up a hammer for such a job are well repaid by the protection afforded the pliers.

There are many sizes and types of pliers, each designed for a specific use. While pliers are flexible in their adaptability and a single pair can be used for a large number of jobs, care should be taken to see that the proper size is used, as pliers can be overloaded and ruined by such practices as extending the length of the handles to secure greater leverage and trying to cut too large a wire with too small a pair of pliers. Long nose pliers can be spoiled by trying to bend too large or too stiff a wire with the tips of the pliers.

When cutting wire with diagonal cutting pliers, particularly high strength strand or steel core wire, the cut should be made around the wire with the cutter knives perpendicular to the wire. The pliers should never be rocked from side to side or the wire bent back and forth against the knives, as there is great danger of nicking or chipping them as they were never intended to take this side strain. If cutters will not cut a wire with a straight compression with the hand, it is a clear indication that a heavier cutter is required.

If the cutting edges of the blades become dull, they should not be filed or ground, but may be touched up with a fine grained carborundum stone.

When not in use, pliers should be rubbed with an oily cloth. When so treated they will remain rust free for a long time. An occasional drop of oil at the hinge will lengthen their life and assure easy operation.

Pliers should not be used for loosening or tightening hex nuts as the nut is almost certain to be battered. A wrench is the only satisfactory tool for use on hex nuts.

Adjustable Wrenches.—An adjustable wrench is a sturdy tool which is designed to do one job—to tighten and loosen bolts and nuts. However sturdy they are, wrenches can easily be abused, and the most common causes of failure are abuse and neglect. Wrenches should be kept clean and a drop of oil should be placed occasionally on the moving parts. Dirt and rust accumulating on the knurl make the wrenches hard to operate. Keep them clean.

It is not uncommon to see a wrench used as a hammer. This not only batters the head of the wrench, but also is liable to break it or damage it beyond repair.

Wrench handle lengths are computed to provide safe leverage for the size of the wrench. Extending the length of the handle by slipping a piece of pipe over it increases the leverage but also increases the danger of breakage. If the wrench being used is not of sufficient leverage when used with its own handle, a larger wrench should be used.

Whenever possible, wrenches should be used in the correct position, i.e. when the handle is to the right of the nut being tightened, the sliding jaw should be on the bottom of the nut. The wrench should be turned over from this position to loosen a nut. This procedure puts the greatest load on the solid part of the wrench instead of on the sliding jaw. In tight quarters, however, where it is unavoidable, the wrench may be reversed, but too much pressure in this position is likely to cause damage.

It is important that the jaws of the wrench be tight on the nut that is being turned. This not only prevents battering the head of the nut, but is also a safeguard against the wrench slipping and will prevent bruised knuckles, skinned fingers or perhaps more serious injury to a fellow workman nearby.

Wrenches should be wiped with an oily cloth when not in constant use.

Screwdrivers.—Probably no tool in the electrician's kit is more abused than the screwdriver. Screwdrivers are designed for one purpose—to drive or back out screws. Using them as a pinch-bar or crow bar is apt to bend the shank or blade or loosen the handle as they are not designed for this kind of work. Screwdrivers should never be placed in flame or in hot solder as it draws their temper and renders them useless. Screwdrivers should never be used as chisels. This is liable to chip the blade or bend the shank. Hammering on the handle is apt to split or batter it, making the tool dangerous for further use. It is important to select the proper size screwdriver so that the bit is right for the screw it is to tighten or loosen. If the tip is too narrow, the screwdriver is almost certain to climb out of the slot and damage the screw slot. If the tip is too thin, it will bend and possibly break. Use of a screwdriver with a broken tip is dangerous as well as likely to cause further damage to the screw slot. If the screwdriver has a blade which is too wide, it will scrape around the edge of a countersunk screw head and prevent it from being driven home. The proper size screwdriver is one having a tip that is wide enough to just fill the slot in the screw head and just thick enough to fit the slot without wobbling.

SOME EMERGENCY "TRICKS"

Emergency Socket Wrench.—In an emergency, a socket wrench may be improvised when a nut of equivalent size and a block of wood are available. Hammer the nut into the wood until it is flush with the surface. Then remove the nut with a screw run a few turns into the nut. The impression of the nut in the wood will serve as an emergency socket wrench.

Emergency Phone Tips.—Phone tips may be put on the end of a piece of wire by winding bare or scraped wire of about #28 to #30 gauge around the end and up over the outside insulation. Roll tight and apply a thin even coat of solder.

Testing Paper Capacitors.—Paper capacitors may be checked for "opens" and approximate capacity by connecting the capacitor to a 110-volt 60-cycle a-c source, in series with a lamp, the wattage of the lamp being selected to give a glow. In general, the lower the wattage of the lamp, the smaller the capacity which will give a glow. A neon glow lamp may be used for very small capacitors. By noting the intensity of the glow and comparing it with that produced by known capacitors, an approximate idea of the capacity may be obtained. If the capacitor is "open" no glow is obtained.

Illumination in Receivers.—It is often desirable to illuminate the interior of a receiver to facilitate work in dark quarters. A satisfactory trick is to fasten a dial lamp socket on a fiber tube such as an alignment wrench, connect flexible test leads several feet long to the socket, and at the other end to a base from an old burned out lamp after removing the glass and contents of the base. In use, the lamp is removed from any convenient pilot lamp socket and inserted in the socket of the test lamp, the old base being inserted in the now vacant pilot lamp socket. Thus, illumination is furnished by the receiver's own power transformer, eliminating extra transformers, dropping resistors, etc.

Emergency Top Cap Connector.—An emergency top cap connector for tubes employing top caps may be improvised from a Fahenstock clip. The spring is bent until a snug fit is obtained on the top cap.

Emergency Capacitors.—A capacitor of 1 to 50 micromicrofarads may be made by twisting together two pieces of hook-up wire. The capacity is adjusted by varying the tightness and number of twists.

Magnetized Screwdriver.—Every repair shop has use for a magnetized screwdriver in picking up iron or steel nuts, screws and lock washers that fall into tight places. A screwdriver may be magnetized by placing it near the pole-piece of a field coil dynamic speaker while the speaker is in operation. Another method is to wrap several layers of hook-up wire around the blade and pass several amperes of d-c through the coil. By the same method a screwdriver may be demagnetized, if desired, by passing 60-cycle AC through the coil and slowly withdrawing the blade from the coil while the AC is passing through it.

Alignment Meter.—When aligning a receiver employing automatic volume control, a satisfactory output meter is a low range d-c voltmeter (1,000 ohms per volt) connected across the cathode bias resistor of a radio- or intermediate-frequency stage whose grid is biased from the AVC system. The bias voltage is produced by the plate current which is controlled by the AVC voltage. Hence, correct alignment is indicated by minimum bias voltage as read on the meter. When using this system sufficient signal must be fed into the receiver to provide some AVC voltage.

TUNING WAND

If a receiver is suspected of being out of alignment in the radio-frequency stages, it may be quickly and easily checked for alignment by means of a tuning wand. Furthermore the trimmers are not distributed by this process.

A tuning wand consists of a fiber or bakelite rod or tube on one end of which is fastened a slug of finely divided iron ("polyiron") and on the other a short length of brass rod. It may be easily made from parts found in the "jung box", using a core from an old i-f transformer, an alignment wrench or bakelite rod, and a piece of 3/8" or 1/2" brass rod about 1" long.

Alignment of tuned circuits is checked by inserting first the iron, then the brass end into a coil. The iron increases the inductance, while the brass decreases it. If both the brass and iron cause a decrease in output, then the circuit is correctly tuned. If the iron end causes an increase in output, then *either* the inductance or capacity must be increased to bring the circuit into alignment. Conversely, if the brass end causes increased output, then *either* the inductance or the capacity must be decreased for proper alignment.

ENTERTAINMENT RECEIVERS FOR NAVAL VESSELS

The Models RCU, RCU–1, and RCT radio-phonograph equipments, manufactured primarily for commercial use, where recently added to the electronic material allowance for certain Naval vessels by the Chief of Naval Operations.

Some of the more important characteristics of these equipments are as follows:

Frequency range	535 kc. to 18.4 mc., continuous coverage in three bands.
Record player	RCU and RCU–1 automatic; RCT manual.
Weight	175 pounds.
Type of mounting	Deck.
Power requirements	180 watts, 115/230 volts, 60 cycle, single phase, a. c.
Spare parts	Contained in box inside cabinet
Record stowage cabinet dimensions and weight.	13¾″ high, 24⅞″ wide, 13⅞″ deep, and 67 pounds.

Inasmuch as these units were manufactured primarily for commercial use, no mounting facilities were provided for shipboard installation. It is therefore recommended that these equipments be fastended to a bulkhead by means of four hooks and padeyes. The padeyes should be attached to the equipment near the top and close to the bottom on each side of the unit with the corresponding hooks welded to the supporting bulkhead. This method provides a sturdy installation and will permit the unit to be unhooked and pulled out whenever servicing becomes necessary. Extreme caution should be exercised in attaching the padeyes to the sides of the wooden cabinet as the wood is easily damaged.

These receivers do not meet current requirements insofar as receivers radiation is concerned and, when installed in vessels, shall be considered as "strip ship" items. *6/1/47.*

RECEIVER SECURITY

The U. S. Navy Radio and Sound Laboratory, San Diego, has invited the attention of the Bureau to the fact that in some cases the local-oscillator-radiation-reducing properties of the type CME–50063 preselector are being impaired by locating the preselector at a considerable distance from the receiver and connecting it to the receiver with a long unshielded wire.

Great care should be taken to locate the preselector close to the receiver and to connect the two units with a shielded conductor, the shield of which is grounded. A coaxial type conductor is to be preferred as its capacity from conductor to ground is low and it provides excellent shielding.

OSCILLATOR RADIATION—A SUMMARY OF SAFE AND UNSAFE RECEIVERS

The following information was compiled at the Naval Research Laboratory. It was gathered from the records of tests conducted at the laboratory. The receivers are grouped in two sections—those operating in the frequency range above, and those operating below 30 megacycles. Two columns are entered for all receivers. The first lists those frequencies which are "safe"—i. e., on which operation would present no hazard to security. The other column lists the "unsafe" frequencies—i. e., on which security would be endangered by oscillator radiation. In all cases the frequency listed is the oscillator frequency.

All receivers listed are rated in accordance with a safety limit of 400 micromicrowatts power appearing from antenna to ground at optimum load resistance.

Low-Frequency Receivers (below 30 mc.)

Type rcvr.	Safe frequencies	Unsafe frequencies
REa	All, except with regen. max.	72–130 kc. with max. regen.
RFa	All, except with regen. max.	Above 240 kc. with max. regen.
RAB-1	Up to 23 mc	23–38 mc.
RAC-1	All	
RAL-4	All	
RAO	All	
RAO-2	All	
RAO-3	All	
RAS	Bands 1–5	Part of band 6, Band 7.
RBA	All	
RBB	All	
RBC	All	
RBG	Band 2. Band 1 very close to limit just above at 540 and 1300 kc.	Bands 3, 4, 5.
RBH	All	
RBL	All	
RBL-3	All	
RBM (hf)	Bands 1, 2, 3, Band 4 (14–19 mc).	Band 4 (13–14 and 19–22 mc).
RBM (mf)	All	
RBO	All	
DP-9	All	
TBX-4		All.
TCS		All.
TCS (with Majestic "wonderbox".	All.	
Hallicrafter SX-28 (now RCF).		Definitely above 3 mc.
RMCA 8505 (now RCG).		All.
SCOTT SLR-F (now RCH).	All.	
Bendix BC-348-Q.	2 lowest freq. bands	3rd band 3.5–5 mc. 4th band 6–9 mc. 5th band 9.5–13 mc. 6th band 13.5–17 mc.
Emerson 413		All.
Farnsworth C-138	3 lowest freq. bands	3 high bands.
Hallicrafter Ht-11.		All.
Magnavox CR-155		All.
National HRO (Bakelite ant. block).	Up to 26 mc	Above 26 mc.
National HRO (Styrene ant. block).	2 low-freq. bands	2 high bands.
Philco 42-788T		All.
Philips 512	Up to 3 mc	Above 3.5 mc.
Philips 513AN	Up to 18 mc	18–22.5 mc.
Philips 595AM	Broadcast band 1–2.1 mc.	Elsewhere: 2.1–23 mc.
RCA 8506B	All	
RCA AR88	All	
RCA Q-33		All.
Scott SLR-C	Up to 21 mc	Above 22 mc.
Sparton 842 SX		All.
Zenith 8W 645At.		All.

High-Frequency Receivers (above 30 mc.)

Type rcvr.	Safe frequencies	Unsafe frequencies
RAQ	70–153 mc.	153–190 mc.
RBQ (with shielded crystal).[1]	Harmonics up to 126 mc.	Above 126 mc (except 132 mc).
BL-2		All.
CXBG		All.
TBS [1]	All, if trimmers are not peaked by mistake to oscillator; then only on one frequency is unsafe.	
TBY-2		All.
Hallicrafter S-27 (now RBK).		All.
Bendix BC-639-A.		All.
Communications Co. model 132.[1]	23–67, 100–120. Above 146 mc.	Harmonics below 23 mc., 90 mc., 135, 146 mc.
Hallicrafter NS-27-C.	108–113 mc	113–195 mc.
RCA (rcvr. freq.: 200–400 mc)		All.

●

From time to time the Bureau receives information—usually via the "scuttlebutt"—that commercial receivers are being installed aboard Navy ships for both entertainment and communications. A case in point is a certain destroyer having a Hallicrafter SX-28 receiver which was borrowed from or installed by the Army.

[1] Measured on crystal harmonics.

Tests by the Federal Communications Commission and the Naval Research Laboratory have shown repeatedly that all commercial Hallicrafter receivers have local oscillator radiations far in excess of the safe limit. It should be remembered that the Army does not have the receiver security problem that the Navy does and that it is useless and foolish to put safe receivers aboard a ship only to have the ship's security violated by a commercial receiver.

Commercial *broadcast* receivers can *not* be made safe merely by the use of preselectors due to their usual "spread-out" construction and wooden or plastic cabinets, which provide excellent opportunities for radiation. See the following article for a list of authorized commercial receivers.

COMMERCIAL RADIO RECEIVING EQUIPMENT ABOARD U.S. VESSELS

A number of commercial shipbuilding yards have continued to follow an old peacetime practice of presenting broadcast entertainment receivers to the crews of vessels that were built in their yards. For a number of reasons, this practice should be discouraged and Navy shipbuilding representatives at the various yards involved should take steps to insure that unauthorized receivers are not placed aboard new construction vessels.

The presence of "crew" or "individually" owned receivers on board certain vessels has recently been the subject of an unusual amount of official correspondence which should not have been necessary. In view of this correspondence, certain decisions have been necessitated which were not entirely satisfactory to all parties concerned. Therefore, the cause of such situations should be eliminated at the source.

Practically all available stocks of commercial non-radiating broadcast receivers have been exhausted and replacements are not being manufactured. Therefore, the majority of receivers being presented to vessels at the present time are of the unapproved radiating types which cannot be used while the vessels are at sea. Certain of the various methods used to secure these receivers, while at sea, are somewhat uncertain and, therefore, unsatisfactory from an overall standpoint. In view of the approved type of broadcast entertainment equipment being supplied by the Bureau as a part of each vessel's allowance, it is considered that any additional broadcast receivers are unnecessary and that the practice of placing them aboard Naval vessels should be terminated.

The following types of radio receiving equipment have been approved by the Federal Communications Commission as capable of being used and operated on board ships of the United States in accordance with the limitation regarding the radiation of energy imposed by the rules of the commission, i.e., that the electromagnetic field created does not exceed 0.1 microvolt per meter at one nautical mile from the receiver:

AUTHORIZED COMMUNICATION RECEIVERS

Manufacturer	*Freq. range (kilocycles)*	*Type or model number*
Arnessen Electric Company	841LW	80–550
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	117–C	16–40
		100–200
		300–530
	128–A	16–650
	128–AX	15–650
	130–A	300–500
	138–A	80–560
		1900–25000
Globe Wireless or Heintz & Kaufman	936	70–210
		350–515
Hallicrafters, Inc.	SX-28A[1]	540–40000
National Company	D. C. SW-3RM	100–600
Radiation Products Corporation	R-96-SR	140–500
		1500–12000
Radio Corporation of America	AR-88	535–32000
	AR-67-X	75–1500
	CR-91	75–550
		1500–30000
Radiomarine Corporation of America	AR-8503	15–600
	AR-8506-A	210–550
		1900–25000
Radiomarine Corporation of America	AR-8506-B	90–550
		1900–25000
	AR-8507	70–515
	AR-8510	15–650
E. M. Sargent	AH-10X	34–550

[1] When used with Radiation Suppressor Unit No. 1X381.

Manufacturer	Freq. range (kilocycles)	Type or model number
E. H. Scott Radio Labs.	SLR-C	80-520
		3600-24000
	SLR-D	500-24000
	SLR-F	80-550
		1900-24000
	SLR-H	530-15600
Technical Radio Company	LRR-4	1500-18000
Western Electric Company	Standard receivers incorporated in radiotelephone equipment types	
	224-A	2100-2800
	224-B [2]	2100-2800
	226-A	2100-2800
	226-B	2100-2800
	226-C	2100-2800
	226-D	2100-2800

AUTHORIZED BROADCAST RECEIVERS

Herbach and Rademan Company	AR-93	540-1600
	AR-93-A	540-1600
Maritime Radio Corporation	MA-1	540-1600
	MA1-A [3]	540-1600
	MA1-B [3]	540-1600
Radio Corporation of America	ER-88	535-32000
E. H. Scott Radio Labs.	SLR-12-A	540-1600
		5550-15600
	SLR-12-B	540-1600
		5550-15600

AUTHORIZED DIRECTION FINDERS

Manufacturer	(kilocycles)	Type or model number
Bludworth, Inc.	Standard Binnacle	
	DF-1009	280-520
	DF-1011	280-520
	DF-1012	280-520
	DF-1013	280-520
	DF-1014	280-520
	DF-1015	280-520
	DF-1016	280-520
	DF-1017	280-520
	DF-1018	280-520
	DF-1019	280-520
	DF-1020	280-520
	DF-1022	280-520
	DF-1023	280-520
	DF-1024	280-520
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	102-A & B	250-540
	103-A & B	250-540
	104-A & B	250-540
	105-A & B	250-540
	106-A & B	250-540
	102-BD	250-540
	103-BD	250-540
	104-BD	250-540
	105-BD	250-540
	106-BD	250-540
	AM-4490-DM	250-540
	AM-4490-EM	250-540
	AM-4490-F	250-540
Radiomarine Corporation of America	AR-8700-S	270-520
	AR-8701	270-520
	AR-8702	270-520
	AR-8702-A	270-520
	AR-8703	270-520
	AR-8704	270-520
	AR-8709	270-520
	AR-8700-ASX	270-520
	AR-8701-AX	270-520
	AR-8703-AX	270-520
	AR-8703-BX	270-520
	AR-8073-BX1	270-520
	AR-8707-X	270-520
	AR-8707-X1	270-520
	ER-1445-A	200-525
	ER-1445-B	200-525
	ER-1445-R	200-525

AUTHORIZED AUTO ALARMS

Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	101-B	500
Radiomarine Corporation of America	AR-8600-X	500
	AR-8601	500

This approval was given upon the condition that normal circumstances of operation, including applied voltages and electron tubes, will be maintained whenever the equipment is in use or operation.

UNAUTHORIZED COMMUNICATION RECEIVERS

The following equipments *do not* comply with FCC limitations and their use aboard U.S. vessels is *not authorized*:

Manufacturer	Freq. range (kilocycles)	Type or model number
	IP-501	37.5-1200
	IP-501-A	37.5-1200
	SE-143	92-970
	SE-1220	45-600
	SE-1420	
Arnessen Electric Company	841	80-31000
Ecophone Radio Company	EC-2	550-30000

[2] When modified in accordance with manufacturer's instructions and such modification is designated by the addition of the letter "M" to the serial number of the modified receiver.
[3] Models MA1-A and MA1-B are identical in electrical design to the model MA-1.

Manufacturer	Freq. range (kilocycles)	Type or model number
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	104–B	500–23000
	105–A	16–1500
	117–A	16–35
		100–200
		300–550
		5200–19500
	117–B	16–40
		100–200
		300–550
		5200–19500
Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	122–A & B	300–500
	129–A	540–30000
Hallicrafters, Inc.	S–22R	110–1530
		1715–11500
	SX–24	545–43500
	SX–25	540–42000
Hammarlund Manufacturing Company	SXR–200	535–20000
National Company	NC–44	550–30000
	NC–45	550–30000
Philips	614VN	550–5550
Radio Holland	UO	15–21000
Radio Corporation of America	AR–67	75–1500
Radiomarine Corporation of America	AR–8501	5000–18000
	AR–8504	300–900
	AR–8505	540–30000
E. M. Sargent	AH–10	34–14000
	12–D	34–14000
	12–UD	34–14000
	12–F	34–14000
	12–UF	34–14000
	11–51–TR	80–31000
Western Electric Company	Standard receivers incorporated in radiotelephone equipment type	
	227–A	2100–2800

UNAUTHORIZED DIRECTION FINDERS

Federal Telephone & Radio Corp.	Mackay Radio & Telegraph Co.	
	AM–3800	300–500
	AM–4490–A	250–540
	AM–4490–D	250–540
	AM–4490–E	250–540
Radiomarine Corporation of America	AR–8700–AS	270–520
	AR–8701–A	270–520
	AR–8703–A	270–520
	AR–8703–B	270–520
	AR–8707	270–520

UNAUTHORIZED AUTO ALARMS

Manufacturer	Freq. range (kilocycles)	Type or model number
Radiomarine Corporation of America	AR–8600	500

SPURIOUS RADIATIONS WHILE TUNING TRANSMITTERS

There is a possibility of spurious radiations being emitted, unintentionally, during transmitter tuning processes. Such radiations would have two main sources:

(1) If the transmitter oscillator is operating, then judgment must be exercised to ascertain that there is no form of coupling between this oscillator and the antenna.

(2) If a signal generator is connected to a receiver antenna trunk for the purpose of checking the receiver frequency, or for any other purpose, then radiation from the signal generator will occur.

Elimination of these radiations may be accomplished as follows:

(1) It is feasible to tune the transmitter completely without radiating. A suitable method is described in the article "Tuning Transmitters Under Conditions of Radio Silence," page ANT:5.

(2) Elimination of radiation from signal generators is simply a matter of refraining from coupling the antenna to a signal generator during radio silence. To insure that coupling does not exist, it may be useful to seal off the receiver antenna, and to use a direct connection to the receiver instead of a radiating connection because of the possibility of pickup of this radiation by other antennas.

NEED FOR CAUTION WHEN USING REPAIR SHOP ANTENNAS

Users of repair shop antennas should exercise caution to insure the absence of receiver radiation when testing and aligning receivers while the ship is in restricted areas.

ELECTRIC RAZORS AS A HAZARD TO SECURITY

The Commander Service Force, U. S. Atlantic Fleet, and the San Diego Radio and Sound Laboratory recently conducted a series of tests to

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determine the hazard to the security of a ship caused by the radiation of radio-frequency noise from electric razors. Tests were conducted using razors having vibrator motors and razors having commutator motors, and measurements were made over the frequency range of the model OF noise locator and the models RAK/RAL–5 receivers.

The results of the tests may be summarized as follows:

(1) A field strength of less than one microvolt per meter is produced outside a ship's compartment at a distance of ten feet from the vessel by an electric razor used inside the compartment.

(2) Electric razors when used inside metal enclosed compartments on a ship do not radiate enough energy into the ship's antennas to be detected, provided that no antenna extends out of the compartment in which the razor is operated.

(3) The signal radiated by an electric razor operated outside the compartment of a ship is of such strength that it cannot be detected by a sensitive receiving system at any frequency at a distance of 1000 feet.

As a result of the tests, it may be concluded that the operation of electric razors inside compartments creates no radio hazard to security.

It should be noted that local noise may be produced aboard ship by electric razors. This noise is usually conductively coupled to receivers through power wiring as distinguished from radiation. If this noise is bothersome it may be eliminated by connecting a 400-volt 0.01- to 0.05-mfd. condenser across the power line feeding the shaver. A number of commercial filters, such as the Solar type AE or its equivalent, are on the market which are excellent filters and do not require cutting the shaver attachment cord.

TREATMENT OF RIGGING ON SHIPS EQUIPPED WITH DIRECTION-FINDING EQUIPMENTS

When a direction finder is installed in a ship it is necessary to treat the rigging to reduce deviation. Wires not used as electrical conductors should have their conductivity interrupted at 5- to 8-foot intervals by the insertion of strain insulators. This practice will reduce the reradiation of energy at or near the frequencies to which the direction finder will be tuned and should be applied to whistle cords, signal halyards, triatics, standing rigging, etc. Compression type strain insulators should be used as failure of this type of insulator will not cause the line to part.

In cases where wires cannot be properly insulated, permanent bonds should be attached so that the object is grounded. Large objects such as derrick booms which may not have a constant low-resistance ground connection should also be bonded to ground.

The use of copper for external bonding is unsatisfactory due to its chemical and electrolytic reaction with the steel of the ship. 7/18 or 7/32 steel wire should be used for bonds and corrector loops and should be welded or brazed to the stay and deck. The resistance of the bonds is, and should be, low and any small change in the resistance of the end contacts will produce serious changes in deviation. Bolts, lugs and clamps cannot be depended upon to give a constant low resistance connection.

It is important that a periodic inspection be made of these bonds, employing a check list if necessary to insure that none are overlooked. The breaking or corroding of these bonds will, in most cases, cause an error in calibration which may be either constant or variable. For maximum accuracy in direction-finding work, all rigging must be in the same condition as when the instrument was calibrated.

Care should be taken to see that no closed loops of appreciable size (larger than about one foot in diameter) are constructed near the direction finder, and that none already existing there are removed without a recalibration of the direction finder. The usual closed loop aboard ship is formed by stanchions, rails, decks, stays and by the post, boom and topping lift of cranes. The continuity of these loops may often be broken by insulating material, and this should be done wherever possible. A sheet of conducting material acts as a closed loop, but one that cannot be broken to prevent the flow of circulating currents. It is generally impossible to break up all closed loops aboard ship. The greatest attention should be paid to those of considerable size and those adjacent to the direction finder. In general, when a loop is more distant from the direction finder than twice its largest dimension, it will have little effect on deviation.

It should be emphasized that insulating material used to break up closed loops should *not* be painted with a metallic base paint. A clear insulating varnish such as Pabco No. 2478 or equivalent followed by Glyptol No. 1217 (machine tool gray) or equivalent may be used on wood spacers or other insulating material requiring protection. Special attention should be paid to the insulated joint in the metal shield around the direction finder loop. This joint should *not* be painted, and any paint already on the joint should be removed.

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USE OF STANDARD FREQUENCY BROADCASTS FOR CHECKING FREQUENCY METERS

The Bureau of Ships Manual, chapter 67, requires that all activities check their frequency meters for accuracy against Bureau of Standards standard frequency transmission (WWV) and that a record of each check be made in the material log.

The National Bureau of Standards provides day and night broadcast of standard frequencies and related services from its radio station WWV at Beltsville, Md., near Washington, D. C.

The following excerpts from the National Bureau of Standards publication "Technical Radio Broadcast Services, Radio Station WWV" dated 2 January 1947 are published to assist in securing the maximum benefit from these transmissions.

"A total of eight radio frequencies (*2.5*, *5*, *10*, *15*, *20*, *25*, *30*, and *35* mc) is now given. Seven or more transmitters are on the air at all times, day and night. This insures reliable coverage of the United States and extensive coverage of other parts of the world.

"The services are: (1) standard radio frequencies, (2) time announcements, (3) standard time intervals, (4) standard audio frequencies, (5) standard musical pitch, 440 cycles per second, corresponding to A above middle C, (6) radio propagation disturbance warning notices. All of the frequencies are useful for field intensity recording by persons interested in studies of radio propagation. The four highest frequencies are broadcast particularly for this purpose. The radio frequencies and other data are:

Radio frequency (megacycles per second)	*Time broadcast (GCT)*	*Power output (kilowatts)*	*Audio frequency (cycles per second)*
2.5	2300–1300	1.0	440.
5	2300–1100	10.0	440.
5	1100–2300	10.0	440 and 4000.
10	Continuously	10.0	440 and 4000.
15	"	10.0	440 and 4000.
20	"	.1	440 and 4000.
25	"	.1	440 and 4000.
30	"	.1	440.
35	"	.1	440.

"The station call letters (WWV) and other announcements in voice are given each hour and half hour.

Standard radio frequency.—"The national standard of frequency is of value in radio, electronic, acoustic, and other measurements requiring an accurate frequency. Any desired radio frequency, including microwave frequencies, may be accurately measured in terms of the standard frequencies. This may be done by the aid of one or more auxiliary oscillators, harmonic generators, and radio receivers. The accuracy of each of the radio carrier frequencies, as transmitted, is better than a part in 50,000,000.

Time announcements.—"The audio frequencies are interrupted precisely on the hour and each five minutes thereafter; after an interval of precisely one minute they are resumed.

"The beginnings of the periods, when the audio frequencies are interrupted, are in agreement with the basic time service of the United States Naval Observatory so that they mark accurately the hour and the successive 5-minute periods.

"Eastern standard time is announced in telegraphic code each five minutes. This provides a quick reference to correct time where a time-piece may be in error by a few minutes. The zero—to 24-hour system is used starting with 0000 at midnight. The first two figures give the hour and the last two figures give the number of minutes past the hour. For example, at 4:55 PM, or 1655 EST, four figures (1, 6, 5, and 5) are broadcast in code. The time announcement refers to the start of an announcement interval; i. e., when the audio frequencies are interrupted. It occurs immediately after the beginning of each 5-minute interval. At the hour and half-hour it is followed by the station announcement in voice.

Standard Time Intervals.—There is on each carrier frequency a pulse of 0.005-second duration which occurs at intervals of precisely 1 second. The pulse consists of 5 cycles, each of 0.001-second duration, and is heard as a faint tick when listening to the broadcast; it provides a useful standard time interval, for purposes of physical measurements, and for quick and accurate measurement of calibration of timing devices or very low frequency oscillators. It may be used as an accurate time signal. On the 59th second of every minute the pulse is omitted. The 1-minute, 4-minute, and 5-minute intervals, synchronized with the seconds pulses, are marked by the beginning or ending of the periods when the audio frequencies are off.

"A time interval of one second marked by the pulse is accurate, as transmitted, to one microsecond (0.000001 second). A two-minute or longer interval is accurate to a part in 50,000,000.

The one-minute interval is provided in order to give time and station announcements and to afford an interval for the checking of radio-frequency measurements free from the presence of the audio frequencies.

Standard Audio Frequencies—Two standard audio frequencies, 440 cycles per second and 4,000 cycles per second, are broadcast. They are given on radio carrier frequencies as shown in the table on the preceding page.

The two standard audio frequencies are useful for accurate measurement or calibration of instruments operating in the audio or supersonic regions of the frequency spectrum. They may also be used for accurate measurement of short time intervals.

The accuracy of the audio frequencies, as transmitted, is better than a part in 50,000,000. Transmission effects in the medium (Doppler effect, etc.) may result at times in slight fluctuations in the audio frequencies as received; the average frequency received is, however, as accurate as that transmitted.

In making use of the broadcast, one should select the carrier frequency that gives best reception at a particular time in a given locality. This can be done by tuning to the different frequencies and selecting the most suitable, or by making a study of conditions that affect the propagation of radio-frequency waves. The latter is a fairly involved procedure because of the large number of variables. Also, a separate calculation must be made for each transmission path, this being applicable only for a particular time of day, season, and year, and certain phenomena, as yet unpredictable, are involved. Fortunately, these variations are not rapid and it is possible to give an approximate guide to choosing the carrier frequency for best reception. The following data are for radio receivers located in the northern hemisphere between latitudes of approximately 20 and 50 degrees and local times of noon and midnight at Washington. Reception conditions at other times of day may be estimated by assuming a gradual change from one condition to the other. The ground wave from the transmitter may be received on each of the frequencies out to distances of about 50 miles. Beyond this distance, a skipped area is usually found, and beyond this, the area in which good reception is normally possible. There are times of poor reception because of ionospheric storminess or transient effects which disturb the upper-air regions through which high-frequency radio waves travel.

TABLE 1.—*Approximate distance ranges, summer*

Local time	Frequency (kc/s)	Tone reception (miles)	Carrier frequency reception (miles)
Midnight	2, 500	0 to 1, 100	0 to 1, 900
" ----	5, 000	300 to 2, 500	300 to 3, 000
" ----	10, 000	1, 200 to 10, 000	1, 200 to 12, 000
" ----	15, 000	2, 000 to 10, 000	1, 800 to 12, 000
Noon----	5, 000	0 to 350	0 to 600
" ----	10, 000	450 to 1, 300	400 to 2, 200
" ----	15, 000	800 to 3, 500	700 to 6, 500

TABLE 2.—*Approximate distance ranges, winter*

Local time	*Frequency (kc/s)*	*Tone reception (miles)*	*Carrier frequency reception (miles)*
Midnight	2, 500	0 to 2, 000	0 to 5, 000
" ----	5, 000	400 to 8, 000	300 to 8, 500
" ----	10, 000	900 to 9, 500	800 to 11, 000
" ----	15, 000	(1)	(1)
Noon----	5, 000	0 to 900	0 to 1, 400
" ----	10, 000	0 to 2, 600	0 to 3, 700
" ----	15, 000	200 to 4, 300	150 to 8, 000

Inherent error in a frequency standard may be quickly detected by feeding the crystal output of the meter into the antenna of any Navy standard receiver (with the I. F. band width set on "Sharp" where available), tuned to WWV with the beat frequency oscillator "off." The audio beat between the crystal output signal and the WWV signal can be heard when WWV is transmitting *unmodulated* signals.

While the crystal in the model LM series is not adjustable, it is replaceable; if this equipment is supplied with a satisfactory crystal and is maintained at proper operating temperature, errors occurring in its use may generally be attributed to failure of the operator to use sufficient care in setting the corrector knob, or to an inherent consistent error in the tunable oscillator between check points.

In the model LR series the crystal should be adjusted to zero beat with WWV during the unmodulated portion of the transmission. This is accomplished by turning the screw-driver-slotted dial at the rear of the top shelf, as described in the instruction book. If such adjustment is properly made, any further inaccuracy in the meter may generally be ascribed to operator error, or to the obviously rough or uneven operation of the "counter" interpolator circuit.

The model LR series frequency standards should be kept in the "standby" condition to insure that the crystal is maintained at correct operating temperature. *6/1/47.*

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Pages GEN: 56–58 are obsolete and have been destroyed.

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SERVICE AND MAINTENANCE INFORMATION ON THE SLIP RINGS AND BRUSHES OF THE TYPE A, AM AND AS ABI INDICATOR UNITS

The information contained in this article has been compiled after considerable experience with this type of equipment. In compiling it, we have attempted only to pass on the benefit of the experience of others. Please read this article carefully, use it often, and keep it near the equipment so that it may be referred to at once in case of trouble. While every attempt has been made to build a rugged piece of equipment, some of the parts are necessarily delicate. Maintenance of high precision and reliability is the responsibility of the service and maintenance personnel.

Bad bedding of brushes is undoubtedly the greatest cause of flat spots and excessive slip ring and brush wear. When installing new brushes, it is advisable to "grind in" the surface of the brush so as to fit the slip ring contour. A good job can be made of this by wrapping a piece of fine sandpaper around the slip ring with its abrasive side out and rotating the slip ring and sandpaper back and forth while the brush pressure spring holds the brush lightly against the abrasive surface of the sandpaper. *This is one of the most important jobs in fitting brushes.* Nine-tenths of all the troubles with slip rings and brushes are due simply to bad bedding. New brushes taken from the spare parts kit have been ground to a contour that closely fits the slip ring when it is new, but it is impossible for them to fit the contours exactly, because of normal wear that has occurred while the indicator has been in use. Therefore, we urgently recommend that this final bedding "touch" be incorporated in any brush replacement job.

Thoughtlessness is another factor responsible for an unsuccessful brush servicing job. A very common and not easily detected mistake is changing brushes from one holder to another, or in reversing the position of a brush in its holder. It is quite obvious that an interchange of brushes can only result in a change of contact position on the contour of the slip ring. To avoid this, make sure that a brush, removed from its holder for cleaning or other service, is returned to that same holder and in the same relative position as before removal.

The brushes should be kept at the pressure recommended in this article. This optimum pressure has been selected, after careful experimentation and observation, to give the longest life and best contact with a minimum of maintenance. A decrease in pressure will not allow reliable contact. Increase in pressure will only result in excessive heating of the brush, and rapid wear of both the brush and the slip ring.

Above all, keep the slip rings and brushes clean through periodic inspection and cleaning with carbon tetrachloride. Do not use any "lubricants" on either the brushes or the slip rings. Use abrasives only as indicated in this article.

Experience with a number of these equipments has proven the maintenance and service practices set forth here. Strict adherence to these procedures will result in long life and maximum efficiency for the indicator. It will also decrease the number of repairs you will be required to make.

The rotating slip ring section and brush assemblies of the indicator have been machined to a very high precision and assembled in their places with extreme care and attention by skilled technicians.

Thorough maintenance and servicing of these parts is essential to the indicator operating, at all times, at its peak efficiency. Neglect of these parts will result in the slow deterioration of its efficiency and ultimately in its decommissioning and return to the manufacturer for complete overhauling.

The maintenance personnel should be responsible for seeing that these parts are carefully serviced and never abused and that the servicing equipment, as enumerated, is kept on hand at all times.

The following material will treat the common troubles that occur to the slip rings and brush assemblies together with the manufacturer's recommended methods of servicing and practices in maintenance.

The slip rings are mounted on the outside of the rotating housing, Figure 1. They are insulated from ground and each other by bakelite spacing rings of appropriate size and form. Their brush contact surfaces have been machined to a smooth, highly polished surface and a fine degree of concentricity.

The brush assemblies are mounted by two machine screws and spacers of appropriate height on projections brought to the outside of the rotating unit mount, Figure 1. They are fixed at such a height that the brushes contact the slip rings radially.

Since the use of high voltages, which are dangerous to human life, are necessary to the successful operation of the indicator, certain reasonable precautionary measures must be carefully observed by the maintenance personnel during its servicing. It should be borne in mind that if the cover of the slip ring section is opened, it will allow access to circuits carrying voltages dangerous to human life. Under no circumstances should any person open this cover before throwing the master or amplifier switch to OFF position.

The attention of officers and maintenance personnel is directed to the Bureau of Ships Manual, Chapter 67, on the subject of "Radio Safety Precautions to be Observed."

Slip Rings—General

Any appearance of etching, scoring, pitting, or undue wear to the brush contact surfaces, indicates the immediate need of servicing.

The appearance of a light brown oxide film on

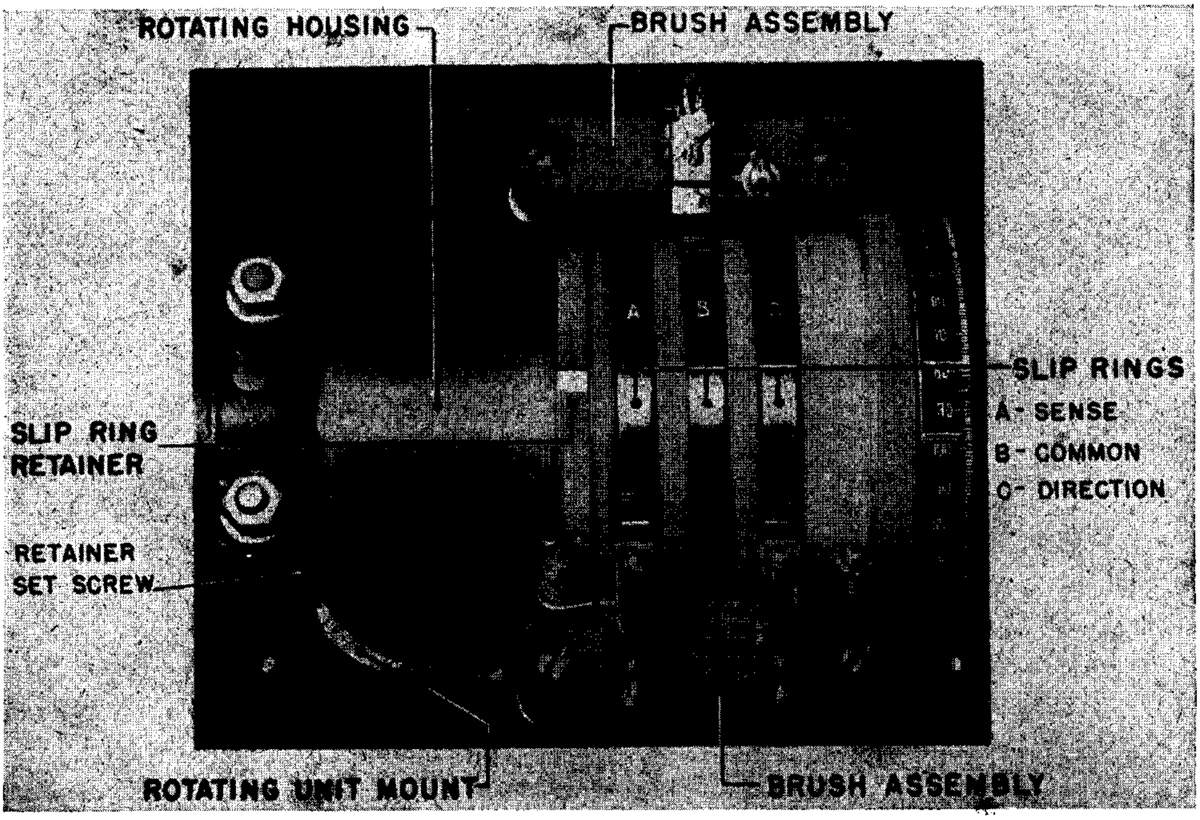


FIGURE 1.—Rotating unit mount.

are firmly held in place. (To tighten, turn counterclockwise as viewed from operator's position.)

(4) Tighten set screws.

(5) Check for concentricity and, if necessary, follow through with procedure outlined under the subtitle "Slip Rings—Concentricity."

Slip Rings—Concentricity

WARNING.—Because of the delicate nature of the adjustments and servicing in this section, only approved maintenance personnel should be allowed to execute them.

At least once every month the slip rings should be inspected for concentricity. A simple field test may be made by observing the protruding arm of the brush pressure spring while the indicator is running. If the spring remains stationary in its slot, this will indicate that the slip ring is concentric and within the allowable tolerance approved by the manufacturer. Any perceptible up and down movement of the brush pressure spring arm, is an indication of eccentricity, and immediate steps should be taken to restore the slip ring to its original concentric position. Figure 2 illustrates the procedure to follow for adjusting slip rings, which is as follows:

(1) Turn master switch to OFF position.

(2 Rotate slip rings until "high spot" of eccentricity is located. Rotate this high spot to a point where it is accessible.

(3) Place the end of a rod of Bakelite, or other nonmetallic material, with a square smooth end on the high spot of the ring and lightly tap the other end of the rod as shown in figure 2.

(4) Recheck high spot and, if necessary, repeat above procedure until it is eliminated.

(5) Recheck entire slip ring for concentricity and repeat above procedure until there is no movement of brush spring arm during the full rotation of slip ring.

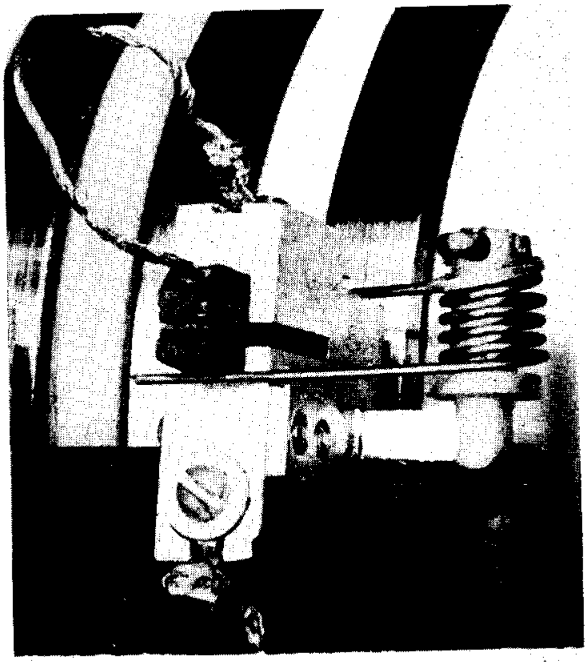
(6) Check other two rings for concentricity and, if necessary, follow through with the above procedure until all three rings register concentric.

CAUTION.—Do not use any metal rods or bars on the slip rings when tapping end of Bakelite bar. As a further precautionary measure, use a rawhide or other soft-faced mallet. Be careful that no damage is done to the contacting surface of the slip rings. Carelessness in this operation may result in a damaged slip ring or in decommissioning, and shipment back to the factory for replacement, and remachining of the rings.

FIGURE 2.—Method of improving the concentricity of the slip rings.

Slip Rings—Etched, Pitted, Scored, or Worn

Slip rings should be serviced as soon as any appearance of pitting, scoring, or wear upon the brush contact surfaces makes itself manifest. In order to obtain the best results from the indicator, the contact surfaces should be restored to their original bright mirrorlike finish, leaving no pits or scores. The procedure, as outlined below, must be followed carefully, and applied continually until all pits and scores have been eliminated:



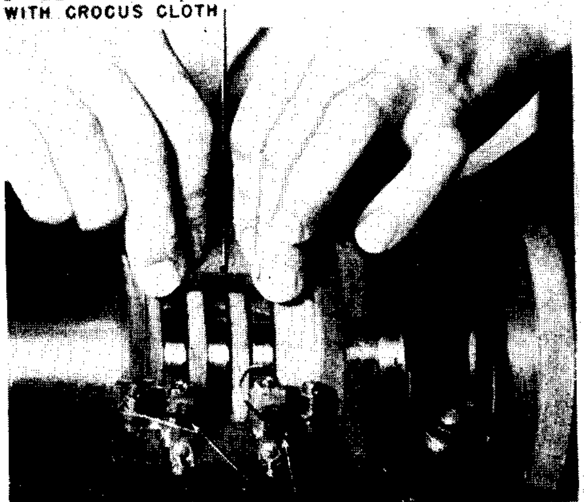
NOTE: SPRING PRESSURE ARM HOLDING BRUSH AWAY FROM SLIP RING.

FIGURE 3.—Method of securing brushes.

(1) Turn amplifier switch to OFF position.

(2) Lift brushes from slip rings and secure in place, letting brush spring pressure arm ride on underneath side of brushes. See figure 3.

BAKELITE BLOCK, WRAPPED WITH CROCUS CLOTH



BRUSHES LIFTED FROM SLIP RINGS

FIGURE 4.—Method of smoothing out slip rings.

(3) Start indicator running. Wrap a piece of crocus cloth approximately 2″ x 1¼″ around a 2″ x ¾″ x ⅛″ thick block of Bakelite or other smooth-surfaced, stiff material, and place it across the three rotating rings parallel to the axis of the indicator, figure 4. Firm pressure upon the block should be used above the ring that is to be smoothed out. This operation should be continued while the indicator is running, until all pits, scores, and etchings disappear.

(4) While indicator is still running, clean the slip rings by saturating a small pad with carbon tetrachloride placed firmly upon the rotating rings as in figure 5.

(5) Replace brushes in their running position.

(6) If the above procedure has been carefully followed, the slip rings will be restored to their original mirrorlike smoothness.

CAUTION.—Do not touch any rotating part of the indicator with the bare fingers! Use only carbon tetrachloride for cleaning rings. Use only Armour Sandpaper Works crocus cloth, or a crocus cloth of equal fineness for smoothing rings.

Brushes—Periodic Inspection

Every week the brushes should be withdrawn from their holders and inspected for wear and cleanliness. If the brushes show any appreciable signs of wear, they should be replaced from the spare parts kit. In replacing the brushes, care should be exercised when handling the brush pressure spring arm so as not to bend it, thereby disturbing the original pressure. When inserting new brushes, it is advisable to check the pressure with a spring tension gauge, figure 6, before setting indicator in operation. Figure 6 indicates a practical method of checking the pressure, which, for the best operation, is 2½ ounces. Gauge reading should be taken as the arm leaves the brush. The contacting surface of the brush should be carefully examined and if found to be dirty, it should be wiped clean with a pad of cheesecloth saturated in carbon tetrachloride.

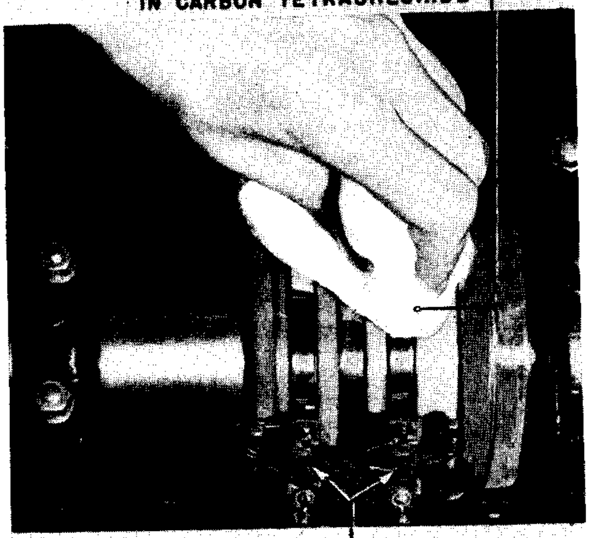


FIGURE 5.—Method of cleaning slip rings.

Brushes—Freeness

Brushes should be checked weekly for freedom of movement in their respective holders. If the brush has a tendency to bind in its slot, or be in any way restricted in its motion, other than that force exerted by the spring pressure arm, it should be serviced and the cause of its impeded movement removed. In general, sticking brushes are usually caused by foreign particles lodging in the space between the brush and the wall of the brush holder. To correct this condition, withdraw brush and wipe it clean with a pad of cheesecloth saturated in carbon tetrachloride, then draw a thin strip of cheesecloth, moistened in carbon tetrachloride, back and forth in the square hole of the brush holder. Other causes of sticking brushes may be attributed to oversize brushes, crumbling edges, cracked brushes, etc. In any of these cases, the safest procedure is to replace them with sound, correctly fitting brushes from the spare parts kit.

Brush Pigtails

Brush pigtails should be inspected monthly for fatigue, broken strands, flexability, corrosion and good contact to the terminal screw on the brush holder. The pigtails should be long and flexible enough so as not to restrict the

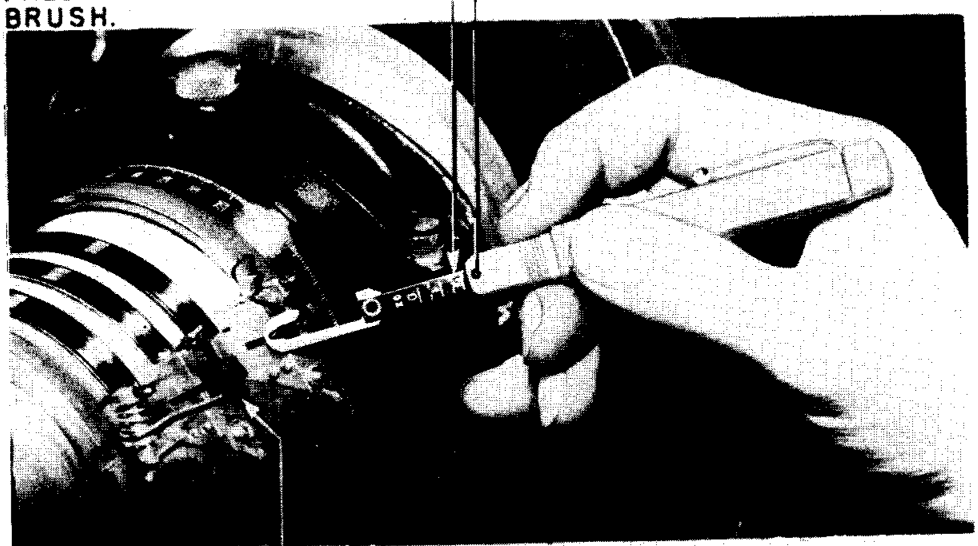


FIGURE 6.—Method of checking brush pressure.

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movement of the brush in its holder. Any signs of corrosion, fatigue, broken strands and brittleness should warrant their replacement.

Brush Pressure

Brush pressure should be checked at least once a month. Figure 6 illustrates a convenient field method of checking the pressure. A spring tension gauge should be used graduated to ½ ounce. The correct pressure for the best operation is 2½ ounces. This should be read just as the arm leaves the brush. Before checking the pressure of the brush spring, the protruding arm should be examined and if found to be bent or scraping against the side of its slot, it should be repaired and straightened out so that it rides in the center of the slot freely and without touching the sides. Figure 7 illustrates two brush assemblies with their pressure spring arms shown in the correct and incorrect positions. The pressure spring arm should be adjusted to its required pressure by winding or unwinding the coiled portion. The arm should never be bent. All adjustments of pressure should be accomplished in the coils of the spring.

Rotating Mount

Once every week the area underneath the slip rings should be cleaned of all accumulated dust, dirt, and grease. Failure to observe this rule faithfully will result in jeopardizing the performance of the indicator. Only if all its parts are scrupulously clean, can the indicator be expected to operate at its highest efficiency. The procedure for cleaning underneath the slip rings is:

(1) Turn master switch to OFF position.

(2) Remove Bakelite brush holder mount screws from both assemblies, and allow entire units to hang over side of indicator, figure 8.

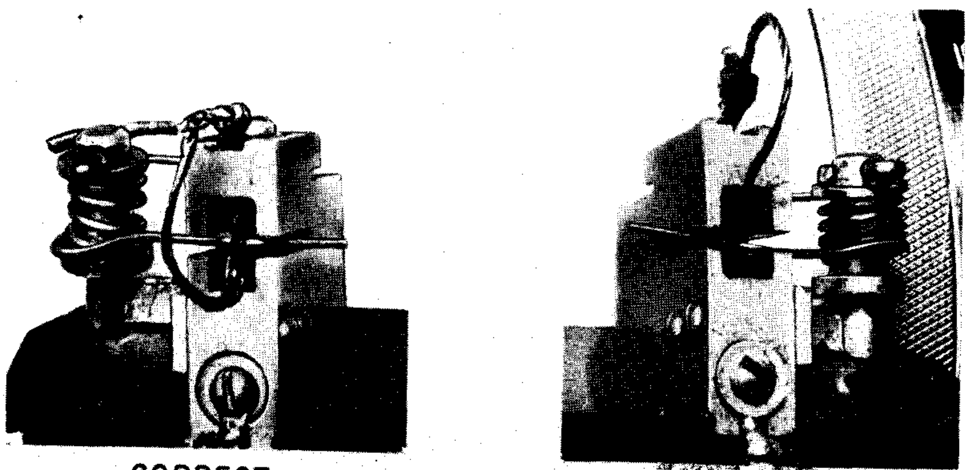
(3) Saturate a long narrow pad of cheesecloth approximately 4″ x 10″ in carbon tetrachloride and pass one end underneath the slip rings, while holding other end. Slowly rotate slip rings and feed pad until end of pad appears on other side.

(4) Pull pad back, forth and sideways, figure 8, until all dirt, dust, and grease are removed from the portion of rotating unit mount underneath slip rings.

(5) Remove pad and replace Bakelite brush holder mount assemblies taking care that they are restored securely to their former position.

Periodic Checks

For the convenience of the maintenance personnel, a checking schedule is given below. Adherence to this schedule will insure longevity



CORRECT
BRUSH SPRING PRESSURE ARM IS IN CENTER OF ITS SLOT.

INCORRECT
BRUSH SPRING PRESSURE ARM TOUCHES SIDES OF SLOT.

FIGURE 7.—Correct and incorrect positions for brush assemblies pressure spring arms.

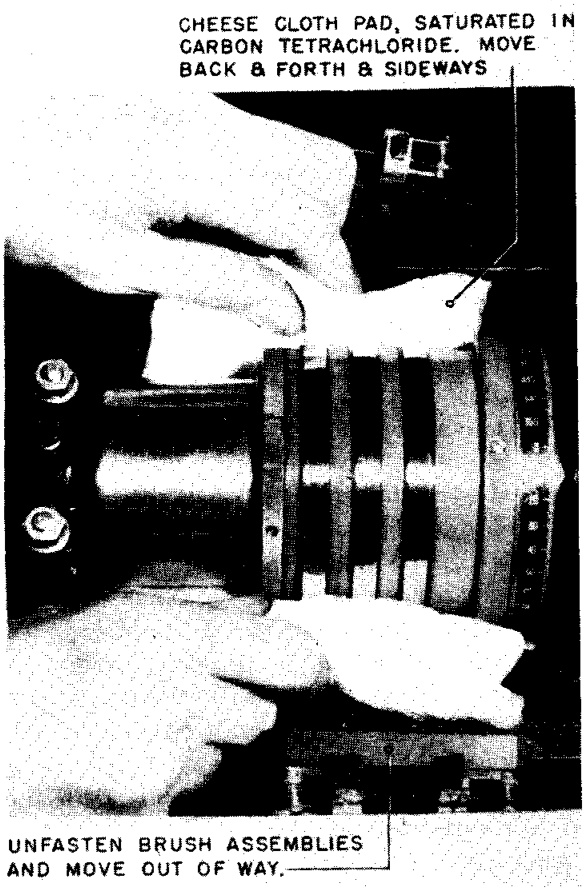


FIGURE 8.—Method of cleaning underneath the slip rings.

of the slip ring section of the indicator, and help considerably toward keeping the indicator at its peak efficiency.

Weekly Check

(1) Clean area underneath slip rings.

(2) Clean slip rings.

(3) Check brushes for wear, cleanliness, and freeness.

(4) Check slip rings for etching, pitting, scoring, and wear.

Monthly Check

(1) Check slip rings for concentricity and looseness.

(2) Check brush pressure.

(3) Check brush pigtails for fatigue, flexibility, corrosion, and contact.

Equipment for Servicing Slip Rings and Brushes

The necessary equipment for servicing the slip rings and brushes is listed below and illustrated in figure 9.

1 pound—Carbon tetrachloride, technical.
5 yards—Cheesecloth.
6 sheets—Armour Sandpaper Works crocus cloth, or a crocus cloth of equal fineness.
1 sheet—Spring tension gauge graduated in ½ ounces.
1 sheet—Block Bakelite or other smooth-surfaced substance 2″ x ¾″ x ⅛″.
1 sheet—Bakelite rod or other non-metallic substance ⅜″ diameter x 5″ long, both ends to be finished square, smooth and without burrs.

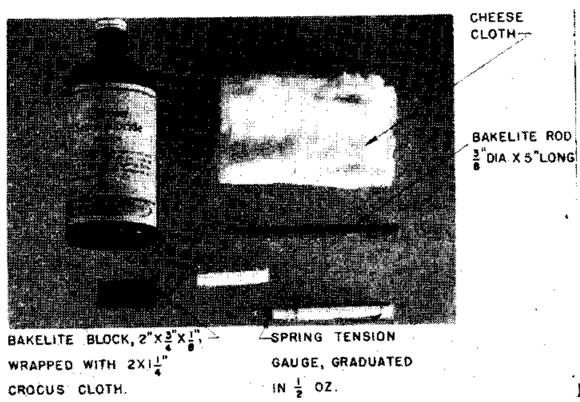


FIGURE 9.—Equipment needed for servicing slip rings and brushes.

FREQUENCY TOLERANCE OF RADIO COMMUNICATION EQUIPMENT

From time to time the Bureau receives inquiries as to the frequency tolerances of Navy radio communication transmitters.

Frequency tolerance is defined as the maximum permissible deviation of the actual carrier frequency from the prescribed carrier frequency, expressed in percent of the prescribed carrier frequency. In the case of emissions without a carrier this definition applies to the frequency of the carrier before its suppression.

The following frequency tolerances have been established for U. S. Navy radio communication equipments now under development:

Frequency Range (kc.):	Shore (percent)	Portable Mobile Aircraft (percent)
10–50	0.05	------
50–1,600	.02	0.05
1,600–30,000	.0025	.01
30,000–400,000	.005	.005

The frequency tolerance for life boats and emergency transmitters operating on the distress frequency, 500 kc., shall be 0.5 percent or better.

RMO'S GET NEW TITLE

The designations of "Radio Material Officer" (RMO) and "Assistant Radio Material Officer" (ARMO) have been changed to "Electronics Officer" (EO) and "Assistant Electronics Officer" (AEO) respectively. This change was effected by a multiple letter from the Chief of the Bureau dated 14 June 1945 (OB/P16-1 (902F-255)EN28/A2-11).

The purpose of this name change was to describe more accurately the duties of these officers in the fields of radio, radar, and sonar. It does not alter their duties and responsibilities.

STANDARD PROCEDURE FOR ORDERING PIEZO-ELECTRIC QUARTZ CRYSTALS

The following procedure has been authorized by the Bureau for the expeditious ordering of piezo-electric quartz crystals. It is believed that much time and paper work will be saved through the use of Form NBS 370 for the procurement of replacement crystals or crystals for newly assigned and authorized frequencies. A number of these forms bound in pads of 100 sheets each have been forwarded to the various Navy yards and other naval activities. Additional quantities may be obtained upon application to the Bureau of Ships on Form NBS 20-1 (ships) or NBS 20-2 (shore).

REQUEST FOR CRYSTALS

The Navy Yard, Washington, is the supply yard for piezo-electric crystals. Crystals shall be requested from the Navy Yard, Washington, via the chain of command, with a copy to the Bureau of Ships (Electronics Division). These crystals are ground in the crystal laboratory, Navy Yard, Washington, D. C., or at other points when obtained commercially, to specifications given by the Bureau for the grinding of crystals. *Crystal orders shall be on Form NBS 370* which provides for inclusion of information on the required crystals and holders, or where the above form is not available, information shall be in accordance with the following:

1. Date needed.
2. Shipment destination and suggested method of shipment.
3. Ship or station requiring the crystals.
4. (*a*) Navy model (or type number) and serial number of equipment for which required.

(*b*) If the equipment has not been assigned a Navy model or type designation through the Bureau of Ships, it will be necessary to give the manufacturer's name, address, and the designation of the equipment.

(*c*) Indicate whether the crystal is for use in a transmitter, receiver, CFI, or frequency meter.

5. Where crystals are required for transmitter or receiver frequency control, state the channel frequency; i. e., the transmitter output frequency, or the receiver input frequency. State the receiver intermediate frequency and whether the oscillator frequency applied to the detector or mixer tube is higher or lower than the incoming channel frequency. Where the crystal is used in a filter circuit, state the filter frequency.
6. Actual frequency to which crystal should be ground. Where this frequency is different from the channel frequency, crystals will be furnished for the channel frequency. Consideration will be given to the proper circuit operation, i. e., whether doubling, tripling, etc., is employed and for the intermediate frequency in the case of receivers.
7. Indicate the method whereby the output frequency is obtained in the transmitter or the heterodyning frequency is obtained in the receiver, i. e., by doubling, tripling, etc., where

the apparatus is not assigned a Navy model designation.

8. Accuracy in percent of crystal frequency to which the crystal should be ground. State whether crystal is to be operated at room or oven temperature. If the crystal is used in temperature compartment, state oven temperature.

9. Type of vacuum tube used in the crystal circuit and the voltage applied to the plate of the tube.

10. Navy type number of the holder, or if a Navy type number has not been assigned by the Bureau of Ships, give complete physical and electrical data on the holder including outer physical dimensions, spacing and number of pins, diameter of pins, electrical connections, size of crystal, and the method of holding the crystal.

11. Any special method of operation, e. g., operation of crystal at harmonic frequency (such as in model TBS).

Dispatch Requests

The minimum data for dispatch request for crystals shall include:

1. Navy model designation *including suffix numbers* (e. g., TCB, TCB–2, etc., as in certain cases crystal holders and circuits have been changed in the later equipment).
2. Shipping information (as in 2 above).
3. Use of crystal (as in 4*c* above).
4. Channel frequency (as in 5 above).

WARNING: This minimum data applies only to equipment assigned a Navy model designation. For other equipment information in conformance with form NBS 370 will minimize delays due to lack of sufficient data.

NOTE: Crystal controlled radio equipment furnished the naval service is normally provided with the initial set of piezo-electric crystals required for operation and, in certain cases, with spare crystals. Any additional crystals that may be required subsequent to receipt of the equipment, due to changes in frequency allocation, will not be furnished until specifically authorized by proper authority.

●

TRANSMITTER CONTROL CIRCUITS

The transmitter control circuit diagrams which follow were prepared by the staff of the Radio Material School, Naval Research Laboratory. They are simplified schematic diagrams of the starting, stopping and keying circuits for various Navy transmitters. It is not intended for them to be complete schematic diagrams of the entire equipment, but it is believed that they will be a help toward the understanding and servicing of the control circuits of Navy transmitters.

Figure 1 shows the basic standard four- and six-wire remote control circuits for transmitters having a-c. supplies. Figure 2 shows the same circuits for transmitters having d.-c. supplies.

As additional simplified diagrams are prepared they will appear in section 9 of later supplements to this bulletin on the pages of the equipment they apply to.

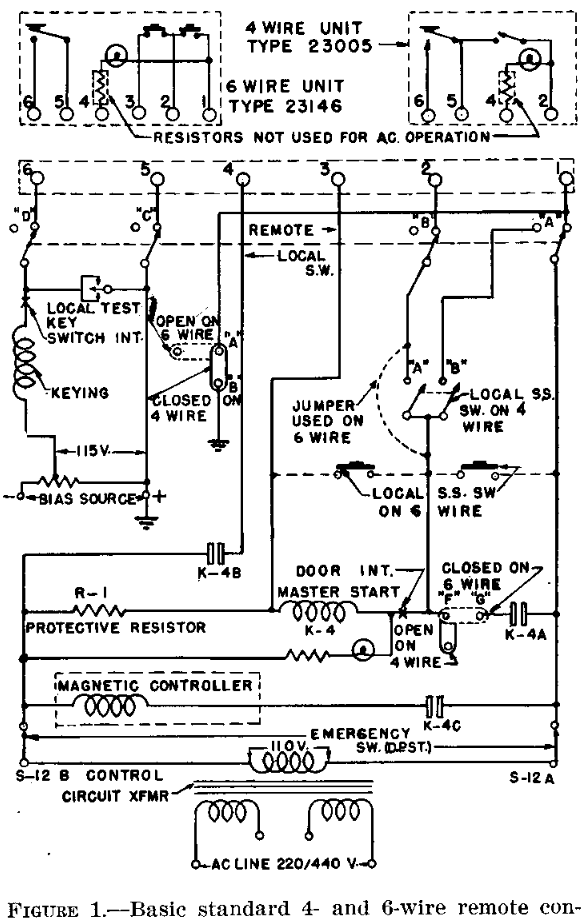


FIGURE 1.—Basic standard 4- and 6-wire remote control circuits for transmitters having a.-c. supplies.

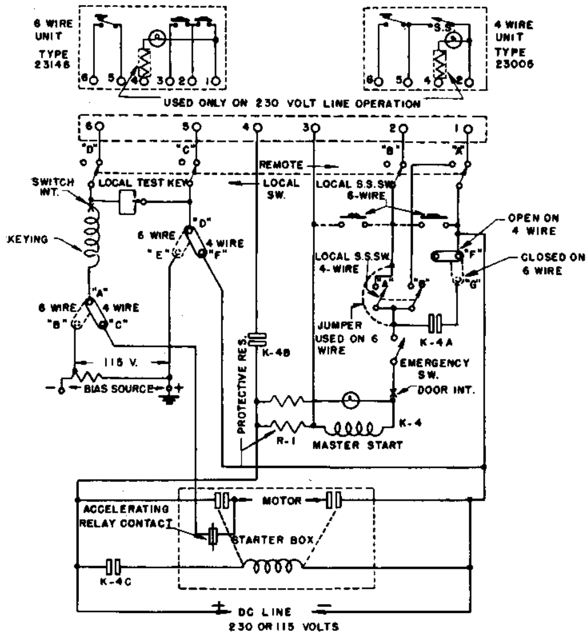


FIGURE 2.—Basic standard 4- and 6-wire remote control circuits for transmitters having d-c supplies.

PREPARATION OF REQUEST FOR SPARE PARTS (NAVSANDA FORM 302)

A new form, request for spare parts (NAVSANDA Form 302), has been designed for use by all activities afloat and ashore, as a means of furnishing the requisitioning officer with sufficient detailed data accurately to identify the needed items. Lack of such information on requisitions has been a major source of difficulty in prompt procurement of spare parts. The department within the activity requiring the material is considered to be in the best position to supply the information needed.

The request for spare parts will be prepared in triplicate in a legible manner by the department requesting the items. Only items pertaining to one type of equipment will be listed on one set of forms; if spares are requested for equipment of different types, a form will be required for each type. All identifying name plate data and/or instruction book information will be placed thereon. Further description can be entered in the space provided, or on the reverse of the form. All descriptive information entered on this form will be transcribed to the formal requisition. The original request for spare parts (NAVSANDA Form 302) will be securely attached to and forwarded with the original of the requisition submitted to the source of supply; one copy will be attached to and filed with the retained copy of the requisition; one copy will be returned to the head of the department requesting the material, endorsed as to the date and number of the requisition.

The NAVSANDA Form 302 may be obtained from the Supply Officer who can obtain a quantity from the Naval Supply Depots, Norfolk and Oakland if he does not already have a supply on hand.

A sample of NAVSANDA Form 302, properly filled out, is shown in figure 1 on the next page.

SHORT TITLE FOR LORAN TRANSMITTING STATION MANUAL

The correct short title of the Loran Transmitting Station Manual is NAVSHIPS 900,-060 and not 900,069 as shown on the enclosing envelope. Holders are requested to change their copies in ink.

REPLACEMENT DRAWINGS FOR LORAN TRANSMITTING STATION MANUAL

The three Coast Guard drawings in the Loran Transmitting Station Manual designated "R-2071D" are incorrect. Corrected drawings, designated "R-2071E," have been printed and given the same distribution as the manual. If your activity has a copy of the manual but has not received the replacement drawings, they should be requested from the Bureau of Ships (Code 250F).

PRACTICAL FACTS ABOUT TESTING ELECTRON TUBES

A tube tester is a very valuable aid in determining many common defects in electron tubes, and is absolutely necessary for speedy maintenance of most electronic equipment. With a tube tester it is possible to isolate defi-

REQUEST FOR SPARE PARTS

NAVSANDA FORM 302

NAME OF ACTIVITY OR SHIP: AS-53 (USS BELLIGUSE)	REQUEST NO.: 42
DEPARTMENT: Communication	DATE: 7 August 1945
SPARE PART BOX NO.: 2	ALLOWANCE LIST: GROUP NO. Buships 90099, See Inst. Book TXX-3
STOREROOM NO.: Radio III	PAGE NO.: 47

ITEM NO.	STOCK NO. OR PART NO.	DESCRIPTION	UNIT	QUANTITY	SPARE PART LIST NO.	ALLOWANCE LIST LINE NO.
1	C-401	500 MFD. +100% - 10%, 15 volt				
		Electrolytic Microphone Capacitor		1	Item 72	--

ABOVE ITEMS TO BE USED ON/WITH: TXX-3 Transmitter

NAME PLATE DATA

SERIAL NO.: 1492	TYPE NO: TXX	MODEL NO.: 3	STYLE: --
MFR.'S DRAWING NO.: 23A17 347	NAVY DRAWING NO.: 48D73217	P. C. NO.: --	CONTRACT NO.: NXsr-78431
HP.: --	R. P. M.: --	GPM: --	CFM: --
VOLTAGE: 15	A. C. OR D. C.: DC peak	AMPS.: --	OHMS: --
PHASE: --	CYCLE: --	BORE: --	STROKE: --
SIZE: 7" x 2" D	JOB ORDER NO.: --	CATALOG NO.: --	SPECIFICATION NO.: --

ADDITIONAL NAME PLATE DATA:

OTHER IDENTIFYING INFORMATION: or Sprague Spec. Co., - Cornell-Dubilier - Aerovox

MANUFACTURER: Solar Mfg. Co.	LATEST ACCEPTABLE DELIVERY DATE: 1 September 1945

MANUFACTURER'S ADDRESS: Bayonne, N. J.

SOURCE OF SUPPLY: NYPEARL

DRAWN OUT OF SPARE PARTS BOX BY: Jones, A. B., RT 2/c	UPON RECEIPT NOTIFY: CRE John Doe, USN
SUBMITTED BY: CRE John Doe, USN	APPROVED BY HEAD OF DEPARTMENT: Lt. John Smith, USNR

DATE ORDERED	ORDERED FROM	REQUISITION NO.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1944 16—42008-1

Last line to be filled in by Supply Officer

FIGURE 1.—A sample of NAVSANDA Form 302 properly filled out.

nitely such tube faults as extremely low-emission tubes, shorts, open elements, and gassy tubes. Since these faults comprise a large percentage of tube failures, the need for intelligent use of a tube tester is self-evident.

However, there is only 100 percent reliable field test for tubes—put the tube in the socket of the radio set in which it will be used and see how it works. The set should be checked to be sure that other components are in proper condition and that the equipment is properly aligned.

Checking tubes with a tube tester is not a complete test, since a tube may test "high" in a tube tester and work poorly in a radio set. Another tube may test "low" in a tube tester but work very well in a set.

Figure 1 shows a typical r-f amplifier circuit and a tube tester circuit, illustrating the differences which exist in circuit constants.

In general, tube testers do not completely indicate tube performance because:

(1) Different voltages are applied. A tube may read "low Gm" when tested at 25 volts E_{sg}, 35 volts E_P and -0.5 volts E_g, and yet work perfectly in a radio equipment with 100 volts E_{sg} and 200 volts E_P. Many tube testers check tubes at low filament, screen grid and plate voltages.

(2) Different impedances are used in plate and grid circuits. A tube with tuned circuits or choke coils in its grid and plate circuits performs altogether differently from the same tube with its elements connected directly to supply voltages. No tube checker can be expected to have grid and plate impedances duplicating those in radio gear.

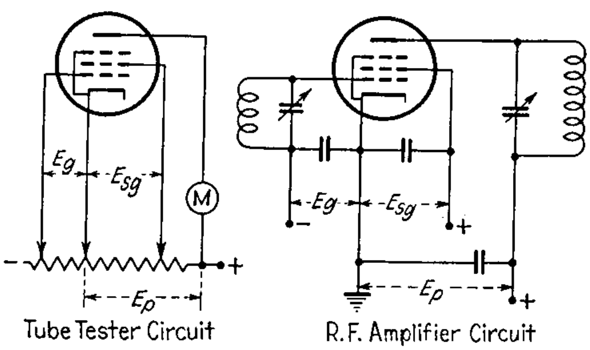


FIGURE 1.—Comparison of a typical tube tester circuit with a typical r-f amplifier circuit.

(3) Different frequencies are used. Most, if not all, tube checkers use either a. c. at power line frequency or rectified d.-c. voltages and no high-frequency voltages are applied. The most serious difference here is in the operation of the grid-cathode circuit as the frequency increases. The grid-cathode circuit of a tube at low frequencies is a very high impedance, but as the frequency is increased, the grid acts like a lower and lower resistance. For example, a 6K7 r-f pentode tube has an effective grid loading equivalent to a 20,000-ohm resistor at 30 mc., while at 500 kc. it is several million ohms. The small r.-f. tubes, such as the 9,000 series and the 6AK5's, were developed to lessen the grid loading on high-frequency tuned circuits.

An electron tube may be regarded as a series of variable resistors. Thus, changing the voltage applied to any element will change all its characteristics including not only mutual conductance, amplification factor and plate resistance, but also effective input capacity, output capacity and grid loading. At the high frequencies used in many equipments the interelectrode capacitance of the tube becomes a good portion of the circuit capacitance. For this reason circuits should be properly aligned to prevent selection of tubes that match certain incorrect capacitance conditions.

It is impracticable to design a complete testing instrument which will evaluate the performance of any tube in any circuit in which you happen to find it operating. Since tube checkers are so different from the r.-f. circuits in which tubes actually are used, it is recommended that:

(1) Only "dead," "shorted," or extremely weak tubes be discarded on the basis of a tube tester check.

(2) No tube working satisfactorily be replaced on the basis of a tube tester check, unless the test shows imminence of failure such as intermittent operation, evidence of gas, etc. Nevertheless, it should be repeated that a large percentage of faulty tubes can be detected by a tube tester and continued use of such equipment is a necessity.

FAILURE OF HANDSET CABLES IN RADIOPHONE UNITS

Several ships have reported frequent failure of the five-wire cable to the handset in the remote radiophone units. This failure is due to frequent sharp bending of the cable at the point where it enters the phone handset. The cure, of course, is to prevent sharp bends at this point, and may be effected in several ways. One way is to make a spiral spring out of steel spring wire and attach it to the handset so that the spring covers the cable at the point of entrance in much the same manner as the spring on a home type iron or coffee percolator heater cord. Another is to cover the cord with a piece of semistiff "spaghetti" or saturated cloth tubing. Other means of curing the trouble may be devised locally using such materials as may be at hand.

Specifications for new radiophone units will include protection for the cord at the points of sharp bending.

●

MODIFICATION KIT FOR THE TIME DELAY RELAY OF RADIO TELEGRAPH TRANSMITTING EQUIPMENT

The purpose of this kit is to prevent signal emission while the keyer tube is heating to operating temperature. It has been found that the transmitter concerned will emit the carrier for a short period of time (seconds) when switching from relay keying to tube keying. This emission is caused by the method of connection of the keying circuit when using vacuum tube keying.

With the aid of a drill, a screw driver, a pair of pliers and a soldering iron, it should be possible to install this kit in a maximum period of several hours.

Modification kits, consisting of time delay relays complete with necessary installation material and instructions, are being shipped. Delivery will be completed in the next few months.

Distribution is being made as follows:

Equipment to be used with—	Power supply	Activity
TAB-5/6/7	220/3/60	Electronics Supply Annex, Long Island City.
TAB-5/6/7	220/3/60	NYMI.
TAB-7	220/3/60	NYNOR.
TAB-7	220/3/60	11 ND, San Pedro.
TAB-7	220/3/60	NYPS.
TBK-11/15/16	220/3/60	Electronics Supply Annex, Long Island City.
TBK-11	220/1/60	Do.
TBK-11/15/16	220/3/60	NYMI.
TBK-16	220/3/60	NYNOR.
TBK-16	220/3/60	11 ND, San Pedro.
TBK-16	220/3/60	NYPS.
TBM-6/8/10	220/3/60	Electronics Supply Annex, Long Island City.
TBM-6/8/10	220/3/60	NYMI.
TBM-8/10	220/3/60	NYNOR.
TBM-8/10	220/3/60	11 ND, San Pedro.
TBM-8/10	220/3/60	NYPS.
TBU-1/4	220/3/60	Electronics Supply Annex, Long Island City.
TBU-1/4	220/3/60	NYMI.
TBU-1/4	220/3/60	NYNOR.
TBU-1/4	220/3/60	11 ND, San Pedro.
TBU-1/4	220/3/60	NYPS.

10/1/45.

●

MEASURING THE IMPEDANCE OF LOUD SPEAKERS

At various times it is necessary to measure the impedance of spare loud speakers due to the fact that the data accompanying the speaker has been lost, or for various other reasons. The following data from the Jensen Radio Manufacturing Co. will help accomplish this:

"If the speaker impedance is not known, it can be measured with the aid of an audio oscillator, calibrated variable resistor and high impedance rectifier type or vacuum-tube-voltmeter, as indicated in figure 1.

"The oscillator output should be adjusted to give about full scale reading on the voltmeter when switched across the speaker voice coil (switch position 1), making sure that the signal level does not exceed the speaker power rating. The variable resistor is then varied until the voltmeter reads the same in positions 1 and 2. The value of R is then numerically equal to the impedance of the voice coil at the frequency of measurement.

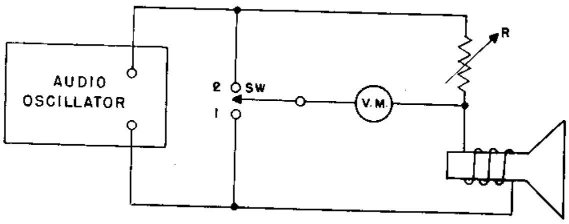


FIGURE 1.—Equipment set up to measure the impedance of a loud speaker.

"A single determination at 400 cycles will probably be satisfactory, although if desired, the impedance can be measured by this method over any desired range of frequencies.

"The principle is the same if the speaker is equipped with an input transformer; here the required impedance is that 'looking into' the primary, with the secondary connected in the normal manner to the voice coil. In this case the circuit would be as shown in figure 2.

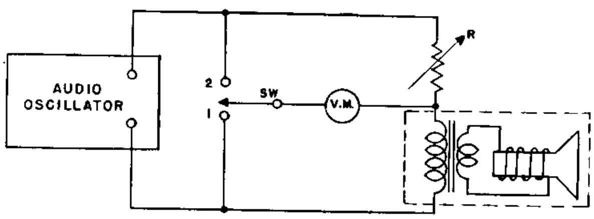


FIGURE 2.—Equipment set up to measure the impedance of a loud speaker equipped with an input transformer.

"The rated impedance of a moving coil loudspeaker is approximately the minimum impedance above the low resonant frequency and this minimum value is usually found at about 400 cycles."—*10/1/45.*

CHECKING TROPICALIZATION

In tropicalization, all the lacquers used, whatever the content, are colorless, or nearly so, in order that the numbers and the identification marks on the various instruments may be plainly read through them. The result is that it is not easy, by ordinary visual inspection, to check on the thoroughness and evenness of the spraying.

A simple field check which can be used in the forward areas to discover weak spots in the spraying of suspected parts is to try writing on the lacquered equipment with an ordinary lead pencil. If the pencil goes along smoothly as on glass the spraying is O. K. However, if the pencil "starts writing," it has found the weak spot or spots. Then the tropicalization can be completed in the field by tropicalizing these spots.—*10/1/45.*

CLASSIFICATION OF SHIPBOARD LORAN EQUIPMENT REDUCED

CNO restricted letter OP-25-A14/dm Serial 30525A of 1 May 1945 to all ships and stations reduced the classification of Loran receiving equipment to *RESTRICTED.* This applies likewise to the following books for Loran shipboard receiving and training equipments:

Title	*Short title*
Loran Handbook for Shipboard Operators.	SHIPS 278.
AN/APN-9 Supplementary Shipboard instructions.	NAVSHIPS 900, 640.
CME-60069/CME-60069A Instruction Book.	SHIPS 269.
DAS/DAS-2 Instruction Book	SHIPS 225A.
DAS-1 Preliminary Instruction Book.	NAVSHIPS 929-1.
DAS-3 Preliminary Instruction Book.	SHIPS 263.
DAS-3 Temporary Instruction Book.	NAVSHIPS 900, 254.
DAS-4 Instruction Book	SHIPS 322.
X-DBE and CXJD Instruction Book.	SHIPS 321.
LRN-1/LRN-1A Instruction Books.	

Activities holding copies of any of these publications should therefore mark the front covers *RESTRICTED—10/1/45.*

FAILURE OF BYPASS CAPACITORS IN ARMY EQUIPMENT

Large numbers of failure reports have been received on plate and screen circuit bypass capacitors used in Army equipment such as the BC-639, the SCR-608, etc. These capacitors usually are rated at 0.006 mfd., 300 volts. Experience has shown that these capacitors can not be depended upon. It is therefore desired that all such capacitors in all models of Army equipment be removed and replaced with capacitors rated at 0.006 mfd., 600 volts. Replacement of the original capacitors should be done on "general principles" before these capacitors fail at a critical time.—*10/1/45.*

REPORTING OF ELECTRONIC FIELD CHANGES

The usual method of reporting a field change to electronic equipment is to fill out and mail the self-addressed card contained in the field change kit.

For reporting those field changes in which no kit is supplied or in which no modification card is available, the Bureau suggests this easy and convenient procedure: Fill out the top half of a NavShips NBS 383 (Failure Report—Electronic Equipment) card and under "Remarks" note: "Navy Field Change ---- made."

If properly filled out, the card should contain the following information:

Equipment model and serial number.
Unit name and serial number.
Navy Field Change number.
Date Field Change made.
Name and rank, rating, or title of person making change.

When the card is filled out, enclose it in its self-addressed envelope, seal and mail. If no self-addressed envelope is available, mail the card to the Bureau of Ships, Code 980, Navy Department, Washington 25, D. C.—*10/1/45.*

PRECAUTIONS IN HANDLING FUNGUS PROOFED WIRE

There are certain precautions to be observed to avoid skin irritations when handling fungus proofed fiberglas insulated wire.

Insulation skinned from wires should, whenever possible, be placed directly into containers to keep it off the floors, benches and clothing. The dust liberated during the skinning and various other operations should be collected with a portable vacuum cleaner at whatever interval is found necessary to keep the benches, equipment and floors clean. Compressed air should not be used for removing dust from the benches, equipment, or floors.

After skinning the wire or handling the skinned wire, wash the hands and arms thoroughly with soap and water. If an itching sensation on the hands and arms is experienced, refrain from scratching, and wash the hands and arms with water and a good hand cleaner to remove particles of fiberglas. Should skin irritation persist, obtain medical advice for "exposure to fiberglas treated with fungicide."—*11/1/45.*

REMOVAL OF FUNGUS GROWTH IN RADIO EQUIPMENTS

A considerable number of failure reports have been received which report arc-over and surface leakage on ceramic insulators used in radio equipments, especially models TDE and TBM. This condition is due to the collection of fungus growth on the surface of these ceramic insulators. The fungus growth collects moisture which provides a leakage path across the insulator with consequent arc-over and formation of a carbonized path or short across the insulator. This condition may be avoided by keeping the surface of insulators scrupulously clean and dry, and making the cleaning of the insulators a daily matter. Once the insulator has a leakage path across it, not much can be done except replacement, but the trouble can be entirely avoided by the preventive measure of keeping the surface of the insulators clean.—*11/1/45.*

IDENTIFICATION OF OUTPUT TRANSFORMERS

Every radio repair shop has a "junk box" which usually contains, among other things, several output transformers from which the winding identification has long been absent. The impedance ratio of these transformers may easily be determined, using nothing more than a source of 115-volt 60-cycle a. c. and an a.-c. voltmeter. The procedure is based upon the fact that the impedance ratio is equal to the square of the turns ratio and that the ratio of primary to secondary voltage is equal to the turns ratio, thus:

$$\frac{Z_P}{Z_S}=\left(\frac{N_P}{N_S}\right)^2$$

and

$$\frac{N_P}{N_S}=\frac{E_P}{E_S}.$$

Therefore

$$\frac{Z_P}{Z_S}=\left(\frac{E_P}{E_S}\right)^2$$

where $\frac{Z_P}{Z_S}$ is the impedance ratio, $\frac{N_P}{N_S}$ is the turns ratio, and $\frac{E_P}{E_S}$ is the voltage ratio.

The first step is to determine which terminals or leads are for the primary and which are for the secondary. This is done with an ohmmeter. Since all output transformers are "stepdown," the secondary winding, especially in units which feed voice coils of dynamic speakers, will have a d.-c. resistance much lower than the primary. Once the windings have been identified, 115-volt a. c. is applied to the primary and, if possible, adjusted to exactly 115 volts. The secondary voltage is then measured and the impedance ratio determined by reference to the following table, which is calculated from the formula

$$E_S=\frac{115\sqrt{Z_S}}{\sqrt{Z_P}}.$$

Primary impedance (ohms)	SECONDARY IMPEDANCE						
	2 ohms	4 ohms	6 ohms	8 ohms	16 ohms	250 ohms	500 ohms
	Volts	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*
25,000	1.03	1.45	1.78	2.06	2.91	11.5	16.3
15,000	1.33	1.88	2.30	2.66	3.75	14.8	21.0
12,000	1.48	2.10	2.57	2.97	4.20	16.6	23.5
10,000	1.63	2.30	2.82	3.26	4.60	18.2	25.7
8,000	1.82	2.57	3.16	3.64	5.14	20.3	28.7
7,000	1.95	2.75	3.37	3.90	5.50	21.7	30.8
6,000	2.10	2.97	3.64	4.21	5.94	23.3	33.2
5,000	2.30	3.26	3.99	4.61	6.51	25.7	36.4
4,000	2.57	3.64	4.46	5.15	7.27	28.8	40.7
3,000	2.97	4.20	5.15	5.95	8.40	33.2	47.0
2,000	3.64	5.15	6.30	7.29	10.3	40.7	57.6
1,000	5.14	7.28	8.91	10.3	14.5	57.6	81.4
500	7.27	10.3	12.6	14.6	20.5	81.4	115

For example, a secondary voltage of 2.9 volts indicates an impedance ratio of 1500:1. This transformer could be used to couple a 2-ohm voice coil to a tube requiring a 3000-ohm load, a 4-ohm load to a tube requiring a 6000-ohm load, an 8-ohm load to a tube requiring a 12,000-ohm load, etc. It should be noted that a transformer is a "changer" or "reflector" of impedances and that it merely reflects to the primary an impedance which depends on the impedance connected to the secondary and the impedance ratio (turns ratio squared) of the transformer. The terms "primary impedance" and "secondary impedance" do not refer to the impedance of the appropriate windings. In the above example, the secondary voltage was found at the intersection of a primary impedance of 3000 ohms and a secondary impedance of 2 ohms. This meant that this transformer would present a 3000-ohm load to a tube when a 2-ohm load was connected to the secondary, or that it had an impedance ratio of 1500:1. Thus, any impedance connected to the secondary would be reflected to the primary multiplied by a factor of 1500.

There are several factors which limit the accuracy of this method of measurement. In the first place, the nominal impedances listed in catalogues for speakers and transformers are measured at 400 cycles. The above procedure assumes that the frequency response of the transformer is the same at 60 cycles as at 400 cycles. In practice this is no disadvantage as in a good transformer there is only a slight attenuation at 60 cycles, while in cheap or midget set transformers, mismatch is not serious due to the usually poor performance of associated equipment. In the second place, the accuracy is limited by voltmeter errors. The table is calculated to three significant figures which is much greater accuracy than that of the instruments employed. Finally, the table is calculated on the basis of exactly 115 volts applied to the primary. Any deviation from this value will, of course, introduce a proportionate variation in secondary voltage.

It is believed that this method is a practical means of determining the impedance ratio of output transformers. However, whether or not a transformer can be used in a certain application depends not only on the impedance ratio, but also on the power handling capability (which is determined by the gauge of wire used for the windings, core area, etc.), the size of the unit, mounting facilities and other factors which must be evaluated by the user.—*11/1/45*

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STATUS OF GENERAL PURPOSE POWER SUPPLIES FOR ELECTRONIC EQUIPMENT

The present status of general purpose power supplies for electronic equipment is summarized in the following list. This list includes all types of general purpose power supplies which have been procured during the past five years. It is the ultimate aim of this Bureau to eliminate the existing confusion in the identification of power conversion equipment brought about by the procurement of many types of commercial units with identical electrical ratings and different mechanical characteristics which necessitated different Navy type numbers.

At the present time there is a variety of the above commercial motor-generator sets available in limited quantities at the various electronic material pools. Although a great many of these are obsolete insofar as further procurement is concerned, the Bureau desires that they be utilized whenever they adequately satisfy requirements.

Navy type number	*Input*	*Output*
*211575	230 V DC	115/1/60—0.5 KVA
211762	230 V DC	115/1/60—0.5 KVA
*211305	230 V DC	115/1/60—0.5 KVA
*21431	230 V DC	115/1/60—0.5 KVA
*211139	230 V DC	115/1/60—0.5 KVA
*21807	230 V DC	115/1/60—0.5 KVA
*21207	115 V DC	115/1/60—0.25 KVA
*21207A	115 V DC	115/1/60—0.25 KVA
211133	115 V DC	115/1/60—0.25 KVA
*211260	115 V DC	115/1/60—0.25 KVA
*211574	115 V DC	115/1/60—0.5 KVA
211761	115 V DC	115/1/60—0.5 KVA

Navy type number	*Input*	*Output*
*211565	115 V DC	115/1/60—0.5 KVA
*211141	115 V DC	115/1/60—0.5 KVA
*211135	115 V DC	115/1/60—0.5 KVA
*21806	115 V DC	115/1/60—0.5 KVA
*21208	115 V DC	115/1/60—0.5 KVA
*211304	115 V DC	115/1/60—0.5 KVA
*21523	230 V DC	115/1/60—2.5 KVA
*21576	230 V DC	115/1/60—2.5 KVA
*21577	230 V DC	115/1/60—2.5 KVA
*211246	230 V DC	115/1/60—2.5 KVA
211303	230 V DC	115/1/60—2.5 KVA
21701	32 V DC	115/1/60—0.25 KVA
21702	230 V DC	115/1/60—0.25 KVA
21800	115 V DC	115/1/60—0.15 KVA
21801	230 V DC	115/1/60—0.15 KVA
21813	115 V DC	115/1/60—4 KVA
*21920	115 V DC	115/1/60—4 KVA
*21870	115 V DC	115/1/60—4 KVA
*21814	230 V DC	115/1/60—4 KVA
*21923	230 V DC	115/1/60—4 KVA
211271	230 V DC	115/1/60—4 KVA
*211256	230 V DC	115/1/60—4 KVA
211007	115 V DC	115/1/60—2 KVA
*21914	115 V DC	115/1/60—2 KVA
211008	230 V DC	115/1/60—2 KVA
*21917	230 V DC	115/1/60—2 KVA
211014	115 V DC	27 V DC—250 W
*211338	115 V DC	27 V DC—250 W
211347	115 V DC	115/1/60—1 KVA
*211204	115 V DC	115/1/60—1 KVA
*211147	115 V DC	115/1/60—1 KVA
*211234	115 V DC	115/1/60—1 KVA
*21821	115 V DC	115/1/60—1 KVA
211151	230 V DC	115/1/60—1 KVA
*211039	230 V DC	115/1/60—1 KVA
211437	115 or 230 V DC	13 or 26 V DC—500 W
211414	115 V DC	13/26 V DC—500 W
*211444	115 V DC	13/26 V DC—500 W
211018	115/230/1/60	27 V DC—250 W
211649	115/230/1/60	13/26 V DC—500 W
211438	115 V DC	13 V DC—150 W
*21698	115 V DC	115/1/60—2.5 KVA
211301	115 V DC	115/1/60—2.5 KVA
211275	115 V DC	115/1/60—5 KVA
211279	230 V DC	115/1/60—5 KVA

Navy type number	Input	Output
211336	115/230/1/60	27 V DC—250 W
211514	230/3/60	115 V DC—2 KW
211627	230/3/60	115/230 V DC—2 KW
21820	230 V DC	440/3/60—3.5 KVA
21817	115 V DC	440/3/60—7.5 KVA
211037	230 V DC	440/3/60—7.5 KVA
211134	115/1/60	115 V DC—250 W
21823	32 V DC	115/1/60—1 KVA
*20350	115/1/60	13/26 V DC—500 W
Rectifier		6 V DC—250 W
*20341	115/230/1/60	7/14/28 V DC—750 W
Rectifier		

*Further procurement of this type unit will not be made. Present stocks, however, shall be utilized whenever possible.

3/1/46

FINAL INSTRUCTION BOOKS

Final instruction books are available on the equipments listed below. Activities holding preliminary editions should request final books on the basis of the two per equipment from the → nearest Publications and Printing Office. See also additional listing on Page GEN : 98. ←

Equipment	Short title
AN/ARW-34	----------
AN/SPR-2	NavShips 900,654
AN/SPR-2A	NavShips 900,599
AN/UPM-4(XN21)	NavShips 900,949
CMX-49545	NavShips 900,853
CW-35060 FSA keyer	NavShips 900,754
CXGG-1	NavShips 900,788
CXGJ-2	----------
CXGJ-4/5	----------
CXGZ	----------
CXKJ	----------
DAG-1/2	----------
DAH	NavShips 900,757
DAH-2	NavShips 900,758
DAJ	----------
DAK-3	NavShips 900,264A-IB
DAQ	Ships 233
DAS-4	Ships 322
DAU	Ships 301
DAW-1/2	----------
DBB	NavShips 900,769
DBB-1	Ships 332(A)
DBE	NavShips 900,659
FOA	----------
FOC	----------
FQB	----------
FRB and FSJ	----------
FRC-1	NavShips 900,718
FRE	----------
FRF	NavShips 900,208
FRH	NavShips 900,358
LAE	NavShips 900,311
LAE-2	NavShips 900,518
LAH	NavShips 900,550
LM-11	
LM-15	NavShips 900,274
LM-16	NavShips 900,275
LM-17	NavShips 900,276
LO-3	NavShips 900,285-IB
LP-3	NavShips 900,425
LP-5	NavShips 900,425
LR-2	NavShips 900,067
OBN	NavShips 900,429
OCA	NavShips 900,376 (A)
OF	----------
OF-1	----------
RAK-6	----------
RAK-7/RAL-7	NavShips 900,480
RAK-8	----------
RAL-6	----------
RAL-7	NavShips 900,480
RAS-4	----------
RAS-5	----------
RAU-2	NavShips 900,348
RAU/RAV	----------
RBA/1/2/3	----------
RBA-5	NavShips 900,708
RBB/RBC/RBB-1/RBC-1/RBB-2/RBC-2	NavShips 900,477
RBF-1	----------
RBG/1/2	NavShips 900,004-IB
RBJ-1	----------
RBJ-2	----------
RBJ-4	----------
RBK-12/13/14	NavShips 900,235.
RBK-13	----------
RBL-3/4	NavShips 900,292-IB
RBL-5/6	NavShips 900,350
RBM/RBM-1/2/3/4/5	NavShips 900,385
RBO	NavShips 900,608
RBO-1	NavShips 900,607
RBO-2	NavShips 900,610
RBP	----------
RBP-1/RCP	NavShips 900,478
RBR	----------
RBS/RBS-1/2	NavShips 900,324
RCB-1	----------
RCK	----------

Equipment	Short title
RCO	NavShips 900,255–IB
RDC–1	NavShips 900,486
RDE	----------
RDF	----------
RDJ/RDJX	NavShips 900,253 (A)
RDM	----------
TAB–6/7	NavShips 900,379
TAJ–12	NavShips 900,574
TAO–10	NavShips 900,549
TBA–6/10	NavShips 900,406
TBA–8	NavShips 900,290–IB
TBC–4/5	NavShips 900,856
TBK–8/10	----------
TBK–9/TBM–4	NavShips 900,380
TBK–12	----------
TBK–17	NavShips 900,479
TBK–19	NavShips 900,482
TBL–4/8/9	NavShips 900,373
TBL–5/6/7/12/13	NavShips 900,381
TBL–10/11	NavShips 900,390
TBM–5/7/9/11	NavShips 900,388
TBM–6/8/TBK–11/15	NavShips 900,386
TBM–12	NavShips 900,763
TBR/TBR–1	----------
TBS Series	NavShips 900,590
TBU–4	NavShips 900,391
TBW–2/3/4/5	NavShips 900,247
TBX–8	NavShips 900,706
TCA–1	----------
TCB–1	----------
TCC–3	----------
TCE–2	----------
TCG/TCG–1	----------
TCJ–TCJ–1	NavShips 900,402
TCP–2	----------
TCP–3	----------
TCS–4	----------
TCS–5	----------
TCS–6	NavShips 900,269–IB
TCS–7/9/10/11/12	NavShips 900,291–IB
TCS–8	NavShips 900,575–IB
TCX/RBD	----------
TCY/TCY–1	----------
TCZ	----------
TDD–2	NavShips 900,271–IB
TDF	NavShips 900,912
TDG–1	NavShips 900,620
TDH	----------
TDH–2	----------
TDM–1	NavShips 900,832
TDO–	----------
TDP	NavShips 900,330
TDQ	NavShips 900,474–IB
TEB	NavShips 900,352 (A)
TEC	NavShips 900,212
UE–1	NavShips 900,426
UF/UG/UN	----------
UM	NavShips 900,745
UN System	NavShips 900,840
UN Carrier Supply	NavShips 900,201
UN Voice Carrier	NavShips 900,202
XDW	NavShips 900,927
YA–1/YA–2	NavShips 900,220
YE–1	----------
YE–1 (Antenna)	----------
YG	NavShips 900,510
YG–1/YG–2	NavShips 900,252–IB
YG–1/2	NavShips 900,252–IB–1
YJ/YJ–1	Ships 241
YL	NavShips 900,249

8/1/47 ←

TELETYPE LETTER TO ALL SHIPS AND STATIONS

It is desirable that all E. O. Personnel read the following BuShips letter.

Subj: Radio and Interior Communication Teletype Equipment—Installation and Maintenance.

1. The present method of control and handling of teletype equipment entails considerable duplication of effort and personnel training. Various activities have indicated that teletype equipment is being installed, serviced, and maintained by shipyard electrical shops, electronic officers (CRF and radio repair shops), communication and engineering departments of ships, and shore communication activities.

2. To alleviate this situation, the following policies applicable to all Navy teletype equipment are established:

(a) At all naval shipyards and other naval activities all teletype equipment including that used for interior communications shall be stocked, issued, installed and maintained in the same manner as radio communication equipment.

(b) Adherence to the custom of some activities in permitting only certified employees of cryptographic repair facilities to maintain teletype equipment is not required. Instead, the Bureau desires that personnel be assigned to teletype work who have first received maintenance training.

(c) On board ships, the Bureau recommends that responsibility for the maintenance of all teletype equipment be given to the department charged with electronic maintenance. It is further desired that regular schedules be established for preventive maintenance and periodic lubrication.

3. The responsibilities relative to the handling of teletype equipment within the Bureau are set forth as a matter of interest to field activities and forces afloat.

(a) The Electronics Division of the Bureau of Ships is responsible for the design, procurement, distribution, and maintenance of all teletype equipment including complete units, spare parts, and special teletype test equipment for both shore and shipboard use. This division is also responsible for the installation engineering-planning of all shore (radio and wire) teletype equipment and shipboard radio teletype equipment.

(b) The Shipbuilding Division of the Bureau of Ships (Interior Communication and Fire Control Section) is responsible for installation engineering-planning of shipboard teletype equipment used specifically for interior communication (IC) purposes.

4. Teletype maintenance schools are established for the training of both military and civilian personnel. At the present time, the Naval Training School, San Diego, is for military personnel only. However, it is expected that it will be open to civilians in the near future. The course at San Diego requires approximately 2 months. The teletype training previously available at the Electrical Interior Communication School, Washington, D. C., is being terminated and is now being carried on at the San Diego school.

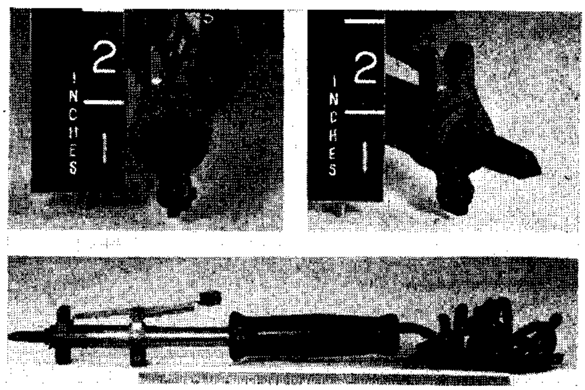
The Fort Monmouth, N. J. (Army Signal Corps) school has been training Navy civilian personnel since the Central Signal Corps School at Camp Crowder, Mo., closed. Due to the crowded conditions at Fort Monmouth at this time no naval personnel are permitted but it is expected that the Navy will be allowed a quota beginning approximately 1 September. This course requires 7 weeks.

5. Requests for military personnel training in teletype may be forwarded through the chain of command to Training Division, Bureau of Naval Personnel. For civilian personnel, the cognizant activity may forward the request to the Bureau of Ships, attention Code 992.

E. L. Cochrane.
Chief of Bureau.
10/1/46

STRIPPING INSULATION FROM UNIT CONDUCTORS OF TYPE TTHFA AND TTHFWA CABLE

The material laboratory, New York Naval Shipyard, has conducted a series of tests to determine the safest and most practical method of stripping the insulation from unit conductors of types TTHFA and TTHFWA cable for terminal connections.



Results of the above tests indicate that any one of the following methods may be safely employed. These are listed in order of preference.

Method "A" (applicable to TTHFA and TTHFWA cable).—This method consists of heating the end of the unit conductors by means of either a match or electrician's alcohol torch and when thus heated immediately wiping off the insulation with a rough cloth or cotton waste. This method is satisfactory for fabric-served and resin insulated wire.

Method "B" (applicable to TTHFA and TTHFWA cable).—This method consists of the use of an ordinary electric soldering iron on which is mounted a V-shaped brass block directly over the heating unit of the iron and a lever arrangement for holding the end of the unit conductor against the heated V-shaped block. (See accompanying photograph.) In this method the conductor is inserted in the heated V-shaped block, held in place by the lever arrangement and withdrawn when the insulation on the conductor is sufficiently heated. The end of the unit conductor is then wiped clean with a cloth or waste. Where electric service is available this method is desirable because of the elimination of open flame in supplying the heat to destroy the organic material at the end of the wire.

Method "C" (applicable to TTHFA cable).—The length of insulation to be removed is gripped between the jaws of a pair of short-nosed pliers and sufficient pressure applied to cut the insulation after which the wire is pulled through the jaws of the pliers thus stripping it free of insulation. In the case of enameled wire, the conductor may have to be redrawn through the pliers two or three times to entirely clean it. Note that knives or diagonal pliers should not be used for this purpose. *10/1/46*

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CALIBRATION OF SHIPBOARD DIRECTION FINDERS

INTRODUCTION

Fundamentally, all direction-finder calibrations are performed with one purpose. This is to accurately record the deviation corresponding to each scale reading of the direction finder on any specified frequency.

This is accomplished by taking simultaneous visual and direction-finder bearings on a target transmitter at small intervals of azimuth (approximately every 3°) and then computing the error for each direction-finder bearing. This error, defined as the difference between the observed direction-finder bearing and the correct bearing of the source of transmission, is called *deviation.* The deviation is plotted on a graph sheet and a smooth curve is drawn through the points. The curve produced then fulfills the original purpose, that of knowing the deviation corresponding to each direction-finder scale reading.

However, the means by which the simultaneous bearings may be taken quickly and accurately on a number of frequencies must be carefully worked out. The intent of this article is to discuss the information necessary to insure the development of a good *calibration technique.* At first, only the general considerations for calibrations in any frequency range will be considered. Following this will be more specific information regarding special problems in each particular frequency range.

GENERAL CALIBRATION INFORMATION

(1) Calibration is normally associated with new installations. However, the necessity for recalibrating equipment already in service is frequently overlooked. Recalibration should be performed when any of the following conditions exist:

(*a*) Any change in the pertinent electrical characteristics of the ship.

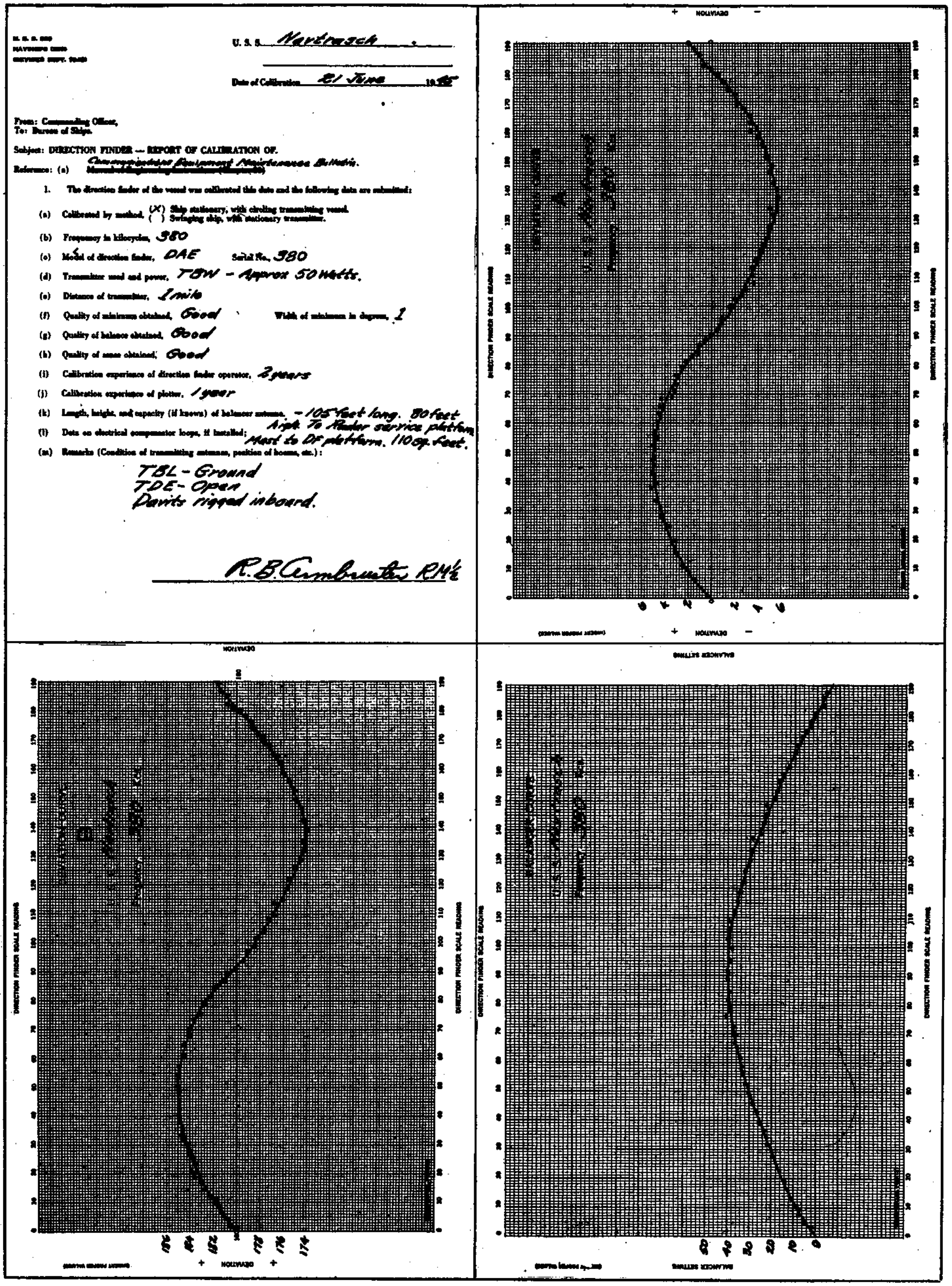
(*b*) Any modifications of topside structures, such as replacing guns, turrets, boat davits, etc.

(*c*) Any modifications in equipments, such as replacing loops, cables, and circuit components electrically ahead of the receiver mixer stage. When any work is done in the indicator unit, it is only necessary to check that azimuth scales are zeroed as at the time of calibration.

(*d*) If sense determination or balancer settings do not agree with a previous calibration.

(*e*) If the deviations on spot frequencies do not agree.

Checks such as (d) and (e) above should be made at every opportunity. Ships at sea in groups may advantageously check on each other. Also ships entering harbors in daylight may



U. S. S. *Navtrasch*

Date of Calibration *21 June* 19*45*

From: Commanding Officer,
To: Bureau of Ships.

Subject: DIRECTION FINDER — REPORT OF CALIBRATION OF.

Reference: (a) *Communication Equipment Maintenance Bulletin.*

1. The direction finder of the vessel was calibrated this date and the following data are submitted:

(a) Calibrated by method, (X) Ship stationary, with circling transmitting vessel. ( ) Swinging ship, with stationary transmitter.

(b) Frequency in kilocycles, *380*

(c) Model of direction finder, *DAE* Serial No., *380*

(d) Transmitter used and power, *TBW - Approx 50 Watts.*

(e) Distance of transmitter, *1 mile*

(f) Quality of minimum obtained, *Good* Width of minimum in degrees, *1*

(g) Quality of balance obtained, *Good*

(h) Quality of sense obtained, *Good*

(i) Calibration experience of direction finder operator, *2 years*

(j) Calibration experience of plotter, *1 year*

(k) Length, height, and capacity (if known) of balancer antenna, *- 105 feet long. 80 feet high To Radar service platform*

(l) Data on electrical compensator loops, if installed; *Mast to DF platform. 110 sq. feet.*

(m) Remarks (Condition of transmitting antennas, position of booms, etc.):

TBL - Ground
TDE - Open
Davits rigged inboard.

R.B. Armbruster RM1/c

FIGURE 1.—Medium frequency curve calibrated half scale (note quadrantal deviation and semicircular balancer characteristics).

make use of shore radio beacons and known commercial transmitting stations. The exact geographical location of the actual transmitting antenna (not studio) must be known and used for these tests.

(2) There are two ways in which a ship's direction finder may be calibrated:

Method A.—The vessel equipped with the direction finder may heave to or anchor and the transmitting vessel (commonly called target boat) circle entirely around it.

Method B.—The vessel equipped with the direction finder may swing ship with respect to an anchored target boat or shore radio installation, commonly called target station.

A variation of the A method is the use of a blimp or an airplane. It finds its main use in VHF and UHF calibration, especially when the equipment's primary use is in connection with aircraft. A blimp is most suitable because of the control on speed. The speed of an airplane makes it necessary for the plane's course to be such that it will remain at a constant relative bearing from the ship long enough for an accurate direction-finder bearing to be taken. Generally, this may be accomplished by arranging to fly a clover-leaf pattern. In either method, certain refinements are necessary in regard to the target boat or target station. These will be taken up in the section on material requirements. Much thought has been given to determine whether A or B is the better method, and it has been found that each has advantages and disadvantages. The A method provides a means which is favorable because it does not require the expenditure of fuel for a large ship nor is a full *underway watch* required. This permits the crew to carry out other urgent work not interfering with calibration; an important factor during wartime. Also, the rate at which the target transmitter changes azimuth can be controlled more easily using the A method. Unfavorable factors of this method are that at certain frequencies and applications, the distance required from calibrating ship to target boat is great enough that the boat cannot circle the ship in the time allowed for each frequency; while with the B method, calibration can be carried on at any speed regardless of the distance. Also, a separate target boat is needed for each ship when a group is calibrating simultaneously whereas with the B method a number of ships can calibrate on the same target transmitter at the same time.

Circumstances will determine the method to be used.

(3) Most modern direction finders are so arranged that it is not necessary for the operator to manually rotate the loop. This is accomplished by mechanically or electrically rotating the loop several times per second. In certain navigational-direction finders, manual control is retained by providing hand rotation of the goniometer search coil; but, due to the small size and weight of this coil in comparison to the loop, finger-tip control is provided. For this reason, most present-day calibrations are conducted on what is known as the "full scale" method of calibration.

By this method, the direction-finder operator follows his direction indication all the way around the 360° of azimuth; reading from the same null or lobe continuously. The calibration curve is then plotted along the abscissa from 0° to 360° (usually in two 180° sections) of direction-finder bearing. Correction necessary (deviation) is plotted on the ordinate with the *no deviation* line marked zero and other values entered as plus above the line and minus below. However, on some old types of equipments, the loop must be hand rotated which usually requires the turning of a large hand wheel. For these equipments, there is a type of calibration known as the *half scale* method.

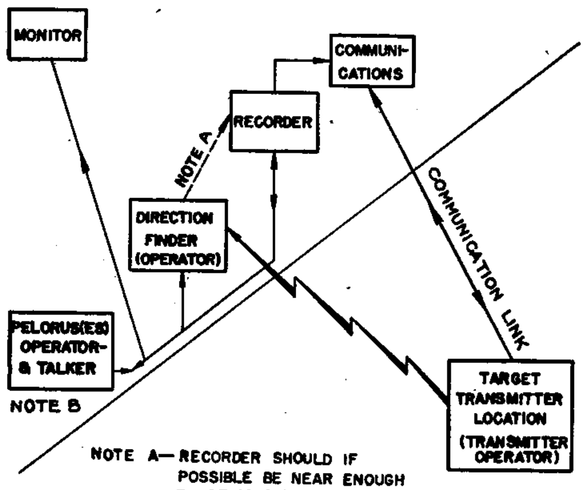
(4) In the *half scale* method, the azimuth through which the operator must turn his loop is reduced to 190°. The principle used is that he can take bearings on signals arriving on the starboard side of the ship with one null of the bilateral pattern; then, without turning the loop clear around, the bearings of signals arriving on the port side may be obtained from the other null. He need only take a sense reading to know exactly which null he has taken, therefore, which calibration curve to apply. The *half scale* method is accomplished as follows. All readings will be taken between 0° and 190° on the azimuth scale. If, at starting, the target is on the starboard side of the ship, the direc-

tion-finder bearing will read approximately the same as the visual bearing and sense will be correct. When the target is on the port side, the direction-finder bearing will read about 180° in error but sense will be reversed. Deviation for the correct sense readings will be plotted on the *A curve*. This will be a typical calibration curve with direction-finder bearings from 0° to 190° on the abscissa and the correction necessary (deviation) plotted plus or minus on the ordinate. Deviation for the sense reversed readings will be plotted on the *B curve*. This will be another typical calibration curve except that the direction-finder bearing entries on the abscissa are again 0° to 190° and the zero deviation line will be labeled +180°. In this way, both the 180° sense correction and the deviation are combined and entered on the abscissa. Thus, if the direction finder bearing is 43° and sense reverse when the visual bearing is 228°, the point will be plotted on the *B curve* at direction-finder bearing 43° and correction (228°−43°=185°) at +185° (this is five spaces above zero deviation line). If the visual bearing is less than the direction-finder bearing, add 360° to the visual bearing before computing deviation. Thus, if the direction finder bearing is 189° and the visual bearing is 7°, the point will be plotted on the *B curve* at direction-finder bearing 187° and correction (7°+360°−189°=178°) at +178° (this is two spaces below the zero deviation line). Notice that above it was stated that readings would be from 0° to 190°. This is protection against missing corrected bearings fore and aft as a result of unsymmetrical conditions from 0°–10° and from 180°–190° relative. The bearings should be taken alternately at each end of the scale and entered on their respective curves. Then both the A and B curves will be complete from 0° to 190°.

CALIBRATION ORGANIZATION

1. Although calibration is not a difficult procedure, the following organization has been found to permit accurate and rapid recording of the desired data. The visual bearings are taken with a pelorus (or two, if necessary) mounted so as to give a 360° visual contact with the target. The pelorus operator follows the target and gives the relative bearing to the direction-finder operator and the recorder. If the pelorus is of such a type that the pelorus operator cannot conveniently follow the target and give the bearings too, he may have a talker to aid him. The direction-finder operator and recorder should each have earphones so that they can both hear the information from the pelorus. If possible, the recorder should be near enough to the direction-finder operator that no phone link is necessary between them. These are the three key positions and every possible arrangement should be made to insure coordination between them. On most modern equipments in which the indication is visual and automatic, it is best for the pelorus operator to give the *mark*. He should do this in fixed increments, usually of 3°. Following the *mark*, he should give the bearing. The direction-finder operator listens for the *mark* and instantly notes the direction-finder bearing which he repeats to the recorder as soon as the pelorus operator has given the visual bearing. If the operator has any other information such as sense or pattern quality, he gives it immediately after his direction-finder bearing. The recorder is responsible for putting down all of the data, computing the deviation, and being alert to notice extreme er-

VESSEL CALIBRATING



NOTE A—RECORDER SHOULD IF POSSIBLE BE NEAR ENOUGH TO DF OPERATOR TO HEAR THE DF BEARINGS WITHOUT PHONE LINK.

NOTE B—NUMBER OF PELORUSES AND NEED FOR SEPARATE TALKER DETERMINED BY CONDITION.

FIGURE 2.—Calibration organization showing intercommunication connections.

rors or poor timing between pelorus and direction-finder operators. He must be sure to note, on the recorder sheet, the frequency and dial setting at which the curve was made. Also, near the completion of a circle, he must notify the person responsible for telling the target transmitter operator to change to the next frequency. In computing deviations on data sheets, the recorder chooses the algebraic signs, using the direction-finder bearings as references, such that when the pelorus bearing is greater than the direction-finder bearing, the deviation is "plus" and when the pelorus bearing is less than the direction finder bearing, the deviation is "minus". The fourth position is that of plotters. If there are enough men available, this is usually done immediately after each frequency has been finished. In this way, a running check can be made on the results of the calibration and peculiarities may be detected. Plotting is usually done by two men, one reading the direction-finder bearing and deviation while the other plots the points on the calibration curve. Both should be alert to notice any mistakes in the deviation computation. After the points are plotted, it is their duty to draw in a smooth curve and enter frequency, sense and special notations. The fifth position is that of monitor and is usually filled by the man responsible for the calibration. He should have means for cutting in on the intercommunications system between pelorus and direction finder. Also, he should check the curves as soon as possible after the plotters have completed them. If the deviation appears to be abnormally large, it is his duty to take steps in finding and correcting the cause.

2. The duties of the man, or men, responsible for tuning the target transmitter consist of rapidly changing to a new frequency, checking it with a frequency meter, and continuously monitoring the communication circuit for further instructions from the ship. When target facilities are furnished by the local electronics officer, the personnel for manning them will also usually be furnished.

3. At the beginning of the calibration, it is the duty of the person in charge of the work to confer with the ship's communication officer and decide what standard antenna conditions are to be maintained during calibration and while taking bearings at sea. There are three possible conditions for any antenna; these are:

(*a*) Grounded—this means that the antenna goes directly to the hull through a *good ground* switch or connection.

(*b*) Open—this means that the antenna is disconnected from the transmitter and has *no grounding* switch or connection.

(*c*) Connected through transmitter *completely tuned* to operate on —— kilocycles.

The conditions are listed above in order of their preference for dependable results. However, operational communication duties and organization aboard ship do not always permit the grounding of all antennas, and the cognizant parties will usually have to reach an agreeable compromise. When a decision is made, the information should be entered on calibration forms and also on special *antenna condition* forms available from the Bureau of Ships. These forms should be posted on the direction finder and in the radio room near transmitting antenna switches and grounding devices.

4. Care should be exercised to keep the pelorus bearing to a minimum of parallax error (less than 1°). This requires that the target transmitter's distance from the loops be 57 times, or more, the distance between the pelorous station and the mast on which the loops are mounted. Thus, if the pelorous station is 100 feet from the mast, the target transmitter should be no closer than 1 mile from the ship being calibrated.

FACILITIES NECESSARY FOR CALIBRATION

(1) First consideration is the selection of transmitters to cover the range of the various types of direction finders. In general and especially for a target boat or aircraft, they should be compact, easily adjusted, stable, and of moderate power. For certain equipments, auxiliary calibration transmitters are provided. In all calibration work, it is necessary that the center of radiation and type of polarization be known. On loop-type direction finders, operation is restricted to vertically polarized waves and for this reason, it is most satisfactory to use

a single vertical or T type antenna. For calibrating above 30 mc. special beam and reflector antennas will be specified.

(2) Factors to be considered in the use of a target boat are sea worthiness, speed, and cruising time. A dependable power supply capable of handling full load of all calibrating equipment must be provided. Planes and blimps, when used, are selected to fit specific requirements for a particular equipment. The major consideration being pattern and polarization requirements of the plane or blimp antenna. Factors to be considered in establishing a target station are a shore line location near waters where the ship can maneuver, suitable land mark (such as tower or flag pole) and dependable power supply.

Calibration should be made in relatively calm waters, as violent motion of the sea waves has been found to cause bearing errors. It has been found that at higher frequencies shifting of the direction finder pattern takes place at the same frequency as the sea waves. Reflections from the surface of large waves cause effective sources of transmissions at azimuths differing by several degrees from the line of sight to the target transmitter. Local electronics facilities that have available technical aide for direction finder maintenance will usually also have target transmitter station or boat and special test equipment when required.

(3) The Bureau of Ships provides necessary recorder sheets, curve blanks, and forms for reporting the calibration. These may be obtained from either the Bureau of Ships or from local electronics facilities. All pertinent information should be carefully recorded on these forms.

GENERAL TESTS AND PREPARATION ABOARD SHIP

1. Before attempting to calibrate any direction finder, a thorough check-up must be made on the equipment. The importance of this cannot be overemphasized and the only reason for brevity on the subject here is because the instruction books for the various equipments cover testing and maintenance very completely. Those responsible for the precalibration work should familiarize themselves with the equipment and all information pertaining to it before attempting the precalibration check. Communications equipment maintenance bulletin pages for the model direction finder to be calibrated should be checked also for any special adjustments or techniques applying to that particular equipment.

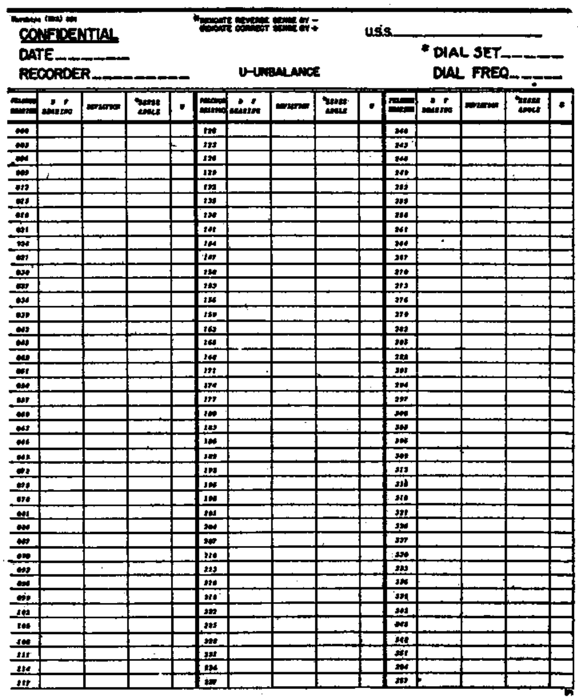


FIGURE 3.—Typical recorder sheet (note columns marked sense angle and "U" are examples of special data columns).

2. In general, the receiver and indicator units should be tested first. The receiver tubes should be tested and several stations tuned in over the frequency range. If the indicator is a visual type, it should be adjusted and checked to see that signals heard in the audio system are getting through to the indicator. A general mechanical and electrical inspection should be made and special attention should be paid to cleaning and lubricating any moving parts. If there are slip rings and brushes, these should be cleaned and adjusted.

3. The collector and transmission line system usually requires the most maintenance. The direction-finder collector must be carefully inspected for dirty or painted insulators, mechanical defects, and moisture intrusion. Steps should be taken to remedy any of these troubles that appear. Resistance and continuity meas-

urements outlined in the equipment instruction book should be carefully made and any difference from the values given should be checked and corrected. The importance of careful maintenance of the collector and transmission lines systems cannot be overemphasized.

4. After the direction finder has been carefully checked and is operating correctly, it is necessary to line up the collector with the indicator bearing circle. Specific instructions for this will be found in the equipment instruction book.

5. During the precalibration check, the ship's rigging must be inspected carefully for loose metallic rigging and intermittent connections. No stays, or guy wires, should rub against other metallic objects. Any mechanical connection of rigging to decks or masts should have a low-resistance electrical bond shunting the mechanical joint.

6. It may be found advisable to have a "check-off" form to use in connection with calibration

NAVSHIPS (NBS) 327

STANDARD D/F CONDITIONS

U.S.S. *Navtrasch* DATE *21 June 1946*

1. TBL Antenna Open.

2. TDE Antenna connected through transmitter tuned to 6420 Kc.

3. All receiving antennas to normal receiver input impedance.

4. DAK sense antenna to normal input impedance.

5. Davits rigged inboard.

6. #3 5-inch gun trained aft and horizontal.

FOR RELIABLE BEARINGS THESE CONDITIONS MUST BE OBSERVED

FIGURE 4.—Antenna conditions form.

preparation. In this way, an outline of the important component and equipment tests is at hand and when completed an accurate history of the work done and condition of the equipment is provided.

CALIBRATION IN SPECIFIC FREQUENCY RANGES

(1) On any shipboard direction-finder installation, the shape and magnitude of the deviation curves are a function of frequency. This is because the electrical length of any metallic object is closely related to its mechanical length. It is known that as the natural resonant frequency of any particular reradiator is approached, the deviation caused by that reradiator increases. In the following paragraphs concerning the specific frequency ranges the way in which this fact determines the type of deviation curve to be expected will be shown. The effect of these reradiators on the null width will also be considered.

(2) In the medium frequency range, shipboard calibrations are performed between 250 kc. and 1500 kc. In this range, wave lengths are so long that only two main reradiators will cause large deviation errors and blurred nulls. These are:

(*a*) The hull, masts and superstructure act as a large loop antenna having its plane along the fore-aft line of the ship. This loop has the same polar directivity pattern as a direction-finder loop and will cause quadrantal error. This error can be almost entirely corrected by the use of wire loop correctors or, in certain equipment, an internal compensator.

(*b*) The tallest mast (or masts) on the ship acts as a single vertical antenna having a non-directional polar directivity pattern. The reradiated field from this source has a small in phase component causing semicircular deviation and a large out of phase component causing blurred nulls. The deviation from this source is not serious enough at these frequencies to require correction but the "blurring" of nulls is serious enough that on some equipments a suitable null cleaning or balancing device is necessary.

REPORT OF HF/DF CALIBRATION CONFIDENTIAL

NAVSHIPS (NBS) 328 - REVISED 4/3/45

REPORT OF HF/DF CALIBRATION U.S.S. Navtrash AT Casco Bay

MODEL DAU EQUIPMENT SERIAL 176 OINC Lt. F.M. Berg DATE 21 June 1945

I. REPORT OF INSPECTION OF INSTALLATION

(A) CONDITION OF CONTROL UNIT: Receiver Sensitivity Good Gain Controls Good Ant. Comp. Good Switches Good BFO Good Indicator Controls Loose Slip Rings Badly Scarred Brushes Worn Brush Tension Too tight Bearings Good Junction Box One poor Solder joint. Loop and Goniometer Alignment 0-180 °. Alidade Good

Comments Cleaned rotating unit. New Slip rings and brushes, adjusted brush tension. Made good solder joint in junction box.

(B) CONDITION OF COLLECTOR SYSTEM: Mechanical Condition Sense Antenna and Counterpoise One Counterpoise rod bent. Tension and Alignment of Loops P-S loop Slack. F-A good. Length and Mechanical Condition of Cables One bend too sharp

Megger Check of Cables: PS Over 10 megohms, FA Over 10 megohms, Sense Over 5 megohms. Continuity Check of Cables All 102 ohms plus or minus 2%. Proper Connection of Cables Good Input Check Gonio Cables Less than 1 ohm across. 51 ohms to ground. Signal Gen. Check F & A checked 180° on Bdcst. Sta.

Comments Straightened rod. Took up P-S loop slack. Relieved sharp cable bend (results of calibration prove cable not damaged).

(C) GENERAL: Control Unit Location: Repair Locker Loop Location Main mast Accessibility of Equipment Fair Intercom. Facilities JX, TBS remote Control Gyro Repeater Visible Clock Visible (Set GCT) General Upkeep Fair. Advised ETM that cleaning rotating parts . xxxxxxxx of indicator would reduce lubrication troubles. Junction box in inaccessible location.

(D) CONDITION OF STAYS AND RIGGING: All bondings checked, renewed lower band on forward stay. Most rigging broken in 10 foot lengths.

(E) STANDARD CONDITIONS: MF/DF Sense Antenna Thru normal DAK impedance.

Receiving Antennas Grounded through receiver impedance.

Transmitting Antennas TCE - Open, TBL - Through transmitter tuned to 6280Kc (Advised RM that this includes complete adjustment of loading coil or condenser.)

Guns, Boats, Davits, Life Lines Ship rigged for War Cruising. 5" gun near enough to loop to require it be in horizontal position trained aft for dependable bearings.

II. REPORT OF FREQUENCIES CALIBRATED: Number of Frequencies Calibrated 21

1600	4420	6290	7948	17810					
2410	4790	6670	8030						
3000	5325	6760	9038						
3795	5530	6795	9395						
4185	5580	7760	12225						
4285	5656	7880	14610						

III. RECEIPT: Receipt of Calibration Curves for frequencies listed under II above is acknowledged. It is understood that changes from standard conditions listed in I(E) above will cause bearing errors.

Lt. R. B. Ackles

FIGURE 5.—Front page of typical check-off sheet.

IV. REPORT OF SENSE CONDITIONS

(A) PREVIOUS SETTING OF BALANCE CONDENSER: 98 °AT 5430 kc. by New York

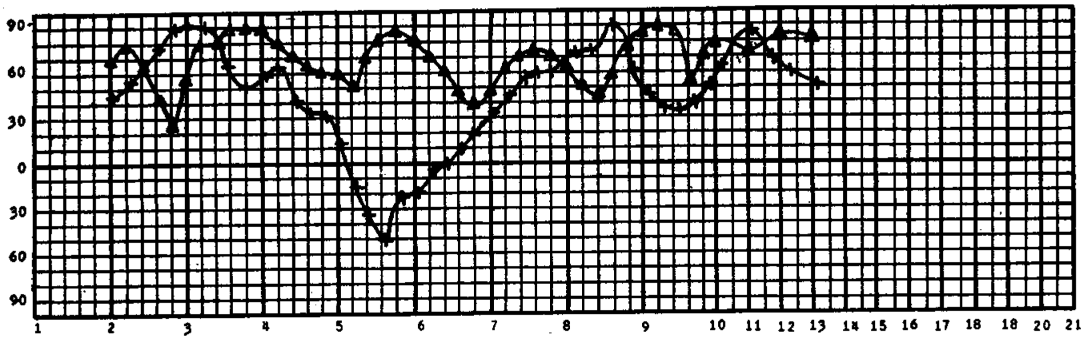
X SENSE ANGLE VS. FREQ. (ZERO BALANCE SETTING) O SENSE ANGLE VS. FREQ. (MAX. BALANCER SETTING)

Δ FINAL PLOT OBTAINED BY PREVIOUS ACTIVITY □ PLOT OBTAINED USING SETTING OF PREVIOUS ACTIVITY.

NOTE:

(1) FOR ORIGINAL CALIBRATION USE – (X AND O)

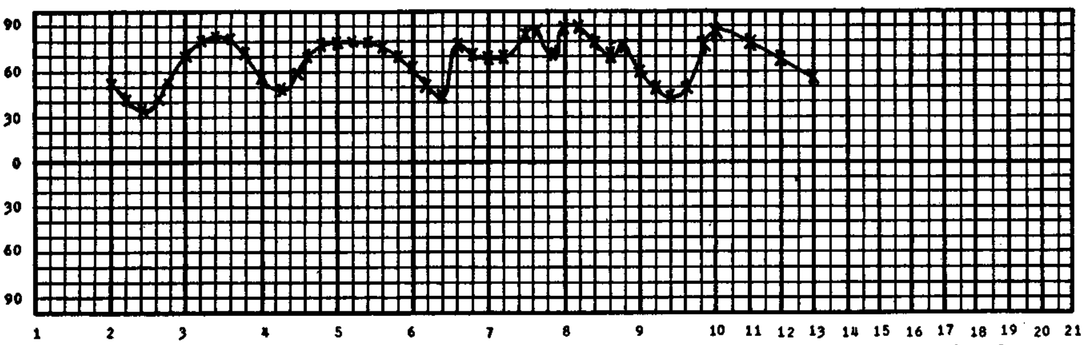
(2) EXCEPT FOR ORIGINAL CALIBRATIONS ALWAYS DRAW FINAL PLOT OF PREVIOUS ACTIVITY AND INDICATE BY (Δ). THEN MAKE SENSE RUN WITHOUT ADJUSTING SENSE BALANCE AND INDICATE BY (□).



(B) EVALUATION: Balance was very poor. New York balance six months ago. Suspected accumulation of salt and soot on insulators. Cleaned loop and rebalanced as shown below using 5430 Kc as mast resonance.

X PLOT OF SENSE ANGLE VS. FREQUENCY FOR 94 ° BALANCER SETTING AT 5430 kc.

O PLOT OF SENSE ANGLE VS. FREQUENCY FOR ____ ° BALANCER SETTING AT ____ kc.



(C) CONCLUSIONS: Experience has taught this ship that best balance can be obtained when loop is clean and in good repair. It is felt that curve above bears this statement out.

V. COMPARISON WITH PREVIOUS CALIBRATION (S):

(A) SHIP OR EQUIPMENT MODIFICATIONS SINCE PREVIOUS CALIBRATION: None.

(B) WEATHER CONDITIONS: Dry and Clear.

(C) EVALUATION OF COMPARISON: High Deviations (Quadrantral in nature) have been reduced. Presume this caused by work in Junction Box.

ANALYSIS: Total Number of Degrees Calibrated 7,950, Number of Degrees Uncertain 280, Degrees Reverse Sense 375, Degrees Bilateral Bearing 174, Number of Curves with Unplottable Portions 2.

FIGURE 6.—Back page of typical check-off sheet.

If the medium frequency direction finder is properly installed and corrected, the calibration curve should be characterized by:

(1) *Small deviation errors.*—The curve should be quadrantal in shape, positive in the first and third quadrants and negative in the second and fourth. The two positive quadrants should be of nearly the same magnitude, also the two negative quadrants. A smooth curve should be drawn through the plotted points.

(2) *Sense correct* on all bearings at all frequencies. This should be noted on the curve along with sense reading instructions (i. e., rotate loop, or manual goniometer, clockwise; if a signal increases, read direct; if signal decreases, read reciprocal).

(3) *Balancer curve.*—Some equipments have quadrature voltage-balancing devices for improving the quality of nulls. If the equipment has such a device, the settings should be plotted for each direction-finder bearing and a smooth curve drawn through the points. This curve should be semicircular in shape, maximum at about 90° and 270°, and should increase in magnitude with frequency.

Note that in this frequency range, the direction finder may be used as a navigational instrument and every effort should be made to make all phases of the calibration as neat and accurate as possible.

(3) The high-frequency range from 1.5 mc. to 30 mc. is one of the most difficult technical problems in the whole field of Navy direction finders. The results obtainable even after elaborate precautions have been taken are, for instance, very much inferior to those which are obtained in ships on medium frequency and under some circumstances in the very high-frequency ranges.

In general, accurate and reliable high-frequency direction finding on shipboard is only possible when the direction-finding antenna can be placed in such a position that the reradiated fields caused by resonate structures in the vicinity are small compared with the main incident field.

In the range 1.5–30 mc., a number of parts of the ship's structure and rigging will successively assume the quarter wave resonant condition as the wave length is progressively decreased. First, the foremast, if approximately 100 feet above the water line, will resonate at a frequency of about 2.5 mc. The various radio antennas may have resonances at about the same frequency. The bridge superstructure may resonate at about double this frequency, and stacks standing about 30 feet above the deck will be in resonance at about 7 mc. There are also numerous other small parts of the ship which are of a height to cause them to resonate at other frequencies below 30 mc. Some of the structures mentioned will resonate at second, third, and even higher harmonics within the working frequency band. If the high frequency direction-finder loop is mounted on a special mast, the mast will resonate according to its height. For instance, a 35-foot mast with loop on top will resonate at about 5.4 mc.

It is seen that any position in a ship where high frequency direction finders may be installed is under the influence of complex reradiation from a large number of objects resonant to different frequencies within the working range.

It is to be noted that for a slight departure from the resonate frequency of each of the structures there will be a large change in the reradiation and therefore in the deviation and null blurring produced.

To avoid harmful effects by reradiation from the mast on which the antenna assembly is mounted, complete symmetry of the antenna about the vertical axis of the mast and its ringing is essential. The antenna assembly must be fixed exactly coaxially with the mounting mast. The mast must be exactly on the ship's center line (fore-aft) and be in a plane which is vertical through that line. This requirement permits a fore-aft rake of the mast but it should be remembered that excessive "rake" of the mast will cause errors. *The slightest asymmetry may produce considerable error, amounting to many degrees.*

Because of the complexity of the reradiated fields in this frequency range, the only correction attempted is the breaking, by insulators, of as many stays as possible into lengths less than 8 feet grounded or 16 feet ungrounded.

ENCLOSURE (A) CONFIDENTIAL SHEET NO. 2

MODEL DAK D.F. EQUIPMENT SERIAL NO. 315 U.S.S. Navtrasch

DATE 6/21/45 FREQUENCY 300 kc. DIAL SETTING 151 DIAL FREQUENCY 310 kc.

LOCATION Casco Bay PLOTTED BY Haller CHECKED BY R.H.B.

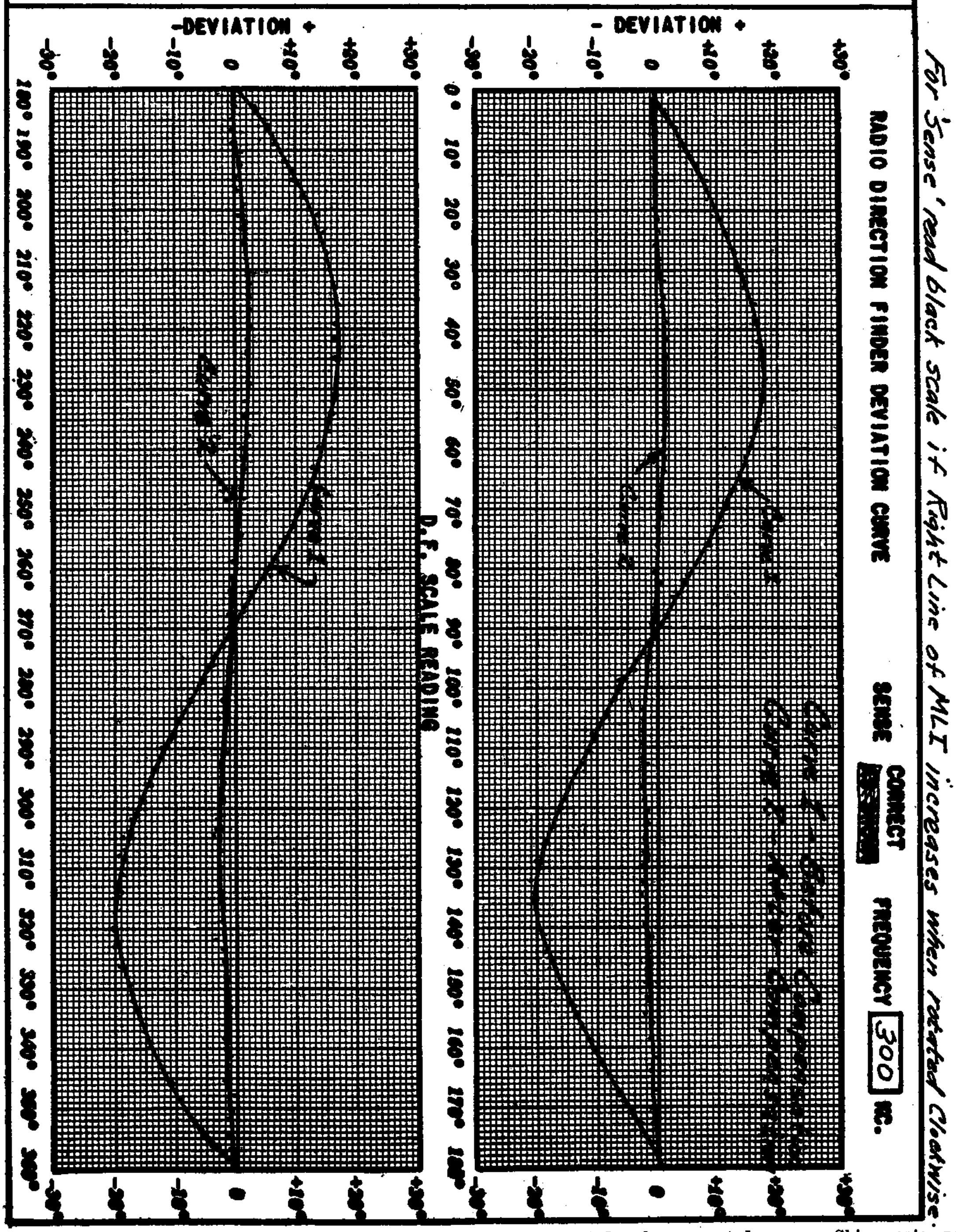


FIGURE 7.—Full scale medium frequency curve. (Showing both corrected and uncorrected curves. Ships copies need only show corrected curve.)

A direction finder covering the range of 1.5 to 30 mc., properly installed, will give calibration results characterized by the following:

(*a*) Deviations will, in general, be larger than those in the medium frequency range. Also, no general curve trend will be apparent over the entire range because of the many different reradiators resonating within the range.

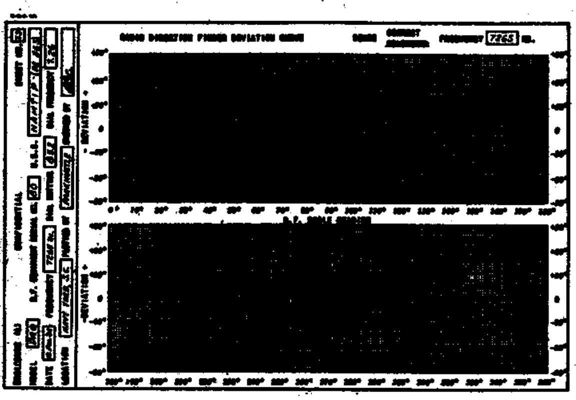


Figure 8.—High-frequency curve on 30° deviation paper. Sense correct and no re-entries

(*b*) Two conditions known as *locking* and *re-entrance* will be apparent; *locking* being a condition in which the direction-finder bearing will remain constant over a considerable change in target relative bearing; *re-entrance* is the case when the direction-finder bearing actually decreases as the target relative bearing increases.

(*c*) When a reradiated signal is out of phase with the main signal and very strong, the equipment may lose all directivity. The effect will resemble *polarization error* but will be constant if the target relative bearing remains constant.

(*d*) Sense determination may become weak or even reversed at some frequencies.

It has been stated that direction finding in the frequency range of 1.5 to 30 mc. is a difficult technical problem and that after all known precautions are taken to obtain good results, serious errors remain. Therefore, it is highly important that the calibration be carefully and accurately performed. Due to the necessity of including *all pertinent data* on the calibration curves, the Bureau of Ships has set up specific plotting requirements in this frequency range. The following is a discussion of these requirements.

1. Fill in all spaces at the top of curve sheet with required data.

2. Plot computed deviations of all direction finder bearings and draw a smooth curve through the plotted points.

3. If a re-entrant portion appears, *do not* average through it. If the curve is drawn correctly, the operator can give the corrected bearings for the highest and lowest reading of the curve and state that the bearing lies within that sector. This obviates the necessity of giving a bearing and a "plus or minus" value.

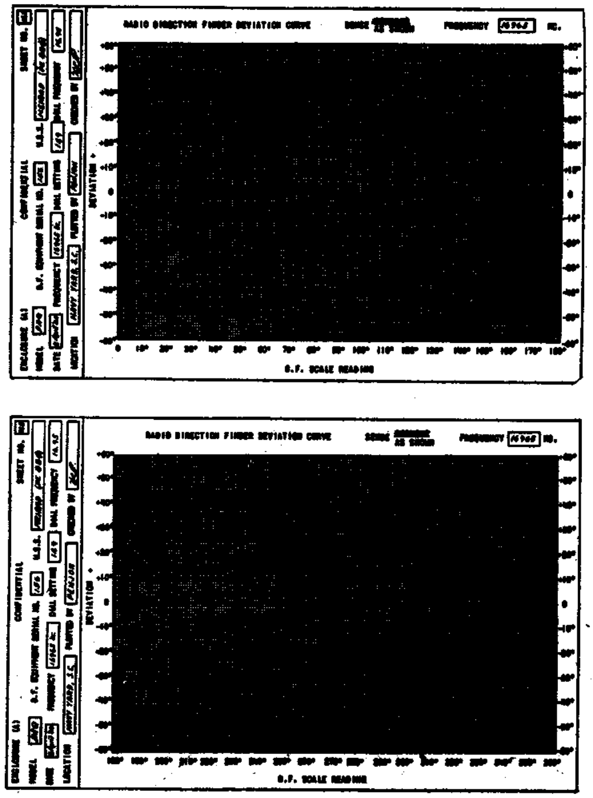


Figure 9.—High-frequency curves on 60° deviation paper. Variable sense and several reentries. Note "cross hatch" in areas of bilateral bearings.

4. If a portion of "bearings unobtainable" appears, block off the portion and label "bearings unobtainable"; *do not* attempt to connect the bearings on either side of the portion by a line.

5. If properly installed and maintained, the direction finder will give correct sense on most

frequencies. If sense is all correct on a curve, strike out the words "as shown" at the top. If sense is all reversed, uncertain, or variable, enter the sense on the curve and strike out the word "*correct*" at the top. Two conditions may exist which would make it impossible for the operator to give a unilateral bearing, this is when bearings are uncertain or correct but sense reversed. To keep the operator from making an error, these portions are crosshatched.

High frequency direction finder operators should familiarize themselves with the methods of plotting these curves in order to understand the many special cases which will appear.

(4) As the frequency is increased above 30 mc., the problems involved in determining the source of the error become, in most cases, more complex. It follows that here again reliable direction-finder bearings can only be realized when the directional antenna is mounted in such a position that reradiation and reflection is at a minimum. In the very high-frequency band, many of the objects that were acting as reradiators because of their resonating characteristics, begin to act as reflectors due to their size and electrical characteristics. As the frequency increases, reflection errors are somewhat alleviated because the wave-length distances, between the directional antenna and the reflecting objects, become greater causing a high ratio of direct signal over reflected signal. Usable results from very high frequency-direction finders (as well as high-frequency equipments) necessitates an unobstructed mounting and any installation made in a less satisfactory location will accordingly give less usable results. The degree of reduction in performance will depend on the number of obstructions present, their qualities of reradiation and reflection and their distance from the direction finder antenna.

At the higher end of the very high-frequency band and in the ultra high-frequency band direction finders depart from loop antenna systems and become dipole, grouped dipole, or horn arrays usually depending on a reflector for sharp directivity. As the frequency is increased, it becomes correspondingly easier to sharpen the directivity and reduce the pick-up from reflecting objects. Finally, the condition is approached whereby reradiated and reflected energy is not sufficiently great to cause any serious deviation troubles. There will be slight trouble experienced here due to *blind spots*, caused when an object effectively shields the reception of signals.

The calibration results in the very high and ultra high-frequency range depend so much on the mounting position that it is difficult to describe the calibration curve characteristics even generally. There will be a gradual transition with the increase in frequency above 30 mc. from deviation through which a smooth curve can be plotted to rather erratic changes in deviation. At these frequencies, it is important that each curve be clearly marked for vertical or horizontal polarization. There is no sense notation for the dipole arrays because the bearing is taken on the major pattern lobe.

10/1/46

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NEW SECTION ADDED TO C. E. M. B.

Beginning with supplement 15 this bulletin will have a section devoted to simplified schematic diagrams of various types of Navy radio equipment. It is not intended that these diagrams be complete schematics of entire equipments but they are presented with the idea that they will be an aid in understanding the equipments and will facilitate servicing.

The majority of these diagrams were prepared by the staff of the Radio Matériel School, Naval Research Laboratory just as were those referred to in the article titled "Transmitter Control Circuits" on page GEN : 67 of this bulletin. This previous article is now superseded by the new section 14 which will in the future contain all simplified schematics prepared for this bulletin. *12/1/46*

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→ ADJUSTMENT OF TRANSMITTING AND RECEIVING EQUIPMENT

The following, reprinted from a circular letter appearing in the Navy Department Bulletin, contains information pertinent to the operation of radio equipment. Personnel should acquaint themselves thoroughly with these provisions in order to obtain maximum performance of radio communication equipment.

1. The attention of the supervisory officers and radio personnel is invited to the dependence of communication efficiency upon the proper adjustment of radio transmitting and receiving apparatus.

2. From a material standpoint, a radio communication channel may be considered to be efficient when—

(*a*) The transmitting equipment radiates on the exact assigned frequency just enough power to give an adequate signal to noise ratio at the receiving stations on the circuit.

(*b*) The receiving equipment continuously provides enough amplification and selectivity to permit the desired signals to be read by the receiving operators.

3. Transmitting equipment is frequently operated with power outputs far in excess of the requirements of the circuit. By reducing the radiation to the point where the requirements of paragraph 2 (*a*) above are satisfied, the following advantages are obtained:

(*a*) A substantial reduction in the amount of interference with adjacent radio channels and thus, aboard ship, an improvement in duplex operation.

(*b*) An increase in the security of communications due to a reduction in the effective range of the transmissions.

(*c*) A substantial reduction in the number of transmitter failures, which occur with greater frequency when operating the equipment at or near its maximum rating.

(*d*) Economy in power consumption and components whose service life depends directly upon the time of operation and the power requirements.

4. There is a growing tendency among radio operators to adjust the receiving equipment to obtain such excessively loud signals that they have to remove the head telephones from their ears and wear them upon the cheek bones. They do this to relieve fatigue and protect their ears from sudden strong signals. The Naval Service generally does not appreciate the fact that such a practice prevents the full utilization of the capabilities of the receiving equipment and progressively lessens the skill of the radio operators. Similarly there has been a marked increase in the installation of one or more loud speakers in the same compartment, for the purpose of monitoring several different circuits. This practice contributes to the high room noise level and this in turn causes operators using head telephones to increase the signal level in the head telephones still further and also detracts from all the operators' ability to concentrate on the desired signal.

5. Tests with a large group of radio operators at the Naval Research Laboratory showed that a good readable signal (R–2) required only two thousandths of a volt across the head telephones when worn upon the ears but that five and a half volts were required to give the same readability when the phones were worn upon the cheek bones. The voltage for this latter condition must be, therefore, 2,750 times that required for proper operation of the receiver and is obtained by increasing the amplification by this amount. Since the available amplification may not be sufficient to give this high voltage across the telephones the operator will fail to hear a weak signal. If he does his hearing may have been so impaired or his training such that he will lack the ability to copy it.

6. The head telephones now supplied to the Naval Service are light and comfortable; fatigue due to weight and pressure has been reduced to a practical minimum. If the audio output limiter now incorporated in new Naval receivers is properly and constantly used there should be no reason for the operators to be wary of sudden loud signals.

7. A little known characteristic of the human hearing mechanism is that the ability of the operator to discriminate between signal and noise intensities or between tones is much superior at *low intensities.* This means that the minimum amplification should always be employed whenever attempting to copy weak signals through comparable noise or interference.

8. During the earlier days of radio communications, when transmitters were relatively inefficient and receivers were incapable of high amplification and selectivity, skillful operators maintained excellent long range communication because they had developed their personal ability to overcome the handicaps of weak signals and interference. Modern apparatus has ap-

SYMPTOMS AND CAUSES OF TROUBLE IN MOTORS AND GENERATORS

The following symptoms and some of their causes are given here for the assistance of personnel responsible for the maintenance of motors and generators:

Symptoms	Causes
Sparking at brushes	(1) Overload. (2) Brushes set worng. (3) Poor brush contact. (4) Commutator rough or off center. (5) Weak field. (6) Armature winding broken or short-circuited by ground or cross.
Noise	(1) Excessive vibration—unbalanced armature. (2) Rattle—loose parts. (3) Bumping—too little end play. (4) Rubbing and pounding—armature hitting pole. (5) Squeaking—dry brushes.
Hot armature coils	(1) Overload. (2) Damp windings. (3) Short-circuited coils.
Hot field coils	(1) Too large field current. (2) Moisture in windings.
Hot bearings	(1) Too little or improper oil. (2) Grit. (3) Not enough end play. (4) Bearing too tight. (5) Poor alignment. (6) Crooked shaft. (7) Hot commutator. (8) Rough shaft.
Hot commutator	(1) Near some hotter part of machine. (2) Sparking under brush. (3) Poor brush contact.
Fails to build up	(1) Field connections reversed. (2) Brushes not in proper position. (3) Wrong direction of rotation. (4) Speed too low. (5) Field circuit open. (6) Not enough residual magnetism. (7) Machine short-circuited.
Too low voltage	(1) Too much resistance in field. (2) Overload. (3) Brushes too far forward. (4) Speed too low. (5) Some reversed poles. (6) Some poles short-circuited.

preciably extended communication ranges but due to improper and careless operation these ranges have not been realized. The selectivity requirements due to decreased channel separation and duplex operation have been more than met by the provision of greater amplification and selectivity in modern receivers and an increase in the stability of the transmitting equipment.

9. The principal limit in transmitter efficiency and power output has already been reached. Future transmitter developments will include advances in stability, facility of adjustment and reliability. An actual reduction in power output and hence in range, especially on the lower frequencies, can now be expected due to mandatory decreases in antenna dimensions and the resulting increased difficulties with insulation and corona effects at high antenna voltages. The ultimate in receiver amplification has already been attained since it has reached the point where electron impacts in tubes and conductors can be amplified to high audio levels. Although efforts are being made to reduce these effects, it is now apparent that future improvements in receiving apparatus will mainly involve refinements in electrical and mechanical designs and not the provision of greater amplification.

10. It is therefore evident that future improvements in the efficiency of radio communication will depend upon the development of the skill of the operating personnel in their ability to hear and read weaker signals under more adverse conditions. The Bureau urges that supervision of radio communication be extended along the following lines:

(*a*) Reduction of transmitter power to the minimum consistent with reliability.

(*b*) Reduction of receiver amplification to levels usable with the head telephones worn upon the ears.

(*c*) Continuous mandatory use of the audio output limited where provided.

(*d*) Elimination of all loud speaker installations, used for radio communications, located in radio communication compartments. *4/1/47*

KEYING RELAYS

Several failure reports have been received concerning sticking of keying relays of the type used in models TCE, TDE, TBL, etc. It is believed that this is due to the use of oil or other lubricants on the relays. Keying relays operate best when *perfectly dry*, and in the event that oil has been used, it should be removed by thorough washing in carbon tetrachloride.

Keying relays should be checked once a week for freedom of action, burned or pitted contacts, etc., as required by Chapter 67, Bureau of Ships Manual, and adjusted in accordance with the instruction book for the equipment. Needless to say, the weekly inspection should also include dusting!

Symptoms	Causes
Too high voltage	(1) Too strong field.
	(2) Brushes too far backward.
	(3) Speed too fast.
Motor fails to start	(1) Wrong connections.
	(2) Open circuits in connecting wires.
	(3) Field weak.
	(4) Overload.
	(5) Friction excessive.
Too high speed	(1) Too much field rheostat resistance.
	(2) Brushes too far forward.
	(3) Connections wrong.
	(4) Open field circuit.
Too low speed	(1) Overload.
	(2) Too little field resistance.
	(3) Brushes set wrong.
	(4) Excessive friction.
	(5) Short or ground in armature.

PREVENTIVE MAINTENANCE OF POWER CORDS

The cordage used to connect component parts of Navy equipment constitutes one of our most important maintenance problems. The following types of faults are frequently found:

(1) Frayed conductors, causing intermittent or unreliable operation.

(2) Broken conductors, causing shutdown of the equipment.

(3) Chafed insulation, causing short circuits between conductors or from conductors to ground.

(4) Short circuits between the contact prongs of plugs because of moisture.

(5) Cables and plugs broken by rough handling.

(6) Insulation damaged by oil, gasoline, acid, and other harmful materials.

Many failures of cordage are caused by normal wear received during the rough usage to which all military equipment is inevitably exposed. Since cordage failure may occur at a time when dependable communications are vitally necessary to the success of a tactical operation, *it is of utmost importance to insure against such failure by frequent periodic inspections.* Operators should be on the watch continually for defects which may develop into failures, and should have equipment repaired or replaced at the first sign of trouble. The following inspection points are important:

(1) Cuts, cracks and bruises in the outer covering of the cordage.

(2) Bent contact prongs on plugs.

(3) Loose contacts in sockets.

(4) Worn gaskets or washers in sockets of power cords which might permit entrance of water.

(5) Stripped threads on screw-type connections.

(6) Burned spots on contacts, which are evidence of short circuits or poor connections.

Most of the plug connections on Navy equipment fit tightly. Great care must be taken when uncoupling such connections. A large number of these plugs are of molded rubber, and a considerable surface of rubber is in contact to make a watertight seal. Such tight-fitting plugs must be disconnected by working back and forth while applying a steady pull. A quick jerk hard enough to separate the plugs will usually result in breaking the cord.

A good example of a frequent source of trouble is the cordage in Signal Corps radio sets SCR–409, SCR–510, SCR–609, and SCR–610, used to connect the power supply to the set. Some failures of this cable are definitely the result of using it as a carrying handle—for which it was never intended! The continual flopping back and forth, while traveling in a vehicle or aboard small Naval vessels, eventually results in fraying insulation and conductors. This cordage should be held securely to prevent its swinging about.

Some plugs are equipped with rubber washers through which the cordage must be threaded before attachment to the plug insert. Repairmen making up these cords have been known either to ream out the washer or to whittle down the cord insulation to make an easier fit, thus making an easy path for water to enter and weakening the cord. When passing the cord through the washer in this type plug, soap suds should be rubbed on the rubber cord jacket. The cord will then slip through the washer easily. Vaseline, grease, oil, or other petroleum products should never be applied for this purpose, since they will deteriorate the rubber.

—*War Dept. TB–Sig–25*

CNO POLICY ON ALTERATIONS

The Chief of Naval Operations has established the following policy relative to alterations on ships:

1. No alterations of any kind will be undertaken which affect the military characteristics of the ship until they have been approved by the Chief of Naval Operations.

2. Alterations not affecting military characteristics will not be undertaken until approved by the cognizant Bureau.

3. Responsibility for determining whether or not military characteristics may be involved will be with the Bureau concerned.

This policy pertains to ships of the Active and Reserve Fleets, as no alterations of any description on vessels in the inactive fleet will be considered. *4/1/46*

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CORRECTIONS TO THE "LORAN HANDBOOK FOR SHIPBOARD OPERATORS"

The following corrections should be made in the "Loran Handbook for Shipboard Operators":

Page 8: Interchange the second line from the bottom of the first column and the ninth line from the bottom of the second column.

Page 12: In the second line of the first column of the table, change "LRN" to "LRN–1".

Page 26: In the 5th line of the second column, change "–E" to "–F".

Page 27: At the top of the page change "770" to "310".

Page 28: At the top of the page change "310" to "770".

Page 29: In the 12th line from the bottom of the first column, change "of" to "as".

Page 43: At the top center of the insert only change "B′" to "B" and "C′" to "C".

Page 49: Delete the 12th line of the first column and substitute "and manipulation of NDRC Model LRN–1".

Page I–12: In the eleventh line from the top of the second column, change "500" to "50".

In a second printing of this book, these errors were corrected.

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PRECAUTIONS FOR HANDLING CATHODE RAY TUBES

If you value your eyesight you should protect yourself when handling cathode ray tubes. An envelope fracture may cause explosive results due to the high vacuum within the tube. To avert such an occurrence and to divert flying glass particles if this should occur the following measures should be taken.

(*a*) Wear goggles when handling evacuated cathode ray tubes of 5″ or larger diameter. The goggles prescribed are the Wilson Mono-Goggle No. 1, having a clear lens and ventilated frame. There are a number of other brands available, but when making a selection, it is suggested that you make certain that the lens withstands a fairly rigid impact test, offers the wearer clear vision and provides front and side protection from flying particles.

(*b*) Remove tube from packing box with caution. Take special care not to strike or scratch the envelope during the process of removal or insertion into equipment socket. Use only moderate pressure when inserting the tube in the socket, taking care not to jiggle the tube back and forth as this may cause a fracture at the juncture of the base and envelope. *8/1/46*

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→ ELECTRONIC EQUIPMENT LUBRICANTS

The Navy is specifying the use of Army-Navy Aeronautical Specification lubricants in the maintenance of various electronic equipments. Some of these already specified, together with their Aviation Supply Office stock numbers, are shown in the following table.

Specification	Item No.	Stock No.	Container size
AN-G-3	71	R14-G-981	8-oz. tube.
	73	R14-G-982-15	1-lb. can.
	75	R14-G-982-30	5-lb. can.
	77	R14-G-983-250	25-lb. can.
	79	R14-G-983-255	35-lb. drum.
	81	R14-G-983-275	100-lb. drum.
AN-G-10	29	R14-G-983-400	½-lb. tube.
	31	R14-G-983-420	10-lb. can.
AN-G-25	--------	R14-G-982-20	1-lb. can.
AN-O-6a	121	R14-O-2405	1-qt. can.

Usually these lubricants are found only aboard carriers and other ships carrying aircraft, but they may be obtained by other activities through requisitions to the nearest Naval Aviation Supply Depot or Annex. For a list of aviation lubricants and their ASO stock numbers refer to the Aviation Supply Office Catalog, Section 1401 Class 14; Lubricants and Preservatives. This catalog may be obtained from:

Aviation Supply Officer,
U. S. Naval Aviation Supply Office,
Navy Aviation Supply Depot,
Oxford Avenue and Martins Hill Road,
Philadelphia, Pa. (11 June 47.) *8/1/47*

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KEY-CONTROL TESTER PANEL

The test panel described herein, submitted to the Bureau as a beneficial suggestion, provides a means of rapidly checking Navy transmitter six-wire key-control circuits.

Its use by field personnel will reduce considerably the time required to check and maintain in operating order the type 23146 key-control panels, radiophone units, transmitter transfer panel receptacles and associated patch cords.

This device, known as the Key-Control Tester Panel, will facilitate the checking of the above circuits for grounds, shorts, continuity, and crosses in the following manner. Refer to schematic diagram below.

The terminals one to six on the schematic diagram of the tester terminate in a receptacle on the tester which is a duplicate of the receptacle on any transmitter transfer panel. A patch cord is plugged from the tester to the position under test on the panel. The lamps in the tester correspond to wires numbered one (1) to six (6); the key is used to test the pilot lamp in the remote key position under test; the transformer T1 is used to isolate the tester from ships 110-volt 60-cycle power supply. The 50-watt 300-ohm resistor is inserted so that when key in tester is pressed, lamp No. 1 and the lamp in the key-control panel (shown in

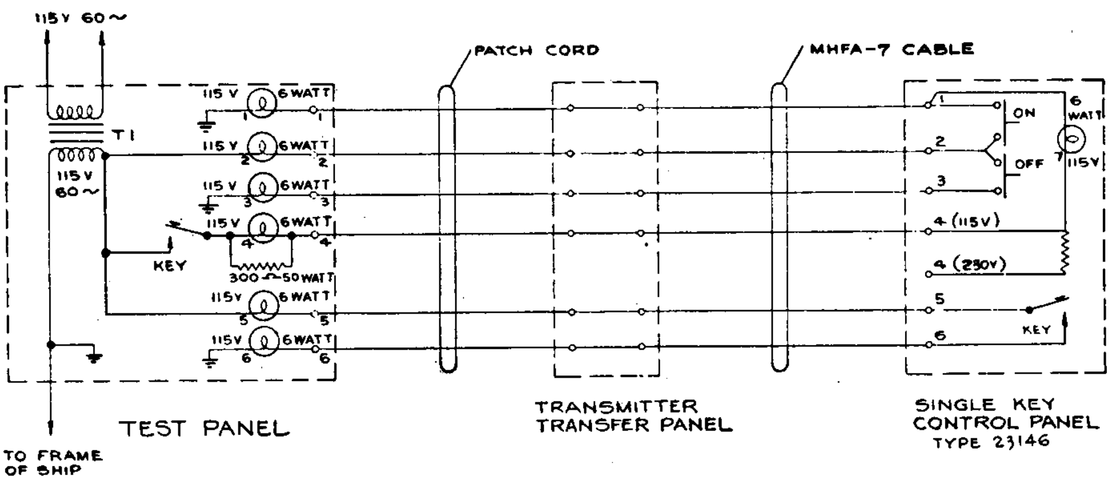

FIGURE 1.—Circuit diagram of key-control tester panel.

schematic diagram as lamp No. 7) will light and lamp No. 4 will not.

PROCEDURE TO USE TESTER

A 110-volt, 60-cycle, source and a ground wire are connected. A patch cord is plugged into the tester (this puts the patch cord under test), and the ON button at the remote keying position is pressed. The lamps on the tester, No. 1 and No. 2, will light. If lamp No. 1 does not light, check for ground on wire going to No. 1 on remote key position. With the ON button released, lamps No. 1 and No. 2 should go out. If lamp No. 2 lights with the ON button released, check for ground on wire No. 2. When the OFF button is pressed, lamps No. 2 and No. 3 should light. If lamp No. 3 does not light, check for ground on wire No. 3. When the hand key on the tester is pressed, lamp No. 1 and the lamp in remote key unit will light. If lamp in the key position is burned out, No. 1 lamp will not light. If lamp No. 4 lights, check for ground on No. 4 wire. When the hand key in the remote unit is pressed, lamps No. 5 and No. 6 will light. If lamp No. 6 does not light, check for ground on No. 6 wire. If lamp No. 5 lights when the key is not pressed, check for ground on No. 5 wire.

If wires No. 1 and No. 2 are shorted, lamps No. 1 and No. 2 will light with the ON button released. Lamps No. 2 and No. 3 will light if a short exists between No. 2 and No. 3 wire with the OFF button released. If wires No. 3 and No. 4 are shorted, lamp No. 3 will light when the tester key is pressed. If wires No. 5 and No. 6 are shorted, lamps No. 5 and No. 6 will light if the key in the remote unit is not pressed.

If wires are open in any circuit, proper lamps will not light. If wires are crossed, improper lamps will light.

It is suggested that activities required to perform such work proceed with the fabrication of these testers, using available material. *8/1/47*

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→ ADDENDUM TO LIST OF FINAL INSTRUCTION BOOKS

Instruction books are available on the following equipments, in addition to the major listing on pages GEN : 76 and GEN : 77, which should be referred to:

Equipment	*Short title*
CN-471138 Matching Transformer	NavShips 900,972
CQC-23496 Remote-Control	----------
LAJ-1	NavShips 900,956
OBQ-3	NavShips 900,945
OJ-3	----------
PF	900,922
PP-286/UR	----------
REK	NavShips 900,961
X-DBH	NavShips 900,974

10/1/47

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REPRINTED ARTICLES FROM NAVAL COMMUNICATIONS BULLETIN

The three following articles are reprinted from the Naval Communications Bulletin No. 11. It is felt that this information is of such importance in the maintenance and operation of communication equipment as to warrant republishing.

THE SUNSPOTS ARE HIGH

Yes, the average sunspot numbers are high and are getting higher. Since early in 1944 the average sunspot numbers have been increasing and they will continue to increase for a year or so yet to come. To us as practical communicators this increase has had great significance. As the numbers have increased so have the frequencies we use in high-frequency communications. For instance, to communicate with Adak, Alaska, from a position 1,000 miles south of there at 0600Z in February 1945, we would have used a frequency near 8 Mc. In February 1947 from the same position at 0600Z we would use 12 Mc. In other words, for long-distance communications during the period of sunspot maximum, we can use a frequency about twice as high as during sunspot minimum, provided the path is the same and the time of day and time of year are the same.

When a part of a transmission path lies in sunlight the radio waves passing through that part are partially absorbed by the atmosphere. This absorption is greater for lower frequencies than it is for higher frequencies. Also, it is greater during a high average sunspot period than during a low one. Therefore, lower frequencies which were adequate for good communications during periods of low sunspot numbers will not be so during periods of high sunspot numbers. Use of higher frequencies becomes imperative during the high sunspot period.

One may argue that "good old 4 Mc. or good old 8 Mc." will always get through if one uses enough power. That statement certainly is true, but this same person would not use a bulldozer to travel over a concrete highway when driving a new super-deluxe would be such a pleasure. Besides, the bulldozer would block the road. So let us raise our frequencies. Get up on 12 Mc., 16 Mc., or higher, and leave the 4 Mc. and 8 Mc. to those who really need them.

The Navy publishes special quarterly issues of NRPM containing only recommended radio frequency bands and a frequency guide for operating personnel. Every Navy radioman should be familiar with their use. From it he may readily select from the available frequencies that which is most suited to his needs.

For the long-haul transmissions over great distances DNC–13–1 series should be used. This series is more suitable for fixed point-to-point communications.

AIRCRAFT HOMING

Judging from action reports which reached the CNC during the war, Communication Officers on more than one occasion have been called upon to improve the operation of aircraft homing equipment.

On the shake-down cruise of the U. S. S. *Bennington* (CV-20), an officer on duty in the office of the CNC (Op–20–E) was requested to arbitrate to break a deadlock between the Air Department and the Communication Department. The former said that 90 aircraft couldn't be wrong, and the latter maintained that its Model YE equipment was operating satisfactorily. In any event, few aircraft could hear the homing signals up to as much as 15 miles from the flight deck.

Several means of checking the transmitter were used, which resulted in the conviction that all the radiated power was adequate. It then was assumed that the frequencies were correct, and that the aircraft should be checked. Three ZBX receivers were removed from aircraft on the flight deck, and an attempt was made to verify their operation using the standard test oscillator. This also disclosed no difficulty, so the test oscillator was checked. Several methods of doing this proved to be unreliable, even one using a suitable harmonic of an available crystal from an aircraft transmitter. Following this, a cable was run between Radio VII and the aircraft radio test shop; the leakage into and out of this cable was used to check the receivers, with the assumption that the transmitted signal was satisfactory as checked. It was found that receivers lined up on this cable (with the inner conductor not connected to the receivers) proved to be tuned some 3 Mc. away from the frequency indicated by one of the test oscillators, and that the test oscillators were neither consistent nor reliable compared with the transmitter.

During the night, the homing receivers in the first nine planes on the flight deck were retuned. Of the ten planes launched on the first flight, only the unchecked plane reported trouble; the others were still getting homing signals at 150 miles, even at an altitude of 4,000 feet. Within three days, all planes were checked, and there was almost no trouble thereafter.

It was found that the test oscillators had been checked against a shore Model YG equipment—which is not stable enough for that purpose. The cable, therefore, was permanently installed and used to check the receivers, with suitably satisfactory results during the remaining Pacific Operations.

SPURIOUS EMISSIONS

For security reasons, there are serious objections to the emission of spurious frequencies from electronic equipment, particularly l-f or h-f radiation from a u-h-f set which is presumed to be "safe" beyond the horizon.

Further objections to spurious emissions in transmitters and responses in receivers, arise from the congestion encountered in Navy ships and shore radio stations. These undesired phenomena interrupt otherwise good communication, reduce the usable channels, and complicate communication planning beyond all reason.

Some of the forms of this phenomenon were discussed in a paper which appeared in the BuShips ELECTRON for December 1946. The TDZ and RDZ, as indicated therein, are inherently a type which should be expected to encounter this difficulty, although its effects may be restricted in design. The CNC (Op–20–E) has distributed to Fleet and Type commanders a memorandum containing a report of an NRL study of these equipments from the standpoint of undesired interference. It will be noted that careful assignment of channels will avoid "Unusable" frequencies by allocating interfering frequencies to functions which are not required within a few feet or a few hundred yards. In this way, it is hoped that a plan can be proposed which will make all channels useful, and still permit a satisfactory degree of flexibility within groups of frequencies. *10/1/47*

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→USE OF STANDARD FREQUENCY BROADCASTS FOR CHECKING FREQUENCY METERS

The Bureau of Ships Manual, Chapter 67, requires that all activities check their frequency meters for accuracy against Bureau of Standards standard frequency transmission (WWV) and that a record of each check be made in the material log.

The National Bureau of Standards provides day and night broadcast of standard frequencies and related services from Radio Station WWV at Beltsville, Md., near Washington, D. C.

The following is based on information in the National Bureau of Standards publication, "Technical Radio Broadcast Services, Radio Station WWV", dated January 30, 1948, and is published to assist personnel in securing the maximum benefit from these transmissions. The radio frequencies and other data are given in Figures 1 through 4.

The technical radio services broadcast continuously by the National Bureau of Standards, Central Radio Propagation Laboratory, include transmissions at a total of eight radio frequencies: *2.5, 5, 10, 15, 20, 25, 30, and 35 Mc.* Each of the eight radio carrier frequencies are broadcast at all times, day and night. This insures reliable coverage of the United States and extensive coverage of other parts of the world.

The services are: (1) standard radio frequencies, (2) time announcements, (3) standard time intervals, (4) standard audio frequencies, (5) standard musical pitch, 440 cycles per second, corresponding to A above middle C, (6) radio propagation disturbance warning notices. All of the frequencies are useful for field in-

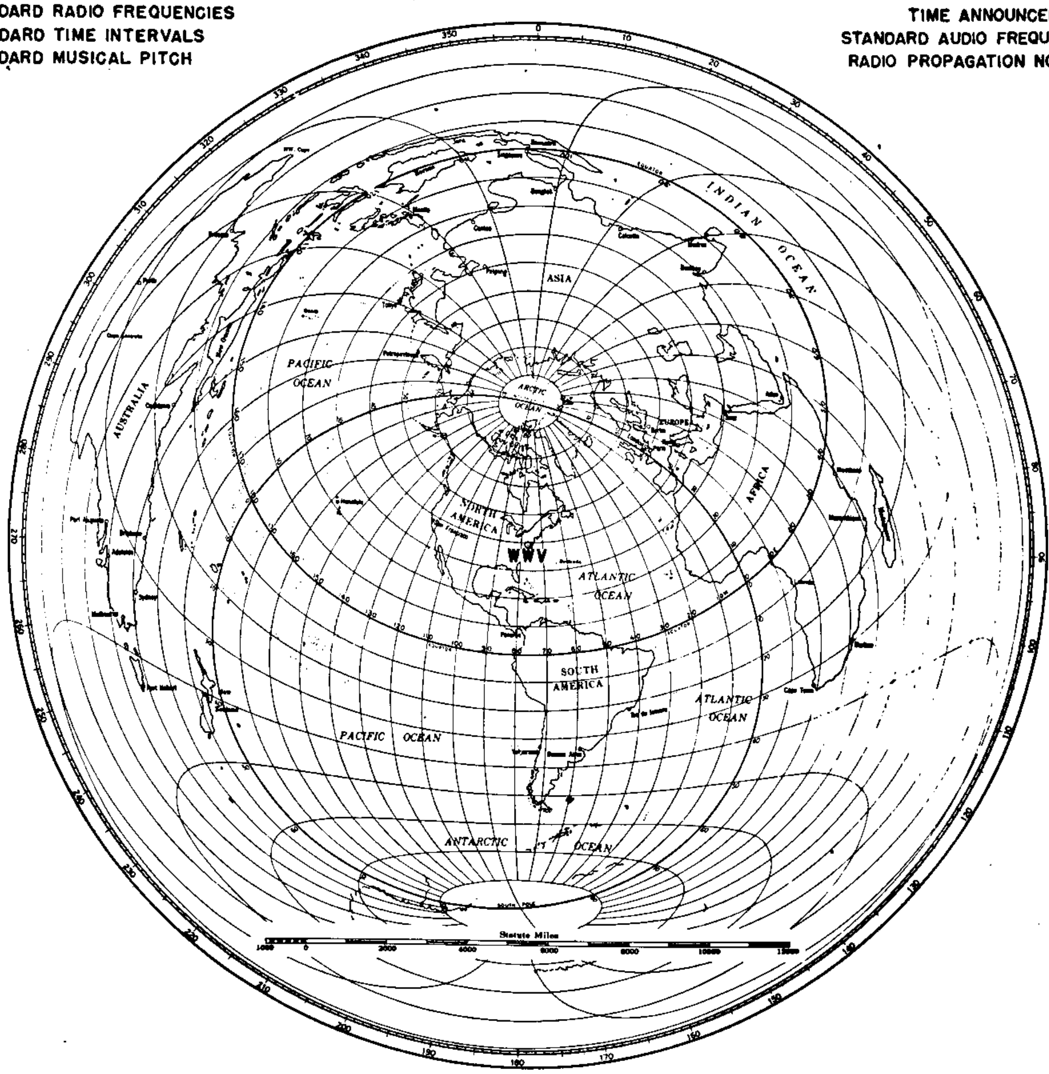
JANUARY 30, 1948

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
CENTRAL RADIO PROPAGATION LABORATORY
WASHINGTON, D. C.

TECHNICAL RADIO BROADCAST SERVICES

STANDARD RADIO FREQUENCIES
STANDARD TIME INTERVALS
STANDARD MUSICAL PITCH

TIME ANNOUNCEMENTS
STANDARD AUDIO FREQUENCIES
RADIO PROPAGATION NOTICES



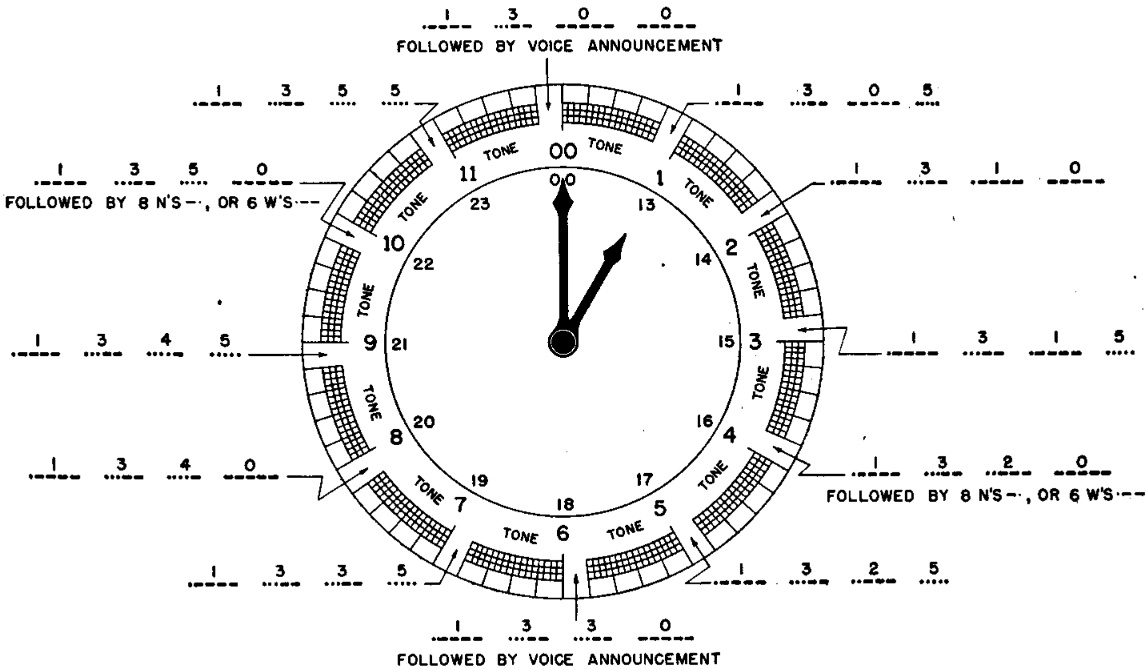
MEGACYCLES	BROADCAST	POWER, KW	MODULATION, C/S
2.5	CONTINUOUSLY, NIGHT AND DAY	0.7	1 AND 440
5	" " " "	8.0	1 AND 440
10	" " " "	9.0	1, 440 AND 4000
15	" " " "	9.0	1, 440 AND 4000
20	" " " "	8.5 *	1, 440 AND 4000
25	" " " "	0.1	1, 440 AND 4000
30	" " " "	0.1	1 AND 440
35		0.1	1

* 0.1 KW, FOR FIRST 4 WORK DAYS AFTER 1ST SUNDAY OF EACH MONTH

FIGURE 1.—Location and broadcast schedule of U. S. Bureau of Standards station WWV.

STATION WWV TIME ANNOUNCEMENTS

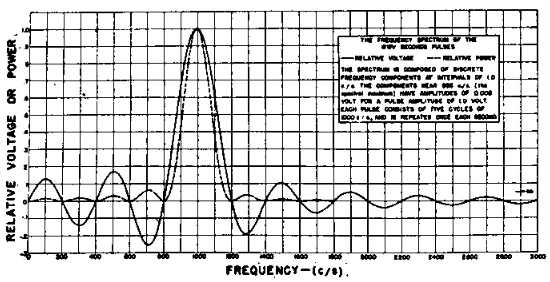
THE HOUR ILLUSTRATED IS 1 TO 2 PM, OR 1300 TO 1400 IN 24 HOUR TIME
EASTERN STANDARD TIME

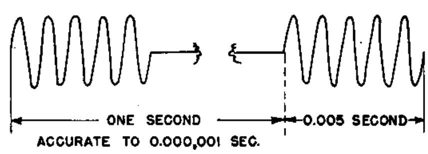


NUMERALS IN INTERNATIONAL MORSE CODE

0	-----	2	..---	4	....-	6	-....	8	---..
1	.----	3	...--	5	.....	7	--...	9	----.

SECONDS PULSE (NO PULSE IS TRANSMITTED AT THE BEGINNING OF THE 59th SECOND OF EACH MINUTE)





WWV TIME SIGNALS, DEVIATIONS FROM U.S. NAVAL OBSERVATORY TIME
JANUARY TO OCTOBER 1947

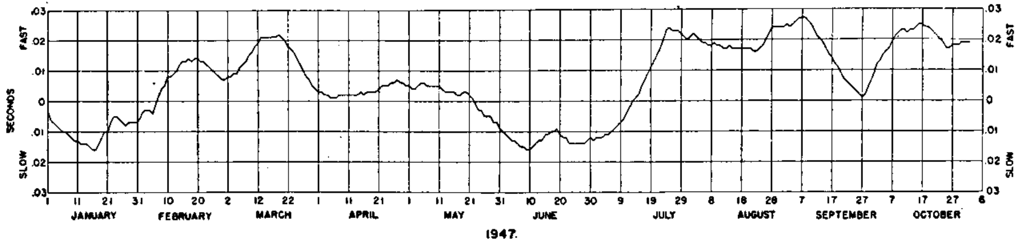


FIGURE 2.—Time announcements and further details.

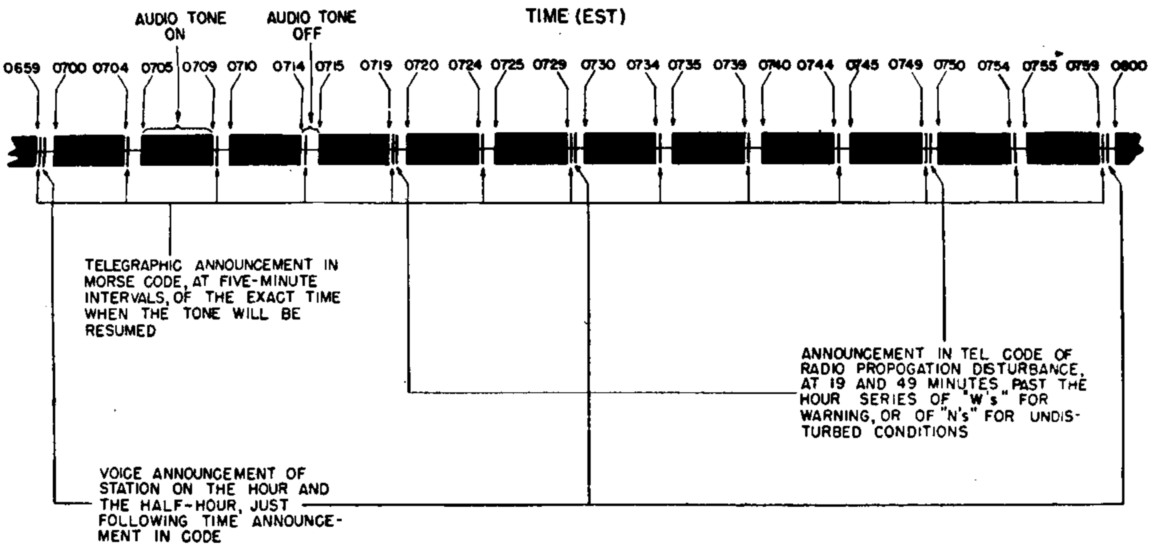


FIGURE 3.—Diagrammatic representation of the sequence of WWV announcements and tone modulations for a typical one-hour period—as it would be actually heard by a radio operator. The scale does not permit showing the one-second "tocks," which are portrayed in figure 4.

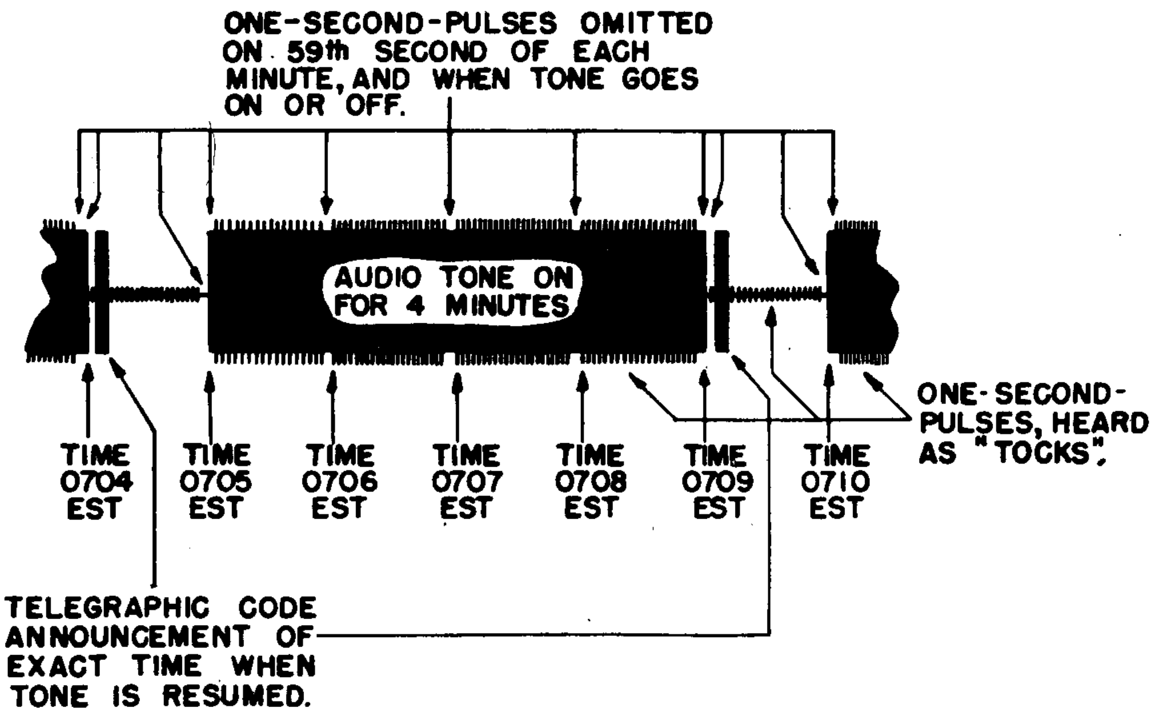


FIGURE 4.—Representation of a small portion of the diagram in figure 3, of a typical 5-minute interval on a scale which shows the 1-second "tocks."

783528°—48——3

tensity recording by persons interested in studies of radio propagation. The three highest frequencies are broadcast particularly for this purpose. Vertical nondirectional antennas are used.

Standard Radio Frequency.—The national standard of frequency is of value in radio electronic, acoustic, and other measurements requiring a source with an accurately maintained frequency. Any desired radio frequency, including microwave frequencies, may be accurately measured by utilization of the standard frequencies. This is accomplished with the aid of one or more auxiliary oscillators, harmonic generators, and radio receivers. The accuracy of each of the radio carrier frequencies, as transmitted, is better than a maximum error of one part in 50,000,000; however, if accuracies of this order are required from the received signals, it is necessary to make measurements over a long interval or to apply corrections for errors introduced by transmission effects in the medium (Doppler effect, etc.).

Time Announcements.—The audio frequencies are interrupted every 5 minutes for a period of 1 minute. Thus, at precisely 1 minute before the hour the tone goes off for 1 minute, is resumed on the hour and continues for 4 minutes, then goes off for 1 minute until 5 minutes past, and so on. The tone is interrupted every 5 minutes, and resumed every 5 minutes: "on" for 4 minutes, "off" for 1, on for 4, "off" for 1, etc. Figures 3 and 4 diagram this sequence very carefully. In the past the hour was marked by silencing the audio note, but at present it is marked by turning it on, it is to be noted.

The beginnings of the periods, when the audio frequencies are interrupted, are in agreement with the basic time service of the U. S. Naval Observatory, so that they accurately mark the hour and the successive 5-minute periods. The 1-minute interval without modulation is provided in order to give time and station announcements and to afford an interval for the checking of radio-frequency measurements free from the presence of the audio frequencies.

Eastern Standard Time is announced in telegraphic code each 5 minutes. See Figures 3 and 4. This provides a quick reference for correcting a timepiece which may be a few minutes in error. The zero- to 24-hour system is used, starting with 0000 at midnight. The first two figures give the hour and the last two figures give the number of minutes past the hour. For example, at 4:55 PM, or 1655 EST, four figures (1, 6, 5, and 5) are broadcast in code. The code used (International Morse) is shown in figure 2. The time announcement refers to the start of an announcement interval, i. e., when the audio frequencies are interrupted. It occurs immediately after the beginning of each 5-minute interval. At the hour and half-hour it is followed by the station announcement in voice.

Standard Time Intervals.—There is on each carrier frequency a pulse of 0.005-second duration which occurs at intervals of precisely 1 second. The pulse consists of five cycles, each of 0.001-second duration, and is heard as a faint tick when listening to the broadcast; it provides a useful standard time interval for purposes of physical measurements and for quick and accurate measurement or calibration of timing devices or very low audio-frequency oscillators. It may be used as an accurate time signal. On the fifty-ninth second of every minute the pulse is omitted. The 1-, 4-, and 5-minute intervals, synchronized with the second pulses, are marked by the beginning or ending of the periods when the audio frequencies are off.

A time interval of 1 second marked by the pulse is accurate, as transmitted, to 1 microsecond (=0.000,001 second. A 1-minute or longer interval is accurate to a part in 50,000,000.

Standard Audio Frequencies.—Two standard audio frequencies, 440 cycles per second and 4,000 cycles per second, are broadcast on radio carrier frequencies as given in figure 1.

The two standard audio frequencies are useful for accurate measurement or calibration of instruments operating in the audio or supersonic regions of the frequency spectrum. They may also be used for accurate measurement of short time intervals.

The accuracy of the audio frequencies, as transmitted, is better than a part in 50,000,000.

Transmission effects in the medium (Doppler effect, etc.) may result at times in slight fluctuations in the audio frequencies as received; the average frequency received however, is of the same order of accuracy as that transmitted.

Standard Musical Pitch.—The 440 cycles per second is the standard musical pitch, A above middle C. It is broadcast for 4 minutes and interrupted for 1 minute. This sequence is repeated continuously on each of the radio carrier frequencies. This service is useful to musicians and those concerned with the manufacture or maintenance of musical instruments. For the past 22 years the standard frequency in the music industry of the United States has been 440 cycles per second.

→*Radio-Propagation-Disturbance Notices.*—An announcement of radio propagation conditions is broadcast in code on each of the standard radio carrier frequencies at 19 and 49 minutes past the hour. If a warning is in effect, the letter "W" (in International Morse code) is repeated six times following the time announcement; if unstable conditions are expected, the letter "U" is repeated six times; if there is no warning, the letter "N" is repeated eight times.

A warning (W) means that radio propagation disturbance of the ionosphere-storm type in the North Atlantic region is anticipated within 12 hours, or is in progress, with its most severe effects on radio transmission paths for which the control points of transmission lie in or near the northern auroral zone. This type of radio propagation disturbance is characterized by low intensities, accompanied by flutter or rapid fading on the normal frequencies used at the different times of the day, or by complete blackouts of signals. By shifting to lower than normal frequencies for that time of day it may be possible to obtain communication, although with lower than normal intensity. Owing to increased auroral-zone absorption during the disturbance, however, usable transmission may be impossible on any high frequency. Also, during a period of radio propagation disturbance, direction-finder observations may be unreliable. Sudden ionosphere disturbances (SID) characterized by simultaneous fade-outs in the entire high-frequency spectrum, on paths in the daylight side of the world, are not covered by this warning.

When conditions are unstable (U), many circuits will experience difficulties, while others which have high power, directive antennas and a wide range of assigned frequencies will be much less affected. This type of warning differentiates between, say, mobile and point-to-point communications systems during periods of moderate disturbance, especially just before and after periods of major disturbance.

If no warning (N) is in effect, satisfactory transmission should be possible on the normal frequencies for the different times of day.

The usual daily time for changing the announced warning is 2119 GMT (4:19 p. m., e. s. t.). The notice is, however, changed at any hour when disturbance becomes noticeable or anticipated. After a warning (W), the announcement is returned to "U" and later to "N" as conditions return to normal. Thus any time a radio operator questions reception of North Atlantic paths, it would be advisable to check with the WWV announcement to see whether conditions are considered disturbed by the Bureau's Warning Service.

Some one of the frequencies of WWV should be receivable at every location in the United States. Only during very severe storms would reception of WWV within the continental United States be difficult. For some Canadian or other users for whom the transmission path from WWV enters into or near the northern auroral zone, it may be impossible to receive any of the WWV frequencies at usable intensities during even moderate storms. It is probable, if no WWV frequency can be heard at hours when normally audible, that a warning is in effect.

The radio disturbance warning does not apply to sudden ionosphere disturbances, which are unpredictable in detail. These occur only at times when at least part of the transmission path is in sunlight. This type of disturbance is characterized by the received intensity's dropping to zero, very rapidly, usually within a minute or so, and remaining out from a few minutes to 2 hours. The effect is greater on the lower high frequencies, and on paths close to the equator or whose control points are close to the noon meridian. Usually the only long distance radio communication possible during a sudden ionosphere disturbance is on frequencies below about 100 kc. About 70 percent of sudden ionosphere disturbances are of less than an hour's duration. The use of the highest frequency available, as long as it is below the maximum usable frequency for the path in question, may shorten the effective duration of the fade-out. During the present years of great solar activity (until about 1951) these sudden ionosphere disturbances will occur more frequently than a few years ago. They are directly associated with eruptions on the sun, more of which are observed during the years around sunspot maximum. *1/1/50* ←

In making use of the broadcast, one should select the carrier frequency that gives the best reception at a particular time in a given locality. This can be done by tuning to the different frequencies and selecting the most suitable, or by making a study of conditions that affect the propagation of radio-frequency waves. The latter is a rather involved procedure because of the large number of variables. Also, a separate calculation must be made for each transmission path—this calculation is applicable only for a particular time of day, season, and year—and certain phenomena, as yet unpredictable, are involved. Fortunately, these variations are not rapid, and it is possible to give an approximate guide for choosing the carrier frequency for best reception. The following data are for radio receivers located in the Northern Hemisphere between latitudes of aproximately 20° to 50° N., and local times of noon and midnight at Washington. Reception conditions at other times of day may be estimated by assuming a gradual change from one condition to the other. The ground wave from the transmitter may be received on each of the frequencies out to distances of about 50 miles. Beyond this distance, a skipped area is usually found, and beyond this, the area in which good reception is normally possible. There are times of poor reception because of ionospheric storms or transient effects which disturb the upper-air regions through which high-frequency radio waves travel.

TABLE 1.—*Approximate Distance Ranges, Summer*

Local time	*Frequency (kc/s)*	*Tone reception (miles)*	*Carrier frequency reception (miles)*
Midnight	2, 500	0 to 1, 100	0 to 1, 900
Midnight	5, 000	300 to 2, 500	300 to 3, 000
Midnight	10, 000	1, 200 to 10, 000	1, 200 to 12, 000
Midnight	15, 000	2, 000 to 10, 000	1, 800 to 12, 000
Noon	5, 000	0 to 350	0 to 600
Noon	10, 000	450 to 1, 300	400 to 2, 200
Noon	15, 000	800 to 3, 500	700 to 6, 500

TABLE 2.—*Approximate Distance Ranges, Winter*

Local time	*Frequency (kc/s)*	*Tone reception (miles)*	*Carrier frequency reception (miles)*
Midnight	2, 500	0 to 2, 000	0 to 5, 000
Midnight	5, 000	400 to 8, 000	300 to 8, 500
Midnight	10, 000	900 to 9, 500	800 to 11, 000
Noon	5, 000	0 to 900	0 to 1, 400
Noon	10, 000	0 to 2, 600	0 to 3, 700
Noon	15, 000	200 to 4, 300	150 to 8, 000

Inherent error in a frequency standard may be quickly detected by feeding the crystal output of the meter into the antenna of any Navy standard receiver (with the i-f band-width set on "sharp" where such a setting is available), tuned to WWV with the beat-frequency oscillator "off". The audio beat between the crystal output-signal and the WWV signal can be heard when WWV is transmitting unmodulated signals.

While the crystal in the model LM series is not adjustable, it is replaceable; if this equipment is supplied with a satisfactory crystal and is maintained at proper operating temperature, errors occurring in its use may generally be attributed to failure of the operator to use sufficient care in setting the corrector knob, or to an inherent constant error between check points in the tunable oscillator.

In the model LR series the crystal should be adjusted to zero-beat with WWV during the unmodulated portion of the transmission. This is accomplished by turning the dial (which is slotted to receive a screw driver (at the rear of the top shelf, as described in the instruction book. If such adjustment is properly made, any further inaccuracy in the meter may generally be attributed to operator error; or to the obviously rough or uneven operation of the "counter" interpolator circuit.

The model LR series frequency standards should be kept in the "stand-by" condition at all times when they are not actually being used by the operator to check frequencies, in order to insure that the crystal is maintained at correct operating temperature. *4/1/48*

LEAKAGE CURRENT IN ELECTROLYTIC CAPACITORS

In the maintenance of electronic equipment, the testing of electrolytic capacitors plays an important role. Shorted and open capacitors are obvious failures, but determining at what point to reject a condenser not obviously in either of these two categories is quite another matter. In the process of effecting repair, a defective electrolytic capacitor may be replaced with one having a high direct-current leakage, which will either fail in a very short time or result in poor over-all operation.

The direct-current leakage of an electrolytic capacitor, when measured with a C&R analyzer such as Navy Type 60007 or equivalent, should not exceed the current value (in milliamperes) calculated from the information listed in the following table:

Rated working-voltage	*Allowable leakage per microfarad*
15–100 volts	0.1 milliampere
101–299	0.2
300 or greater	0.5

Example.—A 16-mfd capacitor rated at 450 volts (working) is to be tested. From the above table, the allowable leakage per mfd for capacitors rated at 300 volts or greater is 0.5 ma per mfd. The total *allowable* leakage is therefore 8 ma (16 x 0.5).

The method described holds true whether the capacitor is a dry or wet electrolytic. If the direct-current leakage as measured on the Type 60007 analyzer exceeds the calculated allowable leakage, the capacitor should be discarded. Capacitors in spares should be tested periodically to insure low leakage. This is especially true of wet electrolytics which deteriorate more rapidly due to the chemical action which occurs.

Note that when electrolytic capacitors which have been idle for some time are checked, they should first be formed as described in the instruction book for the Type 60007 analyzer. It must be remembered that high voltage is employed in measuring current leakage. It is therefore extremely important that the instructions for operating the analyzing equipment be followed implicitly to prevent damage to the meter or injury to operating personnel.

The Bureau is in the process of preparing a copy of the table listed herein for attaching to the cabinet of the Type 60007 C&R analyzer. They will be distributed in the near future to all vessels and activities possessing this analyzer. *7/1/48.*

NAVSHIPS 383—LOST, STRAYED, OR STOLEN

In order to justify replenishment of spares or modification of an electronic or associated equipment to increase its efficiency, the Failure Report Form NavShips 383 must be filled out and sent to the Bureau of Ships for tabulation and study. It is necessary that these failure reports be submitted for all components of an electronic or associated equipment which were repaired or replaced for any reason. In the past the mechanical portions of these equipments have been neglected in the reporting of failures.

Recent instances of equipment failures on the mechanical systems of Models JT, WFA, WCA, QHB, QGB, B/T winches and B/T instruments have come to the attention of the Bureau of Ships. No reports covering these failures were received. Some transducer and radar and radio antenna failures also have never been reported. The S&A form used for survey of a lost or defective piece of equipment, does not eliminate the necessity for submitting a failure report form NavShips 383.

The beacon failures for Models NAD–6, NAD–10, NAC, and NAC–1 are not being reported. It is certain that many of these have been lost or have had component failures of some kind and equally certain that some repairs were made either by ships or repair activities.

It is requested that vessels, repair activities, tenders, and service forces report all component failures or losses due to component failures of the equipments under their cognizance, with equal attention to the mechanical components.

The person actually making the repair fills out the failure report and should furnish the ship or activity with the information necessary to complete their records. However, the authority (usually the commanding officer) responsible for an equipment is also responsible for making arrangements for its repair and seeing that the proper entries are made in the machinery history cards for electronics.

If classified material is included in the failure report, it must be handled accordingly. *10/1/48.*

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ELECTRONICS AND OTHER TECHNICAL BOOKS

Commercial textbooks on the subjects of radio, electronics, mathematics, and electricity, such as those noted in the accompanying list, are furnished to ship and station libraries by the Bureau of Naval Personnel.

Not all the titles listed are provided for each ship or station library, but a representative selection is included in each at the time of commissioning. New titles and new editions of books in these technical fields are distributed from time to time in the monthly issues of new books. Requests for replacements for worn or lost material and for any special titles or additional books desired for libraries should be directed to the Bureau of Naval Personnel. These will be provided insofar as funds permit.

Although funds for the procurement of new technical books and books for recreational reading during the current fiscal year are limited to approximately 55 cents per capita, this amount is being supplemented by redistribution of used copies. It is suggested that the Bureau of Naval Personnel be informed if ships' libraries are deficient in material on electronics, radio, and technical subjects. Titles on hand in each library should be listed in order that supplementary books may be sent, and any particular titles desired should be enumerated.

Although it is not possible to maintain and issue a stock of all books in this field, it is desirable that a representative selection of outstanding publications on these subjects be available to Naval personnel through ship or station libraries. No allowance list has been published, since the list is continually under revision. New titles are being added from time to time and older ones dropped as they become out-dated. The allowance for different types of ships and stations depends upon the number of personnel served by the library and the particular mission of the activity.

LIST OF BOOKS

MATHEMATICS—applied to electrical engineering and radio

Cooke	Mathematics Essential to Electricity
Cooke	Mathematics for Electricians and Radiomen
Kuehn	Mathematics for Electricians.
Smith	Applied Mathematics
Sokolnikoff	Higher Mathematics for Engineers

ELECTRICITY—selected

Abott	National Elec. Code Handbook
Audel	New Electrical Library, 12 volumes
Croft	American Electricians Handbook
Gulliksen	Industrial Electronics
Hund	High-Frequency Measurements
M. I. T	Applied Electronics
Pender	Electrical Engineers Handbook, 2 volumes
Pender	Standard Handbook for Electrical Engineers
Timbie	Basic Electricity

AVIATION—selected

McIntosh	Radio Navigation for Pilots
Morgan	Aircraft Radio and Electrical Equipment

RADIO

Abbot	Handbook of Broadcasting, 2d Ed., 1941
Albert	Electrical Communication
Albert	Electrical Fundamentals of Communication
Albert	Fundamentals of Telephony
Almstead	Radio Fundamentals
Almstead	Radio Material Guide
ARRL	Antenna Book
ARRL	Radio Amateur's Handbook
A. T. & T	Principles of Electricity Applied to Telephone
Brainerd	Ultra-High Frequency Techniques
Burns	Radio
Cameron	Servicing Sound Equipment
Camm	Radio Engineer's Pocket Book
Caverly	Primer of Electronics
Duncan	Radio Telegraphy and Telephony
Dunlap	Electrical and Radio Dictionary
Dunlap	Radar: What It Is and How It Works
Eastman	Fundamentals of Vacuum Tubes
Eddy	Aeronautic Radio
Eddy	Television
Everitt	Fundamentals of Radio
Fink	Principles of Television Engineering
Fink	Radar Engineering
Floherty	Behind the Microphone
Ghirardi	Modern Radio Servicing
Ghirardi	Radio Physics Course
Ghirardi	Radio Troubleshooter's Handbook
Hall	Radar Aids to Navigation
Harper	Rhombic Antenna Design
Hartshorn	Radio-Frequency Measurements
Harvard University Cruft Laboratory.	Electronic Circuits and Tubes
Henney	Principles of Radio, 4th ed.
Henney	Radio Engineering Handbook
Hicks	Principles and Practices of Radio Servicing
Hoag	Basic Radio
Hund	Frequency Modulation
Jordan	Fundamentals of Radio
Kiver	Television Simplified
Kiver	Ultra-High-Frequency Radio Simplified
Marcus & Horton	Elements of Radio
Manly	Drakes Electrical and Radio Dictionary
M. I. T	Loran: Long-Range Navigation
M. I. T. Radar School.	Principles of Radar (2d ed.)

RADIO—Continued

Millman	Electronics
Mills	Electronics
Morecroft	Elements of Radio Communication
Morecroft	Principles of Radio Communication
Morgan	Aircraft Radio
Moyer	Radio Construction and Repairing
Nilson	Practical Radio Communication
Nilson	Radio Code Manual
Nilson	Radio Operating Questions and Answers
RCA	Air-Cooled Transmitting Tubes
RCA	Receiving Tube Manual
RCA	Radio Fundamentals
RCA	Radio Handbook (11th ed., 3 vols.)
RCA	Reference Data for Radio Engineers
Reich	Principles of Electron Tubes
Reich	Theory and Application of Electronic Tubes
Rider	Cathode Ray Tube at Work
Rider	Frequency Modulation
Rider	Servicing Superheterodynes
Roberts	Aviation Radio
Roberts	Radar Beacons
Robinson	Radio Telegraphy and Telephony
Sandretto	Principles of Aeronautical Radio Engineering
Sarbacher	Hyper- and Ultra-High-Frequency Engineering
Slurzberg	Electrical Essentials of Radio
Smith	Radio Handbook
Sterling	Radio Manual
Terman	Fundamentals of Radio
Terman	Radio Engineering (1940 ed.)
Terman	Radio Engineer's Handbook
Tyler	Telecasting and Color
Watson	Understanding Radio
Whinnery	Fields and Waves in Modern Radio

4/1/49

TEST EQUIPMENT ALLOWANCE

The Bureau of Ships is combining Electrical and Electronic Test Equipment into one allowance group. This allowance is the S69 portion. The change-over is gradual, taking place as revisions are made in the allowance of each ship type, either in the S–67 portion or the S–69 portion.

The S69 allowance is divided into two parts. The S69–1 allowance consists of the electronic test equipment (with minor exceptions) now shown in S67 allowance. The S69–2 consists of the present S69 allowance except that all electronic type instruments (oscilloscopes, multimeters, etc.) appear in S69–1.

The S69–1 allowance is forwarded to all holders of NavShips 900,115—Electronic Equipment Type Allowance Book (formerly RE11A100 Radio Type Allowance Booklet) together with the S67 portion.

All S69 allowances are promulgated as Electrical and Electronic Test Equipment Allowance pages of the Ship Electronic Equipment Type Allowance book—NavShips 900,115. (See Fig. 1.) It should be noted that the only firm allowance is that in the column, "Total Allowance Per Ship." The numbers shown in the columns marked "Recommended Custody," are the Bureau's recommendation. Details of custody are subject to the Commanding Officer's direction.

RESTRICTED
SHIP ELECTRONIC EQUIPMENT
TYPE ALLOWANCE.
NAVSHIPS 900,115

GROUP NO. S69-1
TYPE PAGE 1

AP

GROUP NAME: ELECTRICAL AND ELECTRONIC TEST EQUIPMENT
Transports

TOTAL ALLOWANCE PER SHIP	RECOMMENDED CUSTODY				NAME AND DESCRIPTION OF ITEM	EX. ACCT.	CLASS OR STOCK NUMBER
	ET	PL	IC	FC			
1	1				Type 49992 Adapter Kit		
1	1				Type 60007 Capacity and Resistance Bridge		
1	1				Type 60089 Vacuum Tube Megohmmeter		
1	1				Model LR Series Combined Hetrodyne Frequency Meter and Crystal Controlled Calibrator Equipment (Install in Radio Central)		
1			1		Model LAJ Series Audio Oscillator Equipment		
1	1				Model OAA Series Radar Test Equipment (Echo Box) (For SC Series, SRa only)		
1	1				Model OAW Series Transmitting Tube Tester (SC and SK Series only)		
1	1				Model OBU Series Echo Box Test Set (For Mk 26, SG, 1, 16)		
	**				Model OCW Series Insulation Resistance Tester		
1	1				Model AN/UPM-4 Series Radar Test Set (Installed)		
1	1			*	Model AN/URM-25 R. F. Signal Generator Set		
1	1				Model AN/USM-3 Series Test-Tool Set		
1	1				Model ME-11/U Series R. F. Wattmeter		
1	1				Model ME-25/U Series Multimeter (Electronic)		
2	1		1		Model OS-8/U Series Oscilloscope		
1	1				Model TS-34/AP Series Oscilloscope		
1	*1				Model TS-47/APR Series Test Oscillator (For AN/SSQ-11 only)		
1	1				Model TS-89/AP Series Voltage Divider		
1	1				Model TS-107/TPM Series Wave and Power Meter (For AN/SPS-12 only)		
					**See S69-2 Allowance		
					*(For ships designated and receiving AN/SSQ-11 only)		

NOTES: For allowed substitutions and general information see "INTRODUCTION TO GROUP S67". Test Equipment Must be interchanged between groups where necessary.
LEGEND: ET - Electronic Technician; PL - Power and Lighting Electrician
IC - Interior Communication Electrician; FC - Fire Controlman

Revision No. 190 - July 1951 RESTRICTED

FIGURE 1.—Sample copy of S69–1 page to NavShips 900,115.

Electronics Officers will be responsible for test equipment (as in the past) in the S69–1 part of the allowance only. Failure reports will be made on form NavShips 383 (Failure Report, Electronic Equipment), however, and inventories as provided for in NavShips 900,-135, Ship Electronic Equipment Inventory System.

Ships will be guided by the date of the latest allowance in determining which allowance (S67 or S69–1) applies to the electronic test equipment allowance. All ships are provided with multilithed copies of S69 pages (for the particular class of ship) just as they are given the S67 portion.

Under this procedure, electronics technicians have a "recommended custody" allowance of certain electrical test equipment under the S69–2 portion of the allowance where considered necessary by the Bureau. These instruments are under the cognizance of the electrical section of the Bureau of Ships. *10/1/51*

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DISTRIBUTION OF NAVSHIPS 4110 INCREASED

Previously the distribution of the Ship Electronics Installation Record, NavShips 4110, was limited to eight copies because this was the maximum number that could be produced by the tabulating machines in one printing without seriously impairing legibility.

A new duplicating process by which additional copies are made available has been put into use by the Bureau. The following is the new distribution of NavShips 4110 for Active Fleet ships.

→Recent requests necessitate changes be made in the distribution of Navships 4110 for both the Active and Reserve Fleet ships. The new distribution is as follows:

Copies	Activity
	ACTIVE FLEET
3	Ship (one for Operational Commander)
8	Type Commander (3 for overhaul yard to be forwarded with ship's work list)
1	Home Yard
1	Each Service Force Commander
2	Atlantic Fleet Ships Only: 1—CinCLantFlt; 1—Com Second Task Fleet; Pacific Fleet Ships Only: 1—Com First Task Fleet; 1—Held for future disposition
3	Bureau of Ships (one copy for ComOpDevFor ships)
18	Total

RESERVE FLEET

2	Ship (forwarded to Group Commander)
2	Group Commander (one for overhaul yard)
1	Each Service Force Commander
1	Type Commander
1	Home Yard
2	Bureau of Ships
9	Total

1/1/50

NEW NAVY TYPE NUMBER BOOK DISTRIBUTED

A completely revised and expanded Navy type number book entitled the "Catalogue of Navy Type Electronic Material," NavShips 900,109(A), has been distributed to present holders of NavShips 900,109 and the Electronic Materials Cross Reference (EMCR). This catalogue consists of eight volumes, of which Volumes I through VII are "restricted" and Volume VIII is "confidential".

Volume I of the catalogue is a cross-reference listing of all known equivalent numbers (such as the JAN, ESO stock number, Standard Navy stock number, ASO stock number, Signal Corps stock number, manufacturers and contractors numbers) to the Navy type or Army-Navy designation. It also contains an additional JAN to Standard Navy stock number cross index.

Volumes II through VIII are arranged in sequence by Navy type or Army-Navy designation and include a JANAP 109 description for each item, the applicable specifications, drawings, JAN, stock and commercial reference number, as well as the equipments in which each item is used.

Requests for additional copies should be addressed to the Chief of the Bureau of Ships, attention Code 963.

7/1/49

PLASTIC ADHESIVE TAPE FOR ELECTRONICS USE

The Electronics Supply Office has purchased 1,152 rolls of plastic adhesive tape (Minnesota Mining #22) for general use in electronics work. The tape has been shipped to Naval Supply Center, Oakland, and Naval Supply Depot, Bayonne, and may be requisitioned under stock Number N16–T–488.

The tape is one inch wide and 0.010 inches thick. Its dielectric strength is quoted as 9,000 volts. The insulation is vinyl and is relatively resistant to water, acids, alkalies and other elements. It should be particularly useful in making r-f cable splices and covering r-f cable and connector joints to make them watertight. In general, it should be used wherever a waterproof covering with high dielectric break-down is desired.

After this tape has been used awhile, many engineers will have determined its limitations and found other uses for it. Information concerning its application and general desirability should be forwarded to the Bureau of Ships, Attention: Code 980B.

7/1/49

HIGH-VOLTAGE MEASUREMENTS

The policy of the Electronics Divisions of the Bureau of Ships is to disapprove the measurement of voltages in excess of 5,000 volts by means of flexible leads or probes. The policy of providing test points in equipments at which the potentials do not exceed 1,000 volts (by means of voltage dividers or other techniques, such as the use of safety type panel meters, and multipliers) is continued in effect. In extending the permissible voltage readings (as indicated above) it is realized that future equipments may have voltages exceeding this maximum figure. However, there is no intention at present to increase this figure as voltages increase.

For the protection of personnel, suitable precautions should be taken prior to the measurement of any high voltages within the permissible limit by means of flexible leads or probes—one of the most important being to make certain that no contact is made to these leads or probes by personnel, during such time as high voltages are present.

7/1/49

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→ MONTHLY PERFORMANCE AND OPERATIONAL REPORT

In conformance with the Bureau of Ships request, vessels are submitting Monthly Performance and Operational Reports on certain electronic equipment. In order to facilitate the preparation of these reports, the Bureau is providing a new form, NavShips 3878 (11–50), which supersedes NavShips 3642 (11–49). A sample of the new form is included at the end of this article. The new form, NavShips 3837 (11–50) should be requested as soon as possible, and upon receipt, the present supply of old forms should be destroyed. Quantities of the new form may be obtained from District Publication and Printing Offices.

It is essential that the Bureau receive these reports in order to keep informed on equipment performance and operation. These reports provide the Bureau with first hand information under actual operating conditions and are, therefore, of extreme value to the electronics program. Some of the details for the report may be obtained from Ships Electronic History Cards and Installation Records, which should be accurately maintained. The remainder of the form should be filled with data obtained during actual operation and performance of the equipment.

Submit only the original copy of the report to the Bureau of Ships. Coast Guard Vessels submitting reports should send one extra copy to Commandant, Coast Guard. Additional copies of the report are to be made as directed by type or fleet commanders.

Information concerning the newest electronic equipment is desired for comparison with other types and as a check on their troubles and usefulness, etc. It is not desired that reports be made on all equipment. The list below covers radio, countermeasures and infrared equipment, on which reports should be submitted. This list will be changed from time to time as data on equipment is required.

TS–587/U Noise-Field Intensity Meter.
AN/URT–2.
AN/URT–3.
AN/URT–4.
AN/USM–3 Test Tool Set (only for suggested new applications and general remarks).

It is not required that a report be submitted for the equipment listed above, if the equipment has not been in operation or if there is no operational or material data to be reported. In the future, it is not required to submit reports on TDZ, RDZ, MAR, and RDR equipment.

Note that this form is to be used to report on all electronic equipment. A single form will accommodate six (6) equipments of the same model or type.

An explanation of the items marked on the sample copy is as follows:

1—*Ship's Name, Type and Hull Number*—It is important that the ship's name, type and hull number be completely given.

2—*Fleet*—Enter either the word Atlantic or Pacific. (Fleet to which the vessel is assigned.)

3—*Classification*—Indicate the proper classification of the report.

4—*Date*—Enter date that the form was filled out.

5—*Period of Report*—Enter the period of time covered by this report.

6—*Equipment Category*—Check the equipment category reported on. Only one category should be reported per sheet.

7—*Model or Type of Equipment*—Indicate the model or type of equipment being reported. Only one model or type of equipment should be reported per sheet.

8—*Serial Number*—Report the main serial number of the equipment. Do not include serial numbers of the component parts.

9—*Hours of Operation During Period of Report*—Indicate the number of hours the equipment was in operation during the period of this report (item 5) and not the total hours in operation since installation.

10—*Hours Not in Operating Condition During Period of Report*—Indicate only the number of hours the equipment was not in operating condition *due to component and tube failures* or other troubles which prevented normal operation.

11—*Over-all Performance*—Indicate in percentage whether the performance of the equipment was good, average, or poor, using the key listed on the form. Base the rating on such items as reliability, stability, ease of tuning, sensitivity, operation, etc.

12—*Applicable Field Changes Not Accomplished to Date*—Indicate only the field changes which have not been accomplished to date of this report. This data should be taken directly from Electronic Equipment History Cards, NavShips 536, and Field Change Record Cards, NavShips 537. Complete lists of the field changes necessary to keep the equipment at optimum performance are given in sections of maintenance bulletins devoted to the particular equipment concerned.

NOTE: The data reported in the following items should be consistent with the purpose for which the equipment was designed.

13—*Maximum Reliable Range (Radio, Countermeasures, and Infra-Red)*—State the known maximum range at which reliable contact was maintained during the period of the report.

14—*General Remarks*—Indicate any comments, not covered in the above, such as those indicated under General Remarks on the form. Give detailed information as to any unusual trouble encountered in operation and exceptional maintenance required. Suggestions and comments relative to improvements in design features, test or service equipment usefulness, changes and new applications, adequacy of spare parts, tubes, instruction books, etc., should be submitted. The Bureau also desires any information that may not be described herein, but that would be of value to the electronic program. This is not to be construed as authority to modify the equipment in any way.

This report is not to be confused with the failure report form. All activities should continue to report all failures of electronic equipment on the NavShips 383 Failure Report Form, whether or not a special operational report is submitted. Field changes should be listed on the Field Change Record Card, Nav-

ELECTRONICS PERFORMANCE AND OPERATIONAL REPORT

Submit original ONLY to Bureau

FROM: (1) USS EVER SAIL(DD-999) (Ship's Name, Type and Hull No.) (2) Atlantic (Fleet) — Classification (Confidential, etc.) (3) — Date (4) 2 April 1951

TO: Chief, Bureau of Ships — Period of Report (5) From 1 Mar 1951 To 1 April 1951

Check Equipment Category Reported On (6): [X] Radio [ ] Radar [ ] Sonar [ ] Other — Model or Type of Equipment (7) RBX Receiver

Serial Number (8)	642	638	426	168		
Hours of Operation During Period of Report (9)	300	250	275	30		
Hours NOT in Operating Condition During Period of Report (10)	0	8	6	0		
Overall Performance (Poor 0 - 40%, Average 40 - 70%, Good 70 - 100%) (11)	90 %	60 %	85 %	90 %	%	
Applicable Field Changes NOT Accomplished to Date (12)	None	4	None	None		
Maximum Reliable Range (Radio, countermeasures and infra-red) (13)	18 Miles	12 Miles	16 Miles	19 Miles		
Maximum Reliable Radar Range *	MI E	MI E	MI E	MI E	MI E	MI E
Minimum Reliable Radar Range *	YDS E	YDS E	YDS E	YDS E	YDS E	YDS E
Altitude at Maximum Reliable Radar Range						
Average Echo Box Ring Time						
Average Voltage Standing Wave Ratio in Radar Transmission Line						
Maximum Echo Sonar Range	YDS	YDS	YDS	YDS	YDS	YDS
Maximum Listening Sonar Range	YDS	YDS	YDS	YDS	YDS	YDS
Maximum Sounding Sonar Range	FMS	FMS	FMS	FMS	FMS	FMS

GENERAL REMARKS (Report Ambient and Equipment Temperature in DEGREES if undue heating occurs, interference encountered, voltage fluctuation, major failures, new applications, unusual propagation and oceanographic conditions, inadequacy of test equipment aboard, explanation of unusual performance of operational difficulties, etc.) (14)

1. Overheating of transformer, T-107, led to insulation breakdown on primary side. Overheating was due to insufficient ventilation in driver compartment. Suggest improvement of ventilation by appropriate increase in size of blower fan and associated motor, B-109. This is the third failure of transformer, T-107, in the past year.

Signature (15) John Doe, LCDR, USN

*NOTE: Report Signal to Noise Ratio in E Units — Classification (Confidential, etc.) (16)

Ships 537. Field Change Report Card, NavShips 2369, should be mailed promptly upon completion of field changes.

15—*Signature*—The report should be signed by the Commanding Officer of the vessel.

16—*Classification*—Same as item (3). *7/1/51* ←

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SONAR SECTION ADDED TO CEMB

Since the distribution of the Sonar Bulletin is limited to those Naval vessels and installations having sonar ranging equipment, vessels having only sonar echo-sounding equipment installed do not receive the Sonar Bulletin and the pertinent sounding information it contains.

In order to furnish all Naval vessels and activities with relevant echo-sounding equipment information, the echo-sounding section of the Sonar Bulletin is also being published as Section 15 of this Bulletin. *7/1/49*

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TEST OF COPPER OXIDE RECTIFIER STACKS

Copper oxide rectifier units used under normal operating conditions will give long trouble free service, and periodic checking of the rectifier d.-c. output voltage is sufficient to determine the condition of the rectifier.

Under severe service conditions of high temperature, high humidity and salt atmosphere, it is recommended that periodic tests be made of the forward and reverse current characteristics of individual rectifier stacks. These tests can be made by connecting individual stacks as illustrated in figures 1 and 2. The recommended applied voltages and currents to be expected can be read from figure 3. Before making these tests the rectifier should be deenergized for several hours and allowed to reach room temperature, (70° to 80° F.). High temperature will have the effect of increasing both the forward and reverse current. Low temperatures will reduce these currents.

Resistance measurements obtained with an ohmmeter, wheatstone bridge or megger are of little or no value, unless the stock is short circuited or open circuited. *1/1/50*

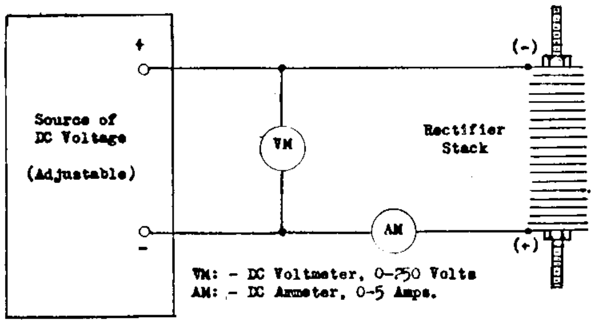

FIGURE 1.—Connections for measuring forward current in copper-oxide rectifier.

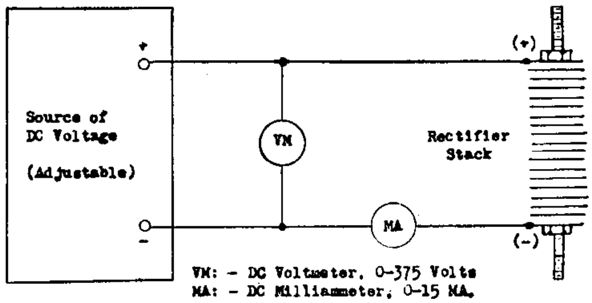

FIGURE 2.—Connections for measuring reverse current in copper-oxide rectifier.

Transmitter Model	Rectifier Type	Rectifier Stack Symbol	Rectifier Stack Mfr. Designation	Forward Fig. 1 Test Voltage	Forward Fig. 1 Amperes (Minimum	Reverse Fig. 2 Test Voltage	Reverse Fig. 2 Milliamperes (Maximum)
TAB-6/7 TBU-4	CAY- 20167	CR-701/718 CR-719/722 CR-723 (*)	S#1292367 S#1292368 S#1292369	232 160 80	0.5 0.5 1.0	348 240 120	7.0 7.0 14.0
TBL-10/11	CAY- 20195	CR-701/706 CR-707/710 CR-711 (*)	S#1303807 S#1292368 S#1292369	200 160 80	0.5 0.5 1.0	300 240 120	7.0 7.0 14.0
TBM-10 TBK-16	CAY 20228	CR-901/915 CR-916/919 CR-920 (*)	S#1303807 S#1312218 S#1315048	200 240 88	0.5 0.5 1.0	300 360 132	7.0 7.0 14.0

FIGURE 3.—Chart showing test voltages to be used when measuring the forward and reverse current of copper-oxide rectifiers.

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DANGER—RADIOACTIVE ELECTRON TUBES

Three classes of electron tubes contain radioactive material:

a. Spark gap tubes—Among the types in this category are the 1B22, 1B29, 1B31, 1B41, 1B42, 1B45, and 1B49.

b. Glow lamps or cold cathode tubes—Among the types in this category are the 313C, 313CA, 313CB, 313CC, 313CD, 333A, 346B, 353A, 359A, 372A, 376B, 395A, 405A, 413A, 423A, and 727A.

c. TR tubes—Among the types in this category are the 1B23, 1B24, 1B26, 1B27, 1B28, 1B40, 1B50, 1B55, 1B58, 1B60, 1B62, 1B63A, 702A, 702B, 709A, 721A, 721B, 724A, and 724B.

Monitoring of some of the tube types listed above has revealed the following information:

a. The amount of radiation emitted by tube type 1B41 and 1B42 was found to be so slight as to be negligible for any quantity of tubes.

Although glow lamps or cold cathode tubes are potentially dangerous, they contain such a small amount of radioactive material as not to be dangerous unless deliberately inhaled or injected into the human system.

b. Types 1B22 and 1B29 showed an intensity of radiation (Beta and Gamma) of about 2.0 milliroentgens per hour when removed from their cartons and placed in contact with probe of the counter. At a distance of 1 foot from the counter, they measured 0.05 mr/hour.

c. Further checks of 1B22 and 1B29 packed in individual cartons of 100, packed in turn in corrugated cartons, indicated an intensity at a distance of 1 foot from the carton of 1.0 mr/hour. An intensity of 4.0 mr/hour was noted when the probe was placed against the carton. A stow of 28 cartons of 100 tubes per carton showed the following intensities: 7.0 mr/hour with the probe placed against the stack; 5.0 mr/hour at a distance of 1 foot; 1.7 mr/hour at 3 feet, and 0.8 mr/hour at 6 feet.

d. The AEC has set a tolerance, based on a 40-hour-week exposure, of 7.5 mr/hour; therefore none of these intensities present an occupational hazard over an 8-hour day. Even the large stow of 2800, 7.0 mr/hour next to the stack is not dangerous, even if personnel were in bodily contact with it for 8 hours. However, if 100 of either 1B22 or 1B29 were piled together, danger of injury to personnel would exist.

Normal stowage of these tubes presents no hazard if personnel will observe warnings against touching internal elements with their hands. It is recommended that all tubes reflected above be conspicuously tagged as follows: "Radioactive—Do Not Handle Broken Tubes." It is further recommended that tube type 1B22 and 1B29 be further tagged: "Do Not Remove From Cartons Until Ready for Use." This tag will preclude the possibility of any accumulation of unpackaged tubes.

Future contracts negotiated by the Electronic Supply Office for the tube types referred to in paragraph 1 above will provide that tubes be tagged: Radioactive—Do Not Handle Broken Tubes" and "Do Not Remove From Cartons Until Ready for Use."

Poisoning from radioactive materials in the subject vacuum tubes may be of three types.

1—Assimilation — Eating, drinking, or breathing radium or radium compounds or absorbing them through cuts. Radium-bearing dust, which may be present in certain tubes, is dangerous in this respect.

2—Breathing radon—Radon is a tasteless, colorless, odorless gas which is given off by radium and radium compounds at all times.

3—Radiation—Radium and radium compounds give off harmful, invisible radiations which can cause dangerous burns.

Radium bromide is used in spark gap, glow lamp, and cold cathode tubes. Radioactive cobalt is used in TR tubes. This radioactive material is generally applied to the glass wall, in the dome or in some other convenient location within the envelope.

Glow lamps or cold cathode tubes and TR tubes contain from 0.01 to 1.0 micrograms of equivalent radium per tube. Spark gap tubes contain from 1.0 to 2.0 micrograms of equivalent radium per tube.

Radium bromide causes the formation of radon gas within the tube envelope and it is dangerous to inhale this gas. Radioactive cobalt has a relatively short life and does not give off radon gas. Radium salts are cumulative poisons and like other radioactive concentrations are extremely hazardous if injected anywhere into the human system.

Useless unbroken tubes should be treated as any other radioactive waste materials. They should be sunk intact at sea. In shore installations, it is best to collect the tubes in special containers which should then be weighted, sealed and shipped out to be sunk at a convenient time. A plot of land may be set aside near the shore station to be used as a burial ground, however, the former method of sinking is recommended. If a burial plot is used it should be adequately posted and supervised.

Tubes containing radon gas can be broken up under a ventilated hood, since radon gas is heavier than air, however, burial of such tubes intact or sinking them at sea is the optimum disposal method. If possible, radioactive material that is to be junked should be encased in concrete to insure that no parts will float to the surface when the material is sunk at sea.

Any equipment or tools used in crushing tubes or handling radioactive junk should be thoroughly cleaned before using for other purposes or if practicable such equipment and tools should also be buried or sunk at sea. It should be borne in mind that any buried material may at some later date be exposed by land excavation and cause radium poisoning exposures.

1—Wet method—First pick up large fragments with forceps; Then, using a wet cloth, wipe across the area. Make one swipe at a time and fold cloth in half, keeping the clean side out at all times. When cloth becomes too small, discard and start again with a clean piece of cloth. Care must be taken not to rub the radioactivity into the surface being cleaned by using a back and forth motion. All debris and cloths used for cleaning should be sealed in a container such as a plastic bag, heavy waxed paper ice cream carton, or glass jar and disposed of in the same manner as the unbroken tubes.

2—*Dry method*—Pick up large pieces with a forceps; then clean the area carefully with a vacuum cleaner. If the breakage of tubes is a frequent occurrence, the exhaust from the vacuum cleaner should be analyzed and the appropriate type of collector used. The collecting bag should be disposed of in the same manner as the debris in method (1).

The following rules should be observed in the disposal and handling of any material contaminated by radioactivity:

1—No material contaminated by radioactivity should be allowed to come in contact with any part of the body at any time. Protective gloves should be worn at all times when the handling of radioactive wastes and broken radioactive parts is involved.

2—No food or drink should be brought into the area contaminated or near any material that is radioactive.

3—Personnel handling radioactive material in any way should thoroughly wash hands and arms and remove any clothing which may have been contaminated before eating, drinking, or smoking and immediately after leaving the contaminated area.

In view of the serious damage to an individual's health which could result from wounds contaminated by broken fragments of electron tubes containing radioactive material, it is apparent that every precaution should be observed to prevent the occurrence of such an accident. While it is generally agreed that the introduction of radioactive contaminant into a wound is a potential health hazard, the prediction of definite health damage is variable. Detection of radioactivity contamination in a wound would be practically impossible in the absence of special equipment and techniques. However, assuming that a wound caused by a fragment of a broken radioactive tube will occur, the following first aid procedures are recommended:

1—Immediate application of a venous return tourniquet, if the wound is so placed that a tourniquet is applicable.

2—Stipulation of mild bleeding by manual pressure about the wound and by the use of suction bulbs.

3—The wound should be washed with soap and copious amounts of clean water.

4—If the wound is of the puncture type or the opening is quite small, an incision should be made to promote free bleeding and to facilitate complete flushing of the wound with soap and water.

The above procedures cannot exclude the hazard of a lifetime tolerance of radioactive material entering a wound resulting from breakage of a radioactive tube. However, the best authorities agree that the possibility of such serious results in the circumstances under discussion is so remote as to exclude the necessity for surgery or laboratory analysis. Therefore the measures for wound treatment outlined above represents the only reasonable first aid treatment which would normally be available to doctors in the field or aboard ship.

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CHECK YOUR SHIPYARD OVERHAUL WORK LISTS

From ServLant Monthly Bulletin

➡ Many of the Service Force ships scheduled for Naval Shipyard overhaul submit electronics work lists. Some are compiled by the technician, and some by the Electronics Officer. In many cases, these lists contain items which can and should be accomplished by the ET rather than by shipyard personnel. Due to the shortage of repair funds within the Fleet, it is necessary that an intensive effort be made by the ships to do as much electronic work as possible with the ship's personnel. The following list of items are normally considered to be ship's force work:

1. Antennas—cleaning and painting, replacement of wire antennas.

2. Bearings—replacement of in small motors and generators.

3. Cabling—replacement of small lengths not critical in nature.

4. Direction Finders — cleaning, routine maintenance, loop checks, and calibration.

5. Field Changes—all field changes of a minor nature, and those designated as being accomplished by ships force on the field change bulletin.

6. Generators—routine cleaning, maintetenance, and minor repairs.

7. Insulators—cleaning and replacement as required.

8. Jacks (phone)—replacement and repair.

9. Keys (telegraph)—installation, replacement, adjustment, and repair.

10. Loran—repair and adjustment.

11. Meters—minor repairs only, replacement of meters which are integral parts of equipment.

12. Oscilloscopes—repair and adjustments.

13. Receivers (all types)—all repairs except alignment; all tests.

14. Transmitters (all types)—all repairs and alterations, except major changes and repairs to sealed oscillator compartments; all tests.

15. Test instruments—all repairs except where special instruments or techniques are required.

BuShips Comment: Although the above was originally addressed to Service Force Atlantic ships only, the Bureau feels that it applies in general to all ships in active status. Further comment is invited on this subject. *4/1/50*

SUMMARY OF JOINT NOMENCLATURE SYSTEM ("AN" SYSTEM) FOR COMMUNICATION-ELECTRONIC EQUIPMENT

TABLE OF COMPONENT INDICATORS

COMP. IND.	FAMILY NAME	DEFINITION OF EXAMPLE (Not to be construed as limiting the application of the component indicator to those items)
AB	Supports, Antenna	Antenna mounts, mast bases, mast sections, towers, etc.
AM	Amplifiers	Power, audio, interphone, radio frequency, video, servo (nonrotating), etc.
AS	Antenna Assemblies	Complex: Arrays, parabolic type, masthead, etc.
AT	Antennae	Simple: Whip or telescopic, loop, dipole, reflector, also transducer, etc. (See H).
BA	Battery, primary type	B-batteries, battery packs, etc.
BB	Battery, secondary type	Storage batteries, battery packs, etc.
BZ	Signal Devices, Audible	Buzzers, gongs, horns, etc.
C	Control Articles	Control box, remote tuning control, etc.
CA	Commutator Assemblies, Sonar.	Peculiar to Sonar equipment.
CB	Capacitor Bank	Used as a power supply.
CG	Cables and Transmission Line, R. F.	R. F. cables, wave guides, etc., with terminals.
CK	Crystal Kits	A kit of crystals with holders.
CM	Comparators	Analyzes or compares two or more input signals.
CN	Compensators	Electrical and/or mechanical compensating, regulating or attenuating apparatus.
CP	Computers	A mechanical and/or electronic mathematical calculating device.
CR	Crystals	Crystal in crystal holder.
CU	Coupling Devices	Impedance coupling devices, directional couplers, etc.

COMP. IND.	FAMILY NAME	DEFINITION OF EXAMPLE (Not to be construed as limiting the application of the component indicator to those items)
CV	Converters (electronic)	Electronic apparatus for changing the phase, frequency, or from one medium to another.
CW	Covers	Cover, bag, roll, cap, radome, nacelle, etc.
CX	Cords	Cord with terminals, also composite cables of R. F. and non-R. F. conductors.
CY	Cases	Rigid and semirigid structure for housing or carrying equipment.
DA	Antenna, Dummy	R. F. test loads.
DT	Detecting Heads	Magnetic pick-up device, search coil, hydrophone, etc.
DY	Dynamotors	Dynamotor power supply.
E	Hoist Assembly	Sonar hoist assembly, etc.
F	Filters	Band-pass noise, telephone, wave traps, etc.
FN	Furniture	Chairs, desks, tables, etc.
FR	Frequency Measuring Devices.	Frequency meters, echo boxes, etc.
G	Generators	Electrical power generators without prime movers. (See PU & PD).
GO	Goniometers	Goniometers of all types.
GP	Ground Rods	Ground Rods, stakes, etc.
H	Head, Hand, and Chest Sets	Includes earphone.
HC	Crystal Holder	Crystal Holder less crystal.
HD	Air Conditioning Apparatus	Heating, cooling, dehumidifying, pressure, vacuum devices, etc.
ID	Indicating Devices	Calibrated dials and meters, indicating lights, etc. (See IP).
IL	Insulators	Strain, stand-off, feed-through, etc.
IM	Intensity Measuring Devices	Includes SWR gear, field intensity and noise meters, etc.
IP	Indicators, Cathode Ray Tube.	Azimuth, Elevation, PPI, panoramic, etc.
J	Junction Devices	Junction, jack and terminal boxes, connector panels, etc.
KY	Keying Devices	Mechanical, electrical and electronic keyers, coders, interrupters, etc.
LC	Tools, Line Construction	Includes special apparatus such as cable plows, etc.
LS	Loudspeakers	Separately housed loudspeakers.
M	Microphones	Radio, telephone, throat, hand, etc.
MD	Modulators	Device for varying amplitude, frequency or phase.
ME	Meters, Portable	Multimeters, volt-ohm-milliammeters, vacuum tube voltmeters, power meters, etc.
MK	Maintenance Kits or Equipments.	Radio, telephone, general utility, etc.
ML	Meteorological Devices	Barometer, hygrometer, thermometer, scales, etc.
MT	Mountings	Mountings, racks, frames, stands, etc.
MX	Miscellaneous	Equipment not otherwise classified. Do not use if better indicator is available.
O	Oscillators	Master frequency, blocking, multivibrators, etc. For test oscillators, see SG.
OA	Operating Assemblies	Assembly of operating units not otherwise covered.
OC	Oceanographic Devices	Bathythermographs, etc.
OS	Oscilloscope, Test	Test oscilloscopes for general test purposes.
PD	Prime Drivers	Gasoline engines, electric motors, Diesel motors, etc.
PF	Fittings, Pole	Cable hanger, clamp, protectors, etc.
PG	Pigeon Articles	Container, loft, vest, etc.
PH	Photographic Articles	Camera, projector, sensitometer, etc.
PP	Power Supplies	Nonrotating machine type such as vibrator pack, rectifier, thermoelectric, etc.

COMP. IND.	FAMILY NAME	DEFINITION OF EXAMPLE (Not to be construed as limiting the application of the component indicator to those items)
PT	Plotting Equipments	Except meteorological. Boards, maps, plotting table, etc.
PU	Power Equipments	Rotating power equipment except dynamotors. Motor-generator, etc.
R	Receivers	Receivers, all types except telephone.
RD	Recorders and Reproducers	Tape, facsimile disc, magnetic, etc.
RE	Relay Assemblies	Electrical, electronic, etc.
RF	Rado Frequency Component	Composite component of R. F. circuits. Do not use if better indicator is available.
RG	Cables and Transmission Line Bulk R. F.	R. F. cable, wave guides, etc., without terminals.
RL	Reel Assemblies	Antenna, field wire, etc.
RP	Rope and Twine	Nonelectrical cord, etc.
RR	Reflectors	Target, confusion, etc. Except antenna reflectors. (See AT.)
RT	Receiver and Transmitter	Radio and radar transceivers, composite transmitter and receiver, etc.
S	Shelters	House, tent, protective shelter, etc.
SA	Switching Devices	Manual, impact, motor driven, pressure operated, etc.
SB	Switchboards	Telephone, fire control, power, panel, etc.
SG	Generators, Signal	Includes test oscillators and noise generators. (See O.)
SM	Simulators	Flight, aircraft, target, signal, etc.
SN	Synchronizers	Equipment to coordinate two or more functions.
ST	Straps	Harness, straps, etc.
T	Transmitters	Transmitters, all types except telephone.
TA	Telephone Apparatus	Miscellaneous telephone equipment.
TD	Timing Devices	Mechanical and electronic timing devices, range device, multiplexers, electronic gates, etc.
TF	Transformers	Transformers when used as separate items.
TG	Positioning Devices	Tilt and/or Train Assemblies.
TH	Telegraph Apparatus	Miscellaneous telegraph apparatus.
TK	Tool Kits or Equipments	Miscellaneous tool assemblies.
TL	Tools	All types except line construction. (See LC.)
TN	Tuning Units	Receiver, transmitter, antenna, etc.
TS	Test Equipment	Test and measuring equipment not otherwise included.
TT	Teletypewriter and Facsimile Apparatus.	Miscellaneous tape, teletype, facsimile equipment, etc.
TV	Tester, Tube	Vacuum tube tester.
U	Connectors, Audio and Power	Unions, plugs, sockets, adapters, etc.
UG	Connectors, R. F	Unions, plugs, sockets, choke couplings, adapters, elbows, flanges, etc.
V	Vehicles	Carts, dollies, trucks, trailers, etc.
VS	Signaling Equipment, Visual	Flag sets, aerial panels, signal lamp equipment, etc.
WD	Cables, Two Conductor	Includes non-R. F. wire, cable and cordage in bulk.
WF	Cables, Four Conductor	Includes non-R. F. wire, cable and cordage in bulk.
WM	Cables, Multiple Conductor	Includes non-R. F. wire, cable and cordage in bulk.
WS	Cables, Single Conductor	Includes non-R. F. wire, cable and cordage in bulk.
WT	Cables, Three Conductor	Includes non-R. F. wire, cable and cordage in bulk.
ZM	Impedance Measuring Devices.	Used for measuring Q. C. L., R or PF. etc.

TABLE OF SET OR EQUIPMENT INDICATOR LETTERS

INSTALLATION

A—Airborne (installed and operated in aircraft)
B—Underwater mobile, submarine
C—Air transportable (inactivated, do not use)
D—Pilotless carrier
F—Fixed
G—Ground, general ground use (includes two or more ground installations)
K—Amphibious
M—Mobile (installed as operating unit in a vehicle which has no function other than transporting the equipment)
P—Pack or portable (animal or man)
S—Water surface craft
T—Ground, transportable
U—General utility (includes two or more general installation classes, airborne, shipboard and ground)
V—Ground, vehicular (installed in vehicle designed for functions other than carrying electronic equip- etc., such as tanks)

TYPE OF EQUIPMENT

A—Invisible light, heat radiation
B—Pigeon
C—Carrier (wire)
D—Radiac
F—Photographic
G—Telegraphic or teletype (wire)
I—Interphone and public address
K—Telemetering
L—Countermeasures (inactivated do not use)
M—Meteorological
N—Sound in air
P—Radar
Q—Sonar and underwater sound
R—Radio
S—Special types, magnetic etc. or combinations of types
T—Telephone (wire)
V—Visual and visible light
X—Facsimile or television

PURPOSE

A—Auxiliary assemblies (not complete operating sets)
B—Bombing
C—Communications (receiving and transmitting)
D—Direction finder
G—Gun or search light directing
H—Recording (photographic, meteorological and sound)
L—Searchlight control (inactivated use "G")
M—Maintenance and test assemblies (including tools)
N—Navigational aids (including altimeters, beacons, compasses, racons, depth sounding, approach and landing)
P—Reproducing (photographic and sound)
Q—Special or combination of types
R—Receiving
S—Detecting and/or arrange and bearing
T—Transmitting
W—Remote control
X—Identification and recognition

EXAMPLES OF "AN" TYPE NUMBERS

TYPE NUMBER	INDICATES
AN/SRC-3 ( )	General reference set nomenclature for water surface craft radio communication set No. 3.
AN/SRC-3	Original procurement set nomenclature applied against AN/SRC-3 ( ).
AN/SRC-3A	Modification set nomenclature applied against AN/SRC-3.
AN/APQ-13-T1 ( )	General reference training set nomenclature for the AN/APQ-13 set.
AN/APQ-13-T1	Original procurement training set nomenclature applied against AN/APQ-13-T1 ( ).
AN/APQ-13-T1A	Modification training set nomenclature applied against AN/APQ-13-T1 ( ).
AN/UPT-T3 ( )	General reference training set nomenclature for general utility radar transmitting training set No. 3.
AN/UPT-T3	Original procurement training set nomenclature applied against AN/UPT-T3 ( ).
AN/UPT-T3A	Modification training set nomenclature applied against AN/UPT-T3.

T–51 ( )/ARQ–8	General reference component nomenclature for transmitter No. 51, part of or used with airborne radar special set No. 8.
T–51/ARQ–8	Original procurement component nomenclature applied against T–51 ( )/ARQ–8.
T–51A/ARQ–8	Modification component nomenclature applied against T–51/ARQ–8
RD–31 ( )/U	General reference component nomenclature for recorder-reproducer No. 31 for general utility use, not part of a specific set.
RD–31/U	Original procurement component nomenclature applied against RD–31 ( )/U.
RD–31A/U	Modification component nomenclature applied against RD–31/U.

NOTES

1. This chart was formerly titled SUMMARY OF JOINT ARMY-NAVY NOMENCLATURE SYSTEM ("AN" SYSTEM) FOR COMMUNICATION AND ASSOCIATED EQUIPMENT.

2. The system indicator "AN" does not mean that the Army, Navy, and Air Force use the equipment but simply that the type number was assigned in the "AN" system.

3. In the "AN" nomenclature system, nomenclature consists of a name followed by a type number. The type number will consist of indicator letters shown on this chart and an assigned number.

4. The type number of an independent component not part of or used with a specific set will consist of a component indicator, a number, the slant and such of the set or equipment indicator letters as apply. Example: SB–5/PT would be the type number of a portable telephone switchboard for independent use.

5. All requests for nomenclature assignments will be submitted on an approved form and in accordance with the joint Army-Navy Manual of Standard Descriptions (JANP109) or superseding Munitions Board Cataloging Agency publications.

MODIFICATION LETTERS

Component modification suffix letters will be assigned for each modification of a component when detail parts and subassemblies used therein are no longer interchangeable, but the component itself is interchangeable physically, electrically, and mechanically.

Set modification letters will be assigned for each modification not affecting interchangeability of the sets or equipment as a whole, except that in some special cases they will be assigned to indicate functional interchangeability and not necessarily complete electrical and mechanical interchangeability. Modification letters will only be assigned if the frequency coverage of the unmodified equipment is maintained.

The suffix letters, X, Y, and Z will be used only to designate a set or equipment modified by changing the input voltage phase or frequency. X will indicate the first change, Y the second, Z the third, XX the fourth, etc., and these letters will be in addition to other modification letters applicable.

ADDITIONAL INDICATORS

Experimental Sets: In order to identify a set or equipment of an experimental nature with the development organization concerned, the following indicators will be used within the parentheses:

XA—Air Material Command, Hq., Dayton, Ohio.

XB—Naval Research Lab. Wash. D. C.

XC—Coles Signal Laboratory, Fort Monmouth, N. J.

XE—Evans Signal Laboratory, Fort Monmouth, N. J.

XG—U. S. N. Electronic Lab. San Diego, Calif.

XM—Squier Signal Laboratory, Fort Monmouth, N. J.

XN—Navy

XU—U. S. N. Underwater Sound Lab. Fort Trumbull, New London, Conn.

XW—Watson Laboratories, AMC, Redbank, N. J.

Example: Radio Set AN/ARC-3 ( ) might be assigned for a new airborne radio communication set under development. The cognizant development organization might then assign AN/ARC-3 (XA-1), AN/ARC-3 (XA-2), etc., type numbers to the various sets developed for test. When the set was considered satisfactory for use, the experimental indicator would be dropped and procurement nomenclature AN/ARC-3 would be assigned thereto.

Training Sets: A set or equipment designed for training purposes will be assigned type numbers as follows:

1. A set to train for a specific basic set will be assigned the basic set type number followed by a dash, the letter T, and a number. Example: Radio Training Set AN/ARC-6A-T1 would be the first training set for Radio Set AN/ARC-6A.
2. A set to train for general types of sets will be assigned the usual set indicator letters followed by a dash, the letter T, and a number. Example: Radio Training Set AN/ARC-T1 would be the first training set for general airborne radio communication sets.

Parentheses Indicator: A nomenclature assignment with parentheses, ( ) following the basic type number is made to identify an article generally, when a need exists for a more general identification than that provided by nomenclature assigned to specific designs of the article. Example: AN/GRC-5 ( ), AM-6 ( )/GRC-5, SB-9 ( )/GG. A specific design is identified by the plain basic type number, the basic type number with a suffix letter, or the basic type number with an experimental symbol in parentheses. Examples: AN/GRC-5, AN/GRC-5A, AN/GRC-5 (XC-1), AM-6B/GRC-5, SB-9 (XE-3)/GG.

NOMENCLATURE POLICY

1. AN Nomenclature will be assigned to:

A. Complete sets of equipment and motor components of military design.

B. Groups of articles of either commercial or military design which are grouped for a military purpose.

C. Major articles of military design which are not part of or used with a set.

D. Commercial articles when nomenclature will facilitate military identification and/or procedures.

2. AN Nomenclature will not be assigned to:

A. Articles cataloged commercially except in accordance with Paragraph 1.D.

B. Major components of military design for which other adequate means of identification are available.

C. Small parts such as capacitors and resistors.

D. Articles having other adequate identification in joint military specifications.

3. Nomenclature assignments will remain unchanged regardless of later changes in installation and/or application.

Important.—All personnel are cautioned against originating or changing any part of any nomenclature assignment, including modification letters, without authorization.

4/1/50

→ ELECTRONIC FIELD CHANGE INDEX

The Electronic Field Change Index is a tabulation of pertinent information and data required by field activities concerning all authorized changes and modifications to ship and shore electronic equipment. The index will provide a convenient reference source for operating personnel, maintenance and repair technicians, inspectors, etc., wherein the information essential to the orderly progression of the field change program will be concentrated.

The index will ultimately be published as a permanent feature in the three maintenance bulletins, the Communication Equipment Maintenance Bulletin, Radar Maintenance Bulletin and Sonar Bulletin, according to the category of the equipments involved. Additions and corrections to the index will be included in the regular supplements to the bulletins which are presently issued on a quarterly basis.

In addition to the Bulletins, the entire original issue of the Field Change Index is being published on the installment basis in ELECTRON Magazine in order to expedite dissemination of the important information and data. All activities concerned with these equipments should check both the equipments and the equipment records to ascertain if they are up-to-date. If not, the proper action should be initiated to accomplish the necessary changes.

1—The dates of December 1945 and January 1946 are indicated for many changes. These represent the dates on which serial numbers were assigned to previously unnumbered changes or modifications authorized or issued prior to the initiation of the present field change system.

2—The preferred activity to accomplish each field change is indicated by "SF" (ship's force) or "YF" (yard force).

ELECTRONIC FIELD CHANGE INDEX—D SERIES

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
DAK	Radio Direction Finding Equipment								
1	Modulator Tube Balance Kit		Not applicable						
DAK-1	Radio Direction Finding Equipment								
1	Modulator Tube Balance Kit	Mar. 1, 1946	All	SF	3	Kit			NXsr-97674
DAK-2	Radio Direction Finding Equipment								
1	Modulator Tube Balance Kit	do	do	SF	3	do			NXsr-97674
DAK-3	Radio Direction Finding Equipment								
1	Modulator Tube Balance Kit	do	do	SF	3	do			NXsr-97674
DAQ	Radio Direction Finding Equipment								
1	Installation of Improved Loop Antenna	Aug. 22, 1945	do	YF	12	do		NavShips 900,801	NXsr-96333 NXsr-9553
DAS	Radio Navigation Equipment								
1	Relocate Station Selector Trimmers	Nov. 1, 1945	1 through 5	SF	4	do		Ships 225A	
2A	Change Time Corrector Circuit	do	1 through 106	SF	1	None required		Ships 225A	
2B	Increase Slow Sweep Length	do	do	SF	2	Stock		CEMB	
3	Change DAS to DAS-a (Change Pulse Rate and Improve Cathode-Ray-Tube Focus).	do	1 through 200	SF	2	Kit		Ships 225A	NXsr-26190
4	Remove Filament Ground in Indicator	do	do	SF	1	None required		Ships 225A	
5	Improve Balance Gain Control Circuits	do	do	SF	4	Kit		Ships 225A	NXsr-26190 NXsr-35364
6	Change Gain and Fine Delay Controls	do	do	SF	4	do		Ships 225A	NXsr-26190 NXsr-35364
7	Add Resistors R-285	do	do	SF	½	Stock		Ships 225A	
8	Adjust B+ to 280 Volts instead of 300	do	All	SF	½	None required		CEMB	
9	Change DAS-a to DAS-b, DAS-2 to DAS-2b (Modify coils for 4 medium frequency channels).	do	do	SF	2	Kit			NXsr-35364 NXsr-68004
10	Add Two Microsecond Markers for Monitoring	do	Shore Monitoring Receivers only.	YF		do			S & A order #22515
11	Change Ampl. Balance to B. F. Amplifier	Cancelled							
DAS-1	Radio Navigation Equipment								
1	Change DAS-1 to DAS-1a (Add PRR Switch)	Nov. 1, 1945	All	SF	2	do		NavShips 900, 752	NXsr-26792 NXsr-40989 NXsr-93961
2A	PRR Adjustment (If Field Change No. 1 is not available).	do	do	SF	1	Stock		NavShips 900, 752	NXsr-26792 NXsr-40989 NXsr-93961
2	Change DAS-1a to DAS-1b (Modify Receiver Coils for 4 medium frequency channels).	do	do	SF	2	Kit		NavShips 900, 752	
3	Receiver Diode Connection	do	do	SF	½	Stock		NavShips 900, 752	
4	Nameplate Change	do	1 through 140.	SF	½	See CEMB		NavShips 900, 752	
5	Grounding Change	do	All	SF	1	Stock		NavShips 900, 752	
6	Insulate Capacitor C107/C207	do	do	SF	1	do		NavShips 900, 752	
7	Change Slow Sweep Resistor R167/R267	do	do	SF	½	do		NavShips 900, 752	
8	Change Capacitor C37/C137	do	do	SF	½	do		NavShips 900, 752	
9	Add Resistor R31 in Receiver	do	do	SF	¼	do		CEMB	

DAS-2	Radio Navigation Equipment								
1	Relocate Station Selector Switches		Not applicable						
2A	Change Time Corrector Circuit		do						
2B	Increase Slow Sweep Length		do						
3	Change DAS to DAS-a (Change Pulse Rate and Improve Cathode-Ray-Tube Focus).								
4	Remove Filament Ground in Indicator	Nov. 1, 1945	201 through 375	SF	1	None required		Ships 225A	
5	Improve Balance Gain Control Circuits	do	201 through 408 except 405, 406.	SF	4	Kit		Ships 225A	NXsr-26190 NXs-35364
6	Change Gain and Fine Delay Controls	do	201 through 580	SF	4	do		Ships 225A	NXsh-26190 NXsr-35364
7	Add Resistor R-285	do	200 through 770	SF	½	Stock		Ships 225A	
8	Adjust B+ to 280 Volts instead of 300	do	All	SF	½	None required		CEMB	
9	Change DAS-a to DAS-b, DAS-2 to DAS-b (Modify Coils for 4 medium frequency channels).	do	do	SF	2	Kit			NXsr-35364 NXsr-68004
10	Add Two Microsecond Markers for Monitoring	do	Shore Monitoring Receivers only.	YF		do			S & R order #22515
11	Changes Ampl. Balance to R. F. Amplifier	Cancelled							
DAS-3	Radio Navigation Equipment								
1	Change DAS-1 to DAS-1a (Add PRR Switch)		Not applicable						
1A	PRR Adjustment (If Field Change No. 1 is not available).		do						
2	Change DAS-1a to DAS-1b (Modify Receiver Coils for 4 Medium Frequency Channels).		do						
3	Receiver Diode Connection		do						
4	Nameplate Change		do						
5	Grounding Change	Nov. 1, 1945	1 through 164, 166 through 213, 223, 228, 229, 230, 232.	SF	1	Stock		NavShips 900, 752	
6	Insulate Capacitor C107/C207	do	1 through 420, 423, 424, 427, 435, 437, 445, 460, 461, 468, 470 through 473, 475, 477, 496, 503, 504, 507, 509, 517, 518.	SF	1	do		NavShips 900, 752	
7	Change Slow Sweep Resistor R167/R267	do	1 through 524	SF	½	do		NavShips 900, 752	
8	Change Capacitor C37/C137	do	1 through 541 except 496, 524, 532, 538, 539.	SF	½	do		NavShips 900, 752	
9	Add Resistor R31 in Receiver		Not applicable						
DAS-4	Radio Navigation Equipment								
1	Waterproof Antenna Loading Coil	Nov. 1, 1945	1 through 177	SF		do		CEMB	
2	Change Feedback Capacitor C219	do	1 through 75, 77 through 87, 93, 94, 97.	SF		do		CEMB	
3	Reduce Inductance of L101	do	1-508, 512-516, 519-526, 528, 529, 531, 536, 543, 545, 562, 564, 570, 577, 585.	SF	2	None required		CEMB	
4	Change Slow Sweep Circuit Resistor R269	do	1 through 585	SF	1	Stock		CEMB	
5	Change Feedback Capacitor C220	do	do	SF	1	do		CEMB	
DAU	Radio Direction Finding Equipment								
1	Installation of Improved Loop Antenna	August 1945	All	YF		Kit		NavShips 900, 801	NXsr-96333 NNXsr-9553
2	Scanning Selectivity Kit	January 6, 1946	1-50 inclusive	SF	4	do		FC-41-46	N5sr-10564

ELECTRONIC FIELD CHANGE INDEX—D SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
DBE	Loran Receiving Equipment								
1	Increase Wattage Rating of R-209 and R-211	June 1, 1946	1-36 inclusive	SF	2	Stock	None	CEMB	None
DEM-1	Radar Direction Finding Equipment								
1	Changing Wiring of S-107	Apr. 1, 1946	1-100	SF	6	Kit			NXsr-80024
2	Changing Scanning Capacitor Couplings	do	1-100	SF	1	do		FC-10-45	NXsr-80024
3	Ghanging Bullet in Antenna R. F. Rotary Joint	do	1-252	SF	1	do		FC-26-45	NXsr-80024
4	Installing an Equalizer in the Low Frequency Antenna.	August 1, 1946	1-289	YF	1	do		FC-49-46	NXsr-80024
X-DBS	Loran Receiving Equipment								
1	Improvements to Model X-DBS to Increase Similarity to Model DBS Loran Equipment.	Feb. 15, 1946	2-6	SF	5	do		(With Kit)	NXsr-87700

ELECTRONIC FIELD CHANGE INDEX—L SERIES

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
LRN-1	Loran System Receiver-Indicator								
1	Add PRR Switch	Nov. 1, 1945	All	SF	2	Kit and Stock			NXsr-40989
1A	PRR Adjustment (If Kit for Field Change No. 1 is not available).	do	do	SF	1	Stock		CEMB	
2	Change LRN-1 to LRN-1M, LRN; 1A to LRN-1AM (Modify Coils for 2 medium frequency channels).		Superseded by F. C. #2A						
2A	Change to LRN-1b and LRN-1Ab (Modify coils for 4 medium frequency channels).	Nov. 1, 1945	All	SF	2	Kit			NXsr-40989
3	Change Interconnecting Cable	do	Not applicable						
4	Change CRT Intensifier Circuit	do	do						
5	Add Resistor to Stabilize Square Wave Generator	do				Stock			
6	Receiver Diode Connection	do	All	SF	½	do		CEMB	
7	Grounding Change	do	do	SF	1	do		CEMB	
8	Insulate Capacitor C107/C207	do	do	SF	1	do		CEMB	
9	Change Capacitor C37/C137	do	do	SF	½	do		CEMB	
10	Add Resistor R31 in Receiver	do	do	SF	¼	do		CEMB	
LRN-1A	Loran System Receiver-Indicator								
1	Add PRR Switch	do	do	SF	2	Kit & Stock			NXsr-40989
1A	PRR Adjustment (If Kit for Field Change No. 1 is not available).	do	do	SF	1	Stock		CEMB	
2	Change LRN-1 to LRN-1M, LRN-1A to LRN-1AM (Modify Coils for 2 medium frequency channels).		Superseded by F. C. #2A.						
2A	Change to LRN-1b and LRN-1Ab (Modify coils for 4 medium frequency channels).	Nov. 1, 1945	All	SF	2	Kit			NXsr-40989
3	Change Interconnecting Cable	do	1-75	SF	½	do			
4	Change CRT Intensifier Circuit	do	All (If Required)	SF	1	Stock	•	CEMB	
5	Add Resistor to Stabilize Square Wave Generator	do				do			
6	Receiver Diode Connection	do	All	SF	½	do		CEMB	
7	Grounding Change	do	do	SF	1	do		CEMB	
8	Insulate Capacitor C107/C207	do	do	SF	1	do		CEMB	
9	Change Capacitor C37/C1337	do	do	SF	½	do		CEMB	
10	Add Resistor R31 in Receiver	do	do	SF	¼			CEMB	

ELECTRONIC FIELD CHANGE INDEX—M SERIES

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
MAR	Radio Transmitting-Receiving Equipment								
1	Additional Shockmounts for Shipboard Installation Kit.	October 1947	Model MAR Radio Equipments with Power Supplies, Navy Type—20379 with Serial Numbers 1 through 1400.	FY	4	Kit		CEMB and with Kit.	NXsr-60008
2	Adding Ballast Resistor (R-530) to Operating Spares.	October 1946	1-500	SF	¼	do		do	NXsr-60008
3	Replacement of Time Delay Relay in Universal Power Supply Unit, Type—20379.	March 1947	Model MAR Radio Equipments with Power Supplies, Navy Type—20379 with Serial Numbers 1 through 500.	SF	¼	do		do	NXsr-60008
4	Addition to Allowance of Equipment Spare Parts for AC/DC Universal Power Supply Unit.	April 1947	Model MAR Radio Equipments with Power Supplies, Navy Type—20379 with Serial Numbers 501 and up.	SF	¼	do		do	NXsr-60008
5	Addition of Noise-Suppression Kit for Dynamotor and Blower Motor.	July 1947	All	SF	4	do		do	NXsr-60008
MBF	Radio Transmitting-Receiving Equipment								
1	Improving the Squelch Sensitivity	February 1946	1-1000	SF	1	Stock	None	CEMB	None.
2	Improving Intelligibility	do	1-750	SF	1	do	do	CEMB	Do.

ELECTRONIC FIELD CHANGE INDEX—R SERIES

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
RAK	Radio Receiving Equipment								
1	Providing Concentric Antenna Jack		Not applicable						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	None
3	Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
4	Modification for use with Navy Type-66097 Loop Antenna.		Not applicable						
RAK 1	Radio Receiving Equipment								
1	Providing Concentric Antenna Jack		do						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3	Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
4	Modification for use with Navy Type-66097 Loop Antenna.		Not applicable						
RAK-2	Radio Receiving Equipment								
1	Providing Concentric Antenna Jack		do						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3	Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
4	Modification for use with Navy Type-66097 Loop Antenna.		Not applicable						
RAK-3	Radio Receiving Equipment								
1	Providing Concentric Antenna Jack		do						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3	Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
4	Modification for use with Navy Type-66097 Loop Antenna.		Not applicable						
RAK-4	Radio Receiving Equipment								
1	Providing Concentric Antenna Jack		do						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3	Fusing of the Equipments	do	All	SF	1	None required	do	CEMB	Do.
4	Modification for use with Navy Type-66097 Loop Antenna.		Not applicable						
RAK-5	Radio Receiving Equipment								
1	Providing Concentric Antenna Jack		do						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3	Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
4	Modification for use with Navy Type-66097 Loop Antenna.		Not applicable						

RAK-6 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack	December 1945	All	YF	3	Kit		CEMB and Supplement to 1B.	NOs-95022
2 Replacing Power Supply Resistors R-202, R-203 and R-204.	do	do	SF	2	Stock	None	CEMB	None
3 Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
4 Modification for use with Navy Type-66097 Loop Antenna.	March 1947	All RAK-6 equipments aboard submarines.	YF	8	Kit		With kit	NObsr-37148
RAK-7 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.		do						
3 Fusing of the Equipments	December 1945	All	SF	8	None required	None	CEMB	None
4 Modification for use with Navy Type-66097 Loop Antenna.	March 1947	All RAK-7 equipments aboard submarines.	YF	8	Kit		With kit	NObsr-37148
RAK-8 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.		do						
3 Fusing of the Equipments	December 1945	All	SF	1	None required	None	CEMB	None
4 Modification for use with Navy Type -66097 Loop Antenna.	March 1947	All RAK-8 equipments aboard submarines.	YF	8	Kit		With kit	NObsr-371
RAL Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	None
3 Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
RAL-1 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3 Fusing of the Equipment	do	do	SF	1	None required	do	CEMB	Do.
RAL-2 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3 Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
RAL-3 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3 Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
RAL-4 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3 Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
RAL-5 Radio Receiving Equipment								
1 Providing Concentric Antenna Jack		Not applicable						
2 Replacing Power Supply Resistors R-202, R-203 and R-204.	December 1945	All	SF	2	Stock	None	CEMB	Do.
3 Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.

ELECTRONIC FIELD CHANGE INDEX—R SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
RAL-6	Radio Receiving Equipment								
1	Providing Concentric Antenna Jack	December 1945	All	YF	3	Kit		CEMB and Supplement to IB.	NOs -95022
2	Replacing Power Supply Resistors R-202, R-203 and R-204.	do	do	SF	2	Stock	None	CEMB	None
3	Fusing of the Equipments	do	do	SF	1	None required	do	CEMB	Do.
RAL-7	Radio Equipment								
1	Providing Concentric Antenna Jack		Not applicable						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.		do						
3	Fusing of the Equipments	December 1945	All	SF	1	None required	None	CEMB	None
RAL-8	Radio Equipment								
1	Providing Concentric Antenna Jack		Not applicable						
2	Replacing Power Supply Resistors R-202, R-203 and R-204.		do						
3	Fusing of the Equipment	December 1945	All	SF	1	None required	None	CEMB	Do.
RAO-9	Radio Equipment								
1	Provide Outlet Jack for High Frequency Oscillator Circuit.	June 1950	All PAC-9 Receivers used in conjunction with the Model REM Dual Panoramic Adapter.	SF	2	Kit		NAVSHIPS 98193	P.O. 56702/49

ELECTRONIC FIELD CHANGE INDEX—R SERIES

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
RBA Radio Receiving Equipment									
1	Installation of Type-49059 Plug Adaptors	December 1945	All	SF	2	Kit or Stock		CEMB	NXsr-39245 NXsr-86317
2	Inversion of Power Supply Filter Choke	do	RBA Receivers with NT-20130 power supplies having the following serial numbers: 1- 451, incl.; 488- 492, incl.; 801- 802, incl.; 804- 844, incl.; 846; 848- 850, incl.; 852- 901, incl.; 907; 1601-1695, incl.; 1800-1819, incl.; 1821-1872, incl.; 1874-1899, incl.; 1900-1998, incl.; 2000-2008, incl.; 2012-2016, incl.; 2018-2021, incl.; 2025; 2028-2033, incl.; 2038; 2041; 2050-2051, incl.; 2058; 2069; 2062; 2071-2075, incl.; 2078-2079, incl.; 2172; 2213; 2238; 2241; 2245-2246, incl.; 2249; 2251-2253, incl.; 2255-2257, incl.; 2261-2263, incl.; 2265; 2267-2269, incl.; 2270; 2272-2274, incl.; 2276-2279, incl.; 2281; 2286; 2289; 2293; 2295-2296, incl.; 2298-2299, incl.; 2303-2305, incl.; 2307; 2309-2310, incl.; 2313-2314, incl.; 2316-2317, incl.; 2320-2321, incl.; 2323-2326, incl.; 2328-2336, incl.; 2340-2341, incl.; 2345; 2347-2351, incl.; 2353; 2355-2399, incl.; 2400-2402, incl.; 2404-2416, incl.; 2418-2471, incl.; 2473-2499, incl.; 2500-2527, incl.; 2529-2548, incl.; 2550-2589, incl.; 2591-2600, incl.						
RBA-1 Radio Receiving Equipment									
1	Installation of Type -49050 Plug Adapters	do	All	SF	2	do		CEMB	NXsr-29345 NXsr-86317
2	Inversion of Power Supply Filter Choke	do	RBA-1 Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
RBA-2 Radio Receiving Equipment									
1	Installation of Type -49059 Plug Adapters	do	All	SF	2	Kit or Stock		CEMB	NXsr-39245 NXsr-86317
2	Inversion of Power Supply Filter Choke	do	RBA-2 receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
RBA-3 Radio Receiving Equipment									
1	Installation of Type -49059 Plug Adapters	do	All	SF	2	Kit or Stock		CEMB	NXsr-39245 NXsr-86317
2	Inversion of Power Supply Filter Choke	do	RBA-3 Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None

ELECTRONIC FIELD CHANGE INDEX—R SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
RBA-5	Radio Receiving Equipment								
1	Installation of Type -49059 Plug Adapters		Not applicable						
2	Inversion of Power Supply Filter Choke	December 1945	RBA-5 Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
RBA-6	Radio Receiving Equipment								
1	Installation of Type -49059 Plug Adapters		Not applicable						
2	Inversion of Power Supply Filter Choke	December 1945	RBA-6 Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA	SF	1	None required	None	CEMB	Do.
RBB	Radio Receiving Equipment								
1	Installation of Type-49509 Plug Adapters	do	All	SF	2	Kit or stock		CEMB	NXsr-39245 NXsr-86317
2	Inversion of Power Supply Filter Choke	do	RBB Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA	SF	1	None required	None	CEMB	None
3	Improvement of Band Switch	do	All	SF	3	Stock	do	CEMB	Do.
RBB-1	Radio Receiving Equipment								
1	Installation of Type-49509 Plug Adapters	do	do	SF	2	Kit or Stock		CEMB	NXsr-39245 NXsr-86317
2	Inversion of Power Supply Filter Choke	do	RBB-1 Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
3	Improvement of Band Switch	do	1 through 1000	SF	3	Stock	do	CEMB	Do.
RBB-2	Radio Receiving Equipment								
1	Installation of Type-49509 Plug Adapters	do	All	SF	2	Kit or Stock		CEMB	NXsr 86317 NXsr-76317
2	Inversion of Power Supply Filter Choke	do	RBB-2 Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
3	Improvement of Band Switch		Not applicable						

RBC Radio Receiving Equipment								
1 Installation of Type -49509 Plug Adapters	December 1945	All	SF	2	Kit or Stock		CEMB	NXsr-39245
2 Inversion of Power Supply Filter Choke	do	RBC Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
								NXsr-86317
3 Improvement of Band Switch	do	All	SF	3	Stock	do	CEMB	Do.
RBC-1 Radio Receiving Equipment								
1 Installation of Type -49509 Plug Adapters	do	do	SF	2	Kit or Stock		CEMB	NXsr-39245 NXsr-86317
2 Inversion of Power Supply Filter Choke	do	RBC-1 Receivers with NT-20130 power supplies having the following serial numbers See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
3 Improvement of Band Switch	do	1 through 1000	SF	3	Stock	do	CEMB	Do.
RBC-2 Radio Receiving Equipment								
1 Installation of Type -49509 Plug Adapters	do	All	SF	2	Kit or Stock		CEMB	NXsr-39245 NXsr-86317
2 Inversion of Power Supply Filter Choke	do	RBC-2 Receivers with NT-20130 power supplies having the following serial numbers: See Field Change #2 for RBA.	SF	1	None required	None	CEMB	None
3 Improvement of Band Switch		Not applicable						
RBC-3 Radio Receiving Equipment								
1 Installation of Type -49509 Plug Adapters		do						
2 Inversion of Power Supply Filter Choke		do						
3 Improvement of Band Switch		do						
RBC-4 Radio Receiving Equipment								
1 Installation of Type -49509 Plug Adapters		do						
2 Inversion of Power Supply Filter Chokes		do						
3 Improvement of Band Switch		do						
RBM Radio Receiving Equipment								
1 Shock-Mounting		do						
RBM-1 Radio Receiving Equipment								
1 Shock-Mounting		do						
RBM-2 Radio Receiving Equipment								
1 Shock-Mounting		do						
RBM-3 Radio Receiving Equipment								
1 Shock-Mounting		do						
RBM-4 Radio Receiving Equipment								
1-RBM Shock-Mounting	Mar. 15, 1948	All the HF receivers and power supplies that are to be installed aboard ship.	YF	6	Kit		NAVSHIPS 98066	Project Order 396/47
RBM-5 Radio Receiving Equipment								
1-RBM Shock-Mounting	do	do	YF	6	do		NAVSHIPS 98066	Project Order 396/47

ELECTRONIC FIELD CHANGE INDEX—R SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
RBO Radio Receiving Equipment									
1	Modification of the Audio Circuit		Superseded by Field Change No. 3.						
2	Replacing Power Transformer and Rectifier Tubes.	December 1945	1 through 3799	SF	2	Kit			NXsr-56772 NObsr-30032 NObsr-37960
3	Connecting for Balanced Line Speaker Connection.	do	All	SF	3	do			NXsr-69250
RBO-1 Radio Receiving Equipment									
1	Modification of the Audio Circuit		Superseded by Field Change No. 3.						
2	Replacing Power Transformer and Rectifier Tubes.		Not applicable						
3	Connecting for Balanced Line Speaker Connection.	December 1945	All	SF	3	Kit			NXsr-69250
RBO-2 Radio Receiving Equipment									
1	Modification of the Audio Circuit		Superseded by Field Change No. 3.						
2	Replacing Power Transformer and Rectifier Tubes.		Not applicable						
3	Connecting for Balanced Line Speaker Connection.	December 1945	All	SF	3				NXsr-69250
RCK Radio Receiving Equipment									
1	Additional Tuning Set-UP System	do	do	SF	2	Stock	None	CEMB	None
2	Noise Suppressor Wiring Correction	do	do	SF	1	do	do	CEMB	Do.
3	Installation of Type 49509 Plug Adapters	do	do	SF	2	Kit or Stock		CEMB	NXsr-86317 NXsr-39245
4	Increased Audio Band Width for CCL Service	July 1949	RCK receivers when used in CCL service, provided increased audio band width response is required.	SF	½	Stock	None	CEMB	None
RDJ Pulse Analyzer Equipment									
1	Incorporating Changes to Improve Operation of Model RDJ Pulse Analyzer Equipment.	April 1946	1 through 250	SF	2	do	do	CEMB	Do.
X-RDJ Pulse Analyzer Equipment									
1	Incorporating Changes to Improve Operation of Model X-RDJ Pulse Analyzer Equipment.	do	1 through 25	SF	3	do	do	CEMB	Do.
→ RDO Radio Receiving Equipment									
1	Replacement of 28V Input Receptacle J-305	February 1948	All	SF	1	do	do	CEMB	Do.
2	Insertion of Preamplifier Stage	May 1949	do	SF	6	Kit	FL16TK 4000	NavShips 98140	P. O. 56700/49.
3	Insertion of Pulse Stretcher for Improvement of Audio Signal.	do	do	SF	3	do	FL16TK 4001	NavShips 98134	P. O. 56700/49 ←

RDR Radio Equipment								
1 Shockmount Replacement	October 1946	Shipboard installation kits which include a NT-10508 shockmount assembly.	YF	1	Kit	do	CEMB	NXsh-60008
2 Added Dynamotor Noise Suppressor	June 1947	All	SF	4	do	do	IB38464 (with Kit)	NXsh-60008
RDZ Radio Receiving Equipment								
1 Removal of C-149 Capacitors	March 1946	1 through 896	SF	½	None	do	CEMB	None
2 Adjustment of Tuning Inductance	October 1946	1 through 500	SF	2	Kit	do	CEMB	Do.
3 Bonding for Auto-Tune Unit	March 1947	1 through 2348	SF	½	do	do	CEMB	NObsh-37514
4 Modification to Improve Stability of I-F Amplifier.	September 1948	All	SF	⅛	do	do	CEMB	NObsr-42026
RDZ-1 Radio Receiving Equipment								
1 Removal of C-149 Capacitors		Not applicable						
2 Adjustment of Tuning Inductance		do						
3 Bonding for Auto-Tune Unit	March 1947	1 through 1100	SF	½	Kit	None	CEMB	NObsr-37514
4 Modification to Improve Stability of I-F Amplifier.	September 1948	All	SF	⅓	do	do	CEMB	NObsr-42026
REA Radio Receiving Equipment								
1 Receiver Output Line Connections	January 1946	do	SF	2	Stock	do	CEMB	None
2 AV Circuit Modification	do	do	SF	2	do	do	CEMB	Do.
REA-1 Radio Receiving Equipment								
1 Receiver Output Line Connections	do	do	SF	2	do	do	CEMB	Do.
2 AVC Circuit Modification	do	do		2	do	do	CEMB	Do.
REK Receiving and Reproducing Equipment								
1 Installation of Automatic Record Player	August 1947	do	YF	40	Kit		IB-39242-1A	NXsr-62358

ELECTRONIC FIELD CHANGE INDEX—T SERIES

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TBA	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	None
TBA-1	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	None
TBA-2	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying	December 1945	All when high speed keying is used.	SF	3	Stock	None	CEMB	Do.
4	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBA-3	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation	December 1945	All when used with double ended antennas.	SF	3	Stock	None	CEMB	Do.
3	High speed Keying		Not applicable						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-4	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-5	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-6	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit	do	All	SF	1	do	do	CEMB	Do.
2	Balanced Output Operation	do	All when used with double ended antennas.	SF	3	do	do	CEMB	Do.
3	High Speed Keying	do	All when high speed keying is used.	SF	3	do	do	CEMB	Do.
4	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.

ELECTRONIC FIELD CHANGE INDEX—T SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TBA-7	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	None
TBA-8	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-9	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-10	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit	do	All	SF	1	do	do	CEMB	Do.
2	Balanced Output Operation	do	All when used with double ended antennas.	SF	3	do	do	CEMB	Do.
3	High Speed Keying		Not applicable						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-11	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-12	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBA-13	Radio Transmitting Equipment								
1	Modification of Meter M-111 Bypass Circuit		Not applicable						
2	Balanced Output Operation		do						
3	High Speed Keying		do						
4	Modification of the O-5/FR Exciter Unit	December 1945	All using O-5/FR Exciter Units.	SF	2	Stock	None	CEMB	Do.
TBK	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.

TBK-1 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-2 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-3 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-4 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-5 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-6 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-7 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-8 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-9 Radio Transmitting Equipment								
1 Meter M-107 Erroneously Labeled		Not applicable						
2 Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	do	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.

ELECTRONIC FIELD CHANGE INDEX—T SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TBK-10	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-11	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-12	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-13	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/RF Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-14	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-15	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-16	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled		Not applicable						
2	Paralleled High Speed Keying	December 1945	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBK-17	Radio Transmitting Equipment								
1	Meter M-107 Erroneously Labeled	do	All under contract NXss 28616.	SF	1	do	do	CEMB	Do.
2	Paralleled High Speed Keying	do	All using parallel and high speed keying.	SF	3	do	do	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.

TBL Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch		Not applicable						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-1 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch		do						
2 Wiring Correction to Audio Output Jack, J-101		do						
TBL-2 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch		do						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-3 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch		do						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-4 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch		do						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-5 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch		do						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-6 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch	December 1945	All	SF	½	Stock	None	CEMB	None
2 Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-7 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch.	December 1945	All	SF	½	Stock	None	CEMB	Do.
2 Wiring Correction to Audio Output Jack J-101		Not applicable						
TBL-8 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch		do						
2 Wiring Correction to Audio Output Jack J-101	December 1945	All on contract NXss-33180.	SF	1	Stock	None	CEMB	Do.
TBL-9 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch.		Not applicable						
2 Wiring Correction to Audio Output Jack J-101	December 1945	All on contract NXss-33180.	SF	1	Stock	None	CEMB	Do.
TBL-10 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch.		Not applicable						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-11 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch.		do						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-12 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch.		do						
2 Wiring Correction to Audio Output Jack J-101		do						
TBL-13 Radio Transmitting Equipment								
1 Modification of Labeling of Bond Change Switch.		do						
2 Wiring Correction to Audio Output Jack J-101		do						

ELECTRONIC FIELD CHANGE INDEX—T SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TBM	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	January 1946	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	None
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-1	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	January 1946	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-2	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	January 1946	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-3	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units		Not applicable						
2	Parallel High Speed Keying	January 1946	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-4	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units	do	All	SF	3	Kit			
2	Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-5	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units	do	All	SF	3	Kit			
2	Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-6	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units	do	All	SF	3	Kit			
2	Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-7	Radio Transmitting Equipment								
1	Installation of Peak Limiting Thyrite Units	do	All	SF	3	Kit			
2	Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3	Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.

TBM-8 Radio Transmitting Equipment								
1 Installation of Peak Limiting Thyrite Units	do	All	SF	3	Kit			
2 Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-9 Radio Transmitting Equipment								
1 Installation of Peak Limiting Thyrite Units	do	All	SF	3	Kit			
2 Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-10 Radio Transmitting Equipment								
1 Installation of Peak Limiting Thyrite Units	do	All	SF	3	Kit			
2 Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-11 Radio Transmitting Equipment								
1 Installation of Peak Limiting Thyrite Units	do		SF	3	Kit			
2 Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBM-12 Radio Transmitting Equipment								
1 Installation of Peak Limiting Thyrite Units	do	Not applicable						
2 Parallel High Speed Keying	do	All using parallel and high speed keying.	SF	3	Stock	None	CEMB	Do.
3 Modification of the O-5/FR Exciter Unit	do	All using O-5/FR Exciter Units.	SF	2	do	do	CEMB	Do.
TBS Radio Transmitting Equipment								
1 Providing Standby Circuit	do	All	SF	2	do	do	CEMB	Do.
2 Installation of Transmission Line Filter CHW-53155.	do	do	YF	3	Kit		CEMB	NXsr-56756
3 Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TBS-1 Radio Transmitting Equipment								
1 Providing Standby Circuit	do	do	SF	2	do	do	CEMB	Do.
2 Installation of Transmission Line Filter CHW-53155.	do	do	YF	3	Kit		CEMB	NXsr-56756
3 Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TBS-2 Radio Transmitting Equipment								
1 Providing Standby Circuit	do	do	SF	2	do	do	CEMB	Do.
2 Installation of Transmission Line Filter CHW-53155.	do	do	YF	3	Kit		CEMB	NXsr-56756
3 Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TBS-3 Radio Transmitting Equipment								
1 Providing Standby Circuit	do	do	SF	2	do	do	CEMB	
2 Installation of Transmission Line Filter CHW-53155.	do	do	YF	3	Kit		CEMB	NXsr-56756
3 Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TBS-4 Radio Transmitting Equipment								
1 Providing Standby Circuit	do	do	SF	2	do	do	CEMB	Do.
2 Installation of Transmission Line Filter CHW-53155.	do	do	YF	3	Kit		CEMB	NXsr-56756
3 Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None

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ELECTRONIC FIELD CHANGE INDEX—I SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TBS-5	Radio Transmitting Equipment								
1	Providing Standby Circuit	January 1946	All	SF	2	Stock	None	CEMB	None.
2	Installation of Transmission Line Filter CHW-53155.	do	do	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TBS-6	Radio Transmitting Equipment								
1	Providing Standby Circuit	do	do	SF	2	do	do	CEMB	Do.
2	Installation of Transmission Line Filter CHW-53155.	do	do	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TBS-7	Radio Transmitting Equipment								
1	Providing Standby Circuit		Not applicable						
2	Installation of Transmission Line Filter CHW-53155.	January 1946	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TBS-8	Radio Transmitting Equipment								
1	Providing Standby Circuit		Not applicable						
2	Installation of Transmission Line Filter CHW-53155.	January 1946	All	YF	3	Kit		CEMB	NXsr-56756
3	Improving Reliability of Relay K-101	do	do	SF	2	Stock	None	CEMB	None
TCK	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	do	do	SF	½		Kit	IB & CEMB	Do.
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-1	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	January 1946	do	SF	½		Kit	IB & CEMB	Do.
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-2	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	January 1946	All	SF	½		Kit	IB & CEMB	Do.
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-3	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	January 1946	All	SF	½		Kit	IB & CEMB	Do.
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-4	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	January 1946	do						
2	Replacement of TCK-4 Filament Transformers		All shipped prior to 24 June 1944.	SF	½		Kit	IB & CEMB	
TCK-5	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	January 1946	All	SF	½		do	IB & CEMB	Do.
2	Replacement of TCK-4 Filament Transformers		Not applicable						
TCK-6	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	January 1946	do						
2	Replacement of TCK-4 Filament Transformers		All shipped prior to 24 June, 1944.	SF	2		Kit	IB and CEMB	
TCK-7	Radio Transmitting Equipment								
1	TCK Replacement Brush Kits	January 1946	All	SF	2		do	IB and CEMB	Do.
2	Replacement of TCK-4 Filament Transformers		Not applicable						

TCS Radio Transmitting-Receiving Equipment								
1 Modification of Model TCS Relay Circuit	January 1946	All	SF	1				
2 Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	Do.
3 Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4 Replacement of Motors and Generators		Not applicable						
5 Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6 Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7 Installation of TCS Noise Limiter		Cancelled						
8 Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9 Installation of Radio Interference Elimination Kit.	do	do	SF	3	do			N5ar-799
TCS-1 Radio Transmitting-Receiving Equipment								
1 Modification of Model TCS Relay Circuit	do	do	SF	1				
2 Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3 Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4 Replacement of Motors and Generators		Not applicable						
5 Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6 Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7 Installation of TCS Noise Limiter		Cancelled						
8 Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9 Installation of Radio Interference Elimination Kit	do	do	SF	3	Kit			N5ar-799
TCS-2 Radio Transmitting-Receiving Equipment								
1 Modification of Model TCS Relay Circuit	do	do	SF	1				
2 Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3 Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4 Replacement of Motors and Generators		Not applicable						
5 Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6 Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7 Installation of TCS Noise Limiter		Cancelled						
8 Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9 Installation of Radio Interference Elimination Kit	do	do	SF	3	do			N5ar-799
TCS-3 Radio Transmitting-Receiving Equipment								
1 Modification of Model TCS Relay Circuit	do	do	SF	1				
2 Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3 Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4 Replacement of Motors and Generators		Not applicable						
5 Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6 Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7 Installation of TCS Noise Limiter		Cancelled						
8 Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9 Installation of Radio Interference Elimination Kit	do	do	SF	3	Kit			N5ar-799

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Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TCS-4	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	January 1946	All	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-5	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	do	do	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None.
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-6	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	do	do	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB & CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	do	do	SF	3	Kit			N5ar-799
TCS-7	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	do	do	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						

5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	do	do	SF	3	Kit			N5ar-799
TCS-8	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	do	do	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-9	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	do	do	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None.
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-10	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	do	do	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None.
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-11	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit	do	do	SF	1				
2	Modification of Tap Switches	do	do	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						

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Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TCS—11—Continued									
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit	do	do	SF	3	Kit			N5ar-799
TCS-12	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit		Not applicable						
2	Modification of Tap Switches	January 1946	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators	do	2632 through 2766, 3497 through 3511, 3912 through 4311, 5504 through 5703, 6554 through 6853.	YF	3	do	do	CEMB	Do.
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	3	Stock		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	2	Kit			N5ar-799
TCS-13	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit		Not applicable						
2	Modification of Tap Switches	January 1946	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type-50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-14	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit		Not applicable						
2	Modification of Tap Switches	January 1946	All	SF	2	Stock	None	CEMB	None.
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						

5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type-50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-15	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit		Not applicable						
2	Modification of Tap Switches	January 1946	All	SF	2	Stock	None	CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do	do	CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All	YF	2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do	SF	3	Kit			N5ar-799
TCS-16	Radio Transmitting-Receiving Equipment								
1	Modification of Model TCS Relay Circuit		Not applicable						
2	Modification of Tap Switches	January 1946	All	SF	2	Stock		CEMB	None
3	Modification of the Loading Coil	do	do	SF	1	do		CEMB	Do.
4	Replacement of Motors and Generators		Not applicable						
5	Installation of Power Supply Filter CTD-53173 and CTD-53174.		Cancelled—Superseded by Field Change No. 9.						
6	Type -50159 Noise Limiter Adapter Units	January 1946	All		2	Kit		NavShips 900,005—IB and CEMB.	NXsr-42133 NXsr-48301 NXsr-65286
7	Installation of TCS Noise Limiter		Cancelled						
8	Replacement of Resistors R-303 and R-304	January 1946	All	SF	1	Stock	None	CEMB	None
9	Installation of Radio Interference Elimination Kit.	do	do		3	Kit			N5ar-799
TCZ	Radio Transmitting Equipment								
1	Replacement of 28-volt Generator Brushes	do	All with type 211101 AC Power Units.	SF	½	Kits and Stock		CEMB	NXs-491 NXsr-59134 NXsr-59134
2	Removing of Audio Input Ground of Type COL-23410 Remote Control Unit.	do	All used with standard Navy receivers, such as RBA, RBB and RBC.	SF	½	Stock	None	CEMB	None
TCU-1	Radio Transmitting Equipment								
1	Replacement of 28-volt Generator Brushes	do	All	SF	½	Kits and Stock		CEMB	NXs-491 NXsr-59134 NXsr-65387
2	Removing of Audio Input Ground of Type COL-23410 Remote Control Unit.	do	All used with standard Navy receivers, such as RBA, RBB and RBC.	SF	½	Stock	None	CEMB	None
TCU-2	Radio Transmitting Equipment								
1	Replacement of 28-volt Generator Brushes		Not applicable						
2	Removing of Audio Input Ground of Type COL-23410 Remote Control Unit.		All used with standard Navy receivers, such as RBA, RBB and RBC.	SF	½	Stock	None	CEMB	Do.

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Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
TDE	Radio Transmitting Equipment								
1	Microphone Modification Kit	January 1946	1 through 256, 393 through 441, 448 through 611, 613 through 880, 993 through 1124, 1183 through 1248, 1250, 1293 through 1471, 1475.	YF	2	Kit	None	Kit and CEMB	NXs-3179
2	Installation of Filament Warm-Up Circuit	do	All	YF	3	Stock	do	CEMB	None
3	Installation of Improved Range Switch S-307B	do	do	SF	2	Kit			NXss-3179 NXss-20802 NXsr-33634 NXsr-38682
TDE-1	Radio Transmitting Equipment								
1	Microphone Modification Kit		Not applicable						
2	Installation of Filament Warm-Up Circuit	January 1946	All	YF	3	Stock	None	CEMB	None
3	Installation of Improved Range Switch S-307B	do	do	SF	2	Kit			NXss-3179 NXss-20802 NXsr-33634 NXsr-38682
TDE-2	Radio Transmitting Equipment								
1	Microphone Modification Kit		Not applicable						
2	Installation of Filament Warm-Up Circuit	January 1946	All	YF	3	Stock	None	CEMB	None
3	Installation of Improved Range Switch S-307B	do	1 through 340, 372 through 835, 1046 through 1351.	SF	2	Kit			NXss-3179 NXss-20802 NXsr-33634 NXsr-38682
TDE-3	Radio Transmitting Equipment								
1	Microphone Modification Kit		Not applicable						
2	Installation of Filament Warm-Up Circuit	January 1946	All	YF	3	Stock		CEMB	None
3	Installation of Improved Range Switch S-307B		Not applicable						
TDQ	Radio Transmitting Equipment								
1	Overload Relay K-303 Change	January 1946	All	SF	1	Stock		CEMB	Do.
2	Model TDQ Transmission Line Filter Type CRV-53232.	do	1 through 2881	YF	2	Kit	N16-K-2997.	CEMB	NXsr29644
3	Caution Nameplate for TDQ	do	All	SF	½	do		CEMB	N5sr-14265P
4	Provide Extended Audio Range for Communication Control Link Service.	do	TDQ transmitters when used in CCL service, provided increased audio bandwidth is required.	SF	1	Stock	None	CEMB	None
TDT	Radio Transmitting Equipment								
1	Addition of Send-Receive Relay	do	All	SF	2	do	do	CEMB	Do.
2	Reducing Voltage Surges on Rectifier Tubes	do	1 through 30	SF	2	do	do	CEMB	Do.
3	Replacement of Resistors R-10, R-11 & R-13	do	All	SF	1	do	do	CEMB	Do.
4	Installation of Blower Motor Reactor	do	do	SF	1	do	do	CEMB	Do.

TDY Radio Transmitting Equipment									
1	Addition of Stop-Start Resistor	August 1945	do	SF	1	do	do	CEMB	
2	Extension of Lower Frequency of TDY with Manual Antenna Mount.		Superseded by F. C. #4						
3	Installation of Motor Driven Antenna Mount and Control Indicator.		do						
4	Modernization Kit	August 1945	All	YF	12	Kit		CEMB	NXsr-46934
5	Conversion of Model TDY to TDYa and Model TDY-1 to TDY-1a.	do	As directed	YF	112	do		NavShips 900,551	NXsr-81474
6	Simplification of Monitor System	do	All	SF	6	None required		CEMB	
7	Tube Injector Modification	do	do	SF	4	do		CEMB	
8	Replacement of Two Reflectors in TDY-a/TDY-1a Antenna System.	do	TDY-a/TDY-1a	YF	16	Kit			NXsr-81474
9	Relocation of Magnetron Tube Clamp		Cancelled						
10	Addition of Remote Antenna RF Switch in CAPR-10AFJ Pedestal.		do						
11	Replacement of Magnetron Filament Leads		do						
12	Addition of Second Magnetron Seal Blower	August 1947	TDY Equipments using 35ABL Oscillators having Serial #1-150.	YF	5	Kit			NXsr-46934
13	Installation of Spacer Band for Magnetron Filament Leads.		Cancelled						
14	Change and Relocation of Bleeder Resistors		do						
15	Replacement of Pump Seal Assembly		Not applicable						
16	Improved Conversion of Model TDY to TDY-a and Model TDY-1 to TDY-1a.	1945	As directed	YF	112	Kit		NavShips 600,551 (A).	NXsr-90814
17	Cancelled		Cancelled						
TDY-1 Radio Transmitting Equipment									
1	Addition of Stop-Start Resistor		Not applicable						
2	Extension of Lower Frequency of TDY with Manual Antenna Mount.		do						
3	Installation of Motor Driven Antenna Mount and Control Indicator.		do						
4	Modernization Kit		do						
5	Conversion of Model TDY to TDYa and Model TDY-1 to TDY-1a.	August 1945		YF	112	Kit		NavShips 900,551	NXsr-81474
6	Simplification of Monitor System	do	All	SF	6	None required		CEMB	
7	Tube Injector Modification	do	do	SF	4	do		CEMB	
8	Replacement of Two Reflectors in TDY-a/TDY-1a Antenna System.	do	TDY-a/TDY-1a	YF	16	Kit			NXsr-81474
9	Relocation of Magnetron Tube Clamp		Cancelled						
10	Addition of Remote Antenna RF Switch in CAPR-10AFJ Pedestal.		do						
11	Replacement of Magnetron Filament Leads		do						
12	Addition of Second Magnetron Seal Blower	August 1945	TDY-1 Equipments using 35ABL Oscillators having Serial #1-150.	YF	5	Kit			NXsr-46934
13	Installation of Spacer Band for Magnetron Filament Leads.		Cancelled						
14	Change and Relocation of Bleeder Resistors		do						
15	Replacement of Pump Seal Assembly	1945	Serial #1-134	YF	2	Kit			NXsr-46934
16	Improved Conversion of Model TDY to TDY-a and Model TDY-1 to TDY-1a.	1945	As directed	YF	112	do		NavShips 900,551 (A).	NXsr-90814
17	Cancelled		Cancelled						

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Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
	TDZ Radio Transmitting Equipment								
1	Modification to Automatic Tuning System and Drawer Mechanism.	February 1946	1 through 100, 107 through 109, 111, 113 through 124, 128 through 134, 136 through 137, 140.	YF	60	Kit	None	CEMB	NXsr-55652
2	Modification to Allowance of Tender Spare Parts.	do	Tender Spares, Priorities 1t, 2t, 3t, 4t and 10t.	YF or SF	1	do	do	CEMB	NXsr-55652
3	Installation of Protective Guard on Telephone Type Dial.	do	1 through 1000	SF	1	do	do	CEMB	NXsr-55652
4	Addition of Drawer Fasteners to Equipment Spare Parts.	March 1947	1 through 1000	YF or SF	1	do	do	CEMB	NXsr-55652
5	Provision of Dial Cranks	January 1949	All	SF or YF	0	do	do	None	NXsr-55652

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Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
YE	Radio Homing Equipment								
1	Installation of Matching Transformer Type CRV-47194.	November 1945	All	SF	3	Stock	None	CEMB and I. B. 38147.	None.
2	Modification to Antenna Assembly Drive Unit Heater Circuit.	do	do	SF	1	do	do	CEMB	Do.
3	Addition of Capacitors to Gyro Selsyn System	do	do	YF	2	do	do	CEMB	Do.
4	Shorting of Interlock Switch S-114	do	do	SF	1	do	do	CEMB	Do.
5	Change in Value of Spark Absorbing Resistor 503.	do	do	SF	1	do	do	CEMB	Do.
6	Elimination of Interference in Radio and Radar Equipments.	do	do	SF	1	do	do	CEMB and I. B. 38147.	Do.
YE-1	Radio Homing Equipment								
1	Installation of Matching Transformer Type CRV-47194.	do	do	SF	3	do	do	CEMB	Do.
2	Modification to Antenna Assembly Drive Unit Heater Circuit.	do	do	SF	1	do	do	CEMB	Do.
3	Addition of Capacitors to Gyro Selsyn System	do	do	YF	2	do	do	CEMB	Do.
4	Shorting of Interlock Switch S-114								
5	Change in Value of Spark Absorbing Resistor 503.	November 1945	All	SF	1	Stock	None	CEMB	Do.
6	Elimination of Interference in Radio and Radar Equipments.	do	do	SF	1	do	do	CEMB	Do.
YE-2	Radio Homing Equipment								
1	Installation of Matching Transformer Type CRV-47194.	do	do	SF	1	do	do	CEMB and I. B. 38147.	Do.
2	Modification to Antenna Assembly Drive Unit Heater Circuit	do	do	SF	3	do	do	CEMB	Do.
3	Addition of Capacitors to Gyro Selsyn System	do	do	SF	1	do	do	CEMB	Do.
4	Shorting of Interlock Switch S-114	do	do	YF	2	do	do	CEMB	Do.
5	Change in Value of Spark Absorbing Resistor 503.	do	do	SF	1	do	do	CEMB	Do.
6	Elimination of Interference in Radio and Radar Equipments.	do	do	SF	1	do	do	CEMB	Do.
YE-3	Radio Homing Equipment								
1	Installation of Matching Transformer Type CRV-47194.	do	do	SF	1	do	do	CEMB and I. B. 38147.	Do.
2	Modification to Antenna Assembly Drive Unit Heater Circuit.	do	do	SF	3	do	do	CEMB	Do.
3	Addition of Capacitors to Gyro Selsyn System	do	do	SF	1	do	do	CEMB	Do.
4	Shorting of Interlock Switch S-114	do	do	YF	2	do	do	CEMB	Do.
5	Change in Value of Spark Absorbing Resistor 503.	do	do	SF	1	do	do	CEMB	Do.
6	Elimination of Interference in Radio and Radar Equipments.	do	do	SF	1	do	do	CEMB	Do.

ELECTRONIC FIELD CHANGE INDEX—Y SERIES—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
YG	Radio Homing Equipment								
1	Change in Over-the-Bow Keying Circuit	November 1945	All	SF	1	Stock	None	CEMB	None.
2	Hood for Barco Joint	do	do	YF	3	Kit		With kit	NXs-820
3	Installation of Improved Contacts for Relay K-101.		Superseded by Field Change #4.						
4	Elimination of Keying Relay K-101	November 1945	All	SF	3	Stock	None	CEMB IB	None.
5	Addition of True Bearing Control Unit Type CAIH-23408.	do	do	YF	8	Kit		38258-P3 (with kit)	
6		do	1 through 30	SF	1	Stock	None	CEMB	Do.
YG-1	Radio Homing Equipment								
1	Change in Over-the-Bow Keying Circuit	do	1 through 759	SF	1	do	do	CEMB	Do.
2	Hood for Barco Joint		Not applicable						
3	Installation of Improved Contacts for Relay K-101.		do						
4	Elimination of Keying Relay K-101		do						
5	Addition of True Bearing Control Unit Type CAIH-23408.	November 1945	All	YF	8	Kit		IB-38258-P3 (with kit).	
6			Not applicable						

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ELECTRONIC FIELD CHANGE INDEX—AN AND ARMY EQUIPMENT

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
AN/APN-9 Radar Set									
1	Improved Crystal Clamp	April 1, 1946	All shipboard installations	SF	1	Stock	None	CEMB	None.
AN/ARC-1 Radio Transmitting-Receiving Equipment									
1	Reducing Radio Interference Caused by Dynamotors.	April 1949	All Model DY-9/ARC-1, DY-ARC-1 and DY-9B/ARC-1, Dynamotors with serial numbers prior to 89111.	SF	2	do	do	CEMB	Do.
AN/SPR-2 Radar Receiver									
1	Disconnecting Blower Motor Leads	July 14, 1949	All	SF	1	do	do	NavShips 98144	Do.
AN/UPM-2 Wavemeter Test Set									
1	Replacement of Crystals	April 1948	do	SF	¼	do	do	CEMB	Do.

ELECTRONIC FIELD CHANGE INDEX—MISC EQUIPMENTS AND COMPONENTS

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
FRA	Frequency Shift Converter								
1	Installation of Capacitor, C-120	May 1946	1-16	SF	1	Kit		CEMB (and with Kit).	N5sr-7266
FRF	Frequency Shift Converter								
1	Addition of Shockmounts for Shipboard Installations.	March 1948	All installed aboard ships	YF	8	do		NavShips 98027	N5sr-5971
→Model 14 Transmitter-Distributor Teletype Equipment									
1	Replacement of Motor-Generator Resistor	October 1947	All Model 14 transmitter-distributors having either No. 107151 or No. 6708 AC series governed motors.	SF	1	Stock	None	NavShips 98028	None
TT-23/SG	Teletype Panels								
1	Replacement of Jack Washers and Nuts and Rewiring of Meter Circuit.	June 1948	All	SF	2	Kit	do	NavShips 98085	NObsr-39378 ←

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ELECTRONIC FIELD CHARGE INDEX—NAVY TYPE NUMBERED COMPONENTS

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
→	Type CME-60069 Signal Generator								
1	Addition of Output Control for Type CME-60069 Signal Generator.	February 1946	All CME-60069 Signal Generators used with Loran Skyware Trainers.	SF	½	Stock	None	CEMB	None. ←

ELECTRONICS FIELD CHANGE INDEX—SONAR SOUNDING EQUIPMENT

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
→NJ-3/9 Sonar Sounding Equipment									
1	Add Isolation Transformer to Index Stylus Circuit (CBM-55068).	April 1945	Equipment having ungrounded a. c. supply, not from M-G sets.	SF	3	Kit	F16M 384501-640.	RIB-143	NOs 80423.
2	Add R-119 across C-126	October 1945	All 835 Receiver-Amplifiers.	SF	½	Stock	None	CEMB, SMB, RIB-144, alt. 777 of 5/1/43.	None.
NJ-6 Sonar Sounding Equipment									
1	Stabilization of Receiver Amplifiers (CIP-46173).		Those which do not have terminal No. 10 grounded directly. Also EC-2 equipment.	SF	½	None required	do	CEMB, SMB, RIB-92.	NXs-4853 BLUDWORTH.
NJ-7 Sonar Sounding Equipment									
1	Add R-119 to CBM-46131/46131A (see 2-NJ-3/9)	September 1945	All	SF	½	Stock	do	CEMB, SMB	NOs 80423.
NJ-8 Sonar Sounding Equipment									
1	Resistor Across C-210/N Receiver Ampl	November 1943	1-212 (CET-55093)	SF	½	do	(63288-10).	CEMB, RIB - 48 and 49, SMB.	NXsr 64164 NXs 4853.
2	To permit 115 volt a. c. operation	October 1944	Those on 115 volt a. c. vessels (CET-55093).	SF	2	do	None	CEMB, SMB, RIB-91.	NXs-4853.
3	Improve Recorder Trace	September 1945	CIP-55127 Receiver - Recorders.	SF	1	do	do	CEMB, SMB I. B. Prel CIP-24245.	
NK-2 Sonar Sounding Equipment									
1	Add R-303 in Series with R-301 and 302	June 1944	All	SF	½	Kit	ES 11489, 3 000-10W.	CEMB, SMB, RIB-75.	NXs 2341 and NXss 21997
NMB-1 Sonar Sounding Equipment									
1	Change to Recorder—Indicator	June 1943	4-57	SF				Nearest RCA Representative.	
2	Disconnect C-421-B in Plate of (CRV-55065) of V-409.	April 1944	do	SF	½	None	None	RIB-66, CEMB, FIG 38 of I. B.	
3	Keying Contact—Replace	January 1944	do	YF			F16M-384501-784	IB 38108-e Addendum to I. B.	NOS-80654
NMC Sonar Sounding Equipment									
1	Correction of Factory Wiring Error (-43033)	January 1946	I-301 to I-305, inclusive, I-307, I-390 to I-316, inclusive, I-318, I-319, I-322, I-330, and I-334.	SF	½	None	None	CEMB, SMB, RIB-95-114.	
2	C-453-B Replaced with 0.01 Mfd. Condenser.	May 1945	I-300 and I-301-I-335	SF	1	Kit	F16M-384501-726	NAVSHIPS 98002, RIB-66, -108, W-306185.	NOS-80654
3	Spring Brake for Idler Gear O-422	April 1945	On contracts NOs-80654 1-70 81 on contract I-301 and I-868.	SF				NAVSHIPS 98003, RIB-66.	NOs-80654, NXs-23699.

ELECTRONICS FIELD CHANGE INDEX—SONAR SOUNDING EQUIPMENT—Continued

Field change number	Field change title	Date of field change	Serial numbers of equipment affected	Modifying activity	Man-hours required	Source of material	Stock number of kit	Instruction bulletin	Contract number
NMC Sonar Sounding Equipment—Continued									
4	Pantograph Idler Gear With Ball Bearing	April 1945	70 on contract NXss-23699 1-500.			Kit	F16M-384501-625.	NAVSHIPS 98003, RIB-141, RCA-69095, 383079/28. RIB-108, -109	NOs-80654
5	New Chromium Stylus Needle	Deleted							
6	Addition of R-491, 492, 493, and Change in Valve of R-435.	May 1945	I-300 and I-301-I-335	SF	1	do	F16M-384501-726.	BuShip Spec 9-S-5341-L ALT. 5, 98002.	NOs-80654
7	Installation of Watertight Filter Junction Box.	April 1945	All	SF	4			CEMB, SMB, NAVSHIPS 98090, RIB-251, -276, -277, Pilot Ltr. S68 (983) R-2632 EN28/A2-11, PL. 9-S-53 41-h (A-5), RE-53F-2, 000A.	
8	Replacement of Xducer Diaphrams	November 1948		YF			F16M-384501-738.	NAVSHIPS 98090	NObsr 42418 (RCA)
NMC-1 Sonar Sounding Equipment									
1	Add Parasitic Suppressors	October 1944	1-20 (CBM-52316)	SF	1	Stock		CEMB, SMB, RIB-95, Spec. 8352B.	NXss 23136
2	Replace R-414A and R-414B	February 1945	1-188 of CBM-52316	SF	1	do		RIB-118	NXss 23136

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HANDLING AND STOWAGE OF RADIOACTIVE SAMPLES

Radium is continually active, sending off radiations at all times. Therefore, certain precautions must constantly be observed to protect personnel, and to prevent radiation damage to photographic and radiographic films and papers.

Radium is shipped in wood cases of sufficient size to prevent personnel from approaching near enough to be harmed by these radiations, unless such contact is for an extended time. These cases have screwed-down covers, which may be lifted off to remove the radium safe. For convenience, the radium safe is not replaced in the wooden case except when it is to be reshipped.

The radium safe is usually a hardwood box with a hinged cover, although this hinged cover may be omitted in some designs. Inside this wood box is a continuous lead safe of sufficient thickness to protect the operator while the radium is being carried from place to place. The lead safe is provided with a lead plug, which may be attached to the hinged cover, or may be otherwise securely held in place until it is necessary to use the radium. When the radium is not in use, it should always be kept in this safe, which should either be stored underground or locked in an iron or steel safe having walls three inches thick. A simple means of storage is provided by a hole in the floor, preferably in some place where personnel will not be working. This hole should be lined with concrete or brick and should be covered with a continuous lead slab about two inches thick.

The radium itself, in the form of radium sulphate, is sealed in a silver capsule, usually cylindrical in shape. This capsule is contained in an aluminum or stainless steel holder, either cylindrical or pear-shaped, which is provided with strings for manipulation. THE RADIUM CAPSULE MUST NEVER BE REMOVED FROM THE HOLDER BY THE OPERATOR.

When using the radium, a location must be selected where personnel will not be working within twenty feet, or passing within six feet. The location should be roped off for a distance of six feet and preferably ten feet, and suitable danger signs provided.

When calibrating radiac equipment, it is desirable to have in readiness a wooden block of the correct height, the top of which has been bored out slightly to form a shallow depression of sufficient size to accommodate the particular radium holder. A glass funnel in a ring stand also provides a convenient support, which can be located in the correct position before the radium is removed from the lead safe.

When everything is in readiness, the radium safe is opened and the radium holder removed and placed in position for use. The operator must not touch the radium holder, even though he may be wearing gloves. Ordinary gloves and clothing are not protection against these radiations. Lead aprons or gloves are not much better and may offer a false sense of security.

In order to manipulate the radium and still keep all parts of the body at a safe distance, the operator should be provided with a wood stick about ¾″ x ¾″ in cross-section and four feet long, and which should be notched at one end. To remove and carry the radium the string attached to the holder is placed in the notch, which is held just above the holder in the case. The stick is held by the opposite end, the string being held by the other hand. In this way the radium can be lifted from the safe, carried to the desired spot (which should not be more than a few feet from the safe) and placed in the correct position in a minimum of time, without ever being closer than four feet from any part of the operator's body. As soon as the operation is finished the radium should be returned to the lead safe which should be closed immediately.

When handling radium, the operator should have a healthy respect for the radiation hazards, but need have no fear of harmful physiological effects, provided all necessary precautions are taken in its use. Numerous Naval Inspectors performed radiographic examination almost continuously during World War II, in many cases using radium units as large as 500 milligrams, yet suffered no ill effects. Time and distance are the most important factors to keep in mind. The operator should not approach the exposed radium holder nearer than necessary nor for a longer time than absolutely necessary to conduct the required operations of placing, checking equipment, and replacing in the lead safe. When not in actual use, the radium holder must be kept in the lead safe. This safe is designed to give sufficient protection to the operator while he is carrying it about, or even when working close to it, except for prolonged periods. As a final protection, film badges should be worn by all personnel handling radium, as required by NavMed P–1283, Manual of Radiological Safety, dated March 1948.

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→ RADIO INTERFERENCE AND CABLE REPLACEMENT

Radio interference studies of electronics installations aboard Naval vessels indicate that frequently insufficient thought is given to interference problems that may occur as the result of having high level and low level electronics cables installed close together. In the past when examples of radio interference coupling, caused by the improper placement of high and low level cables have been pointed out, the question usually asked is: "What about the cable armor; doesn't it act as a shield for the cable?" The answer is: "Yes, partly." Cable armor is designed for one purpose: cable protection. The fact that cable armor can also be used as radio frequency shielding is a happy accident, but this property of cable armor must be used intelligently. Too often, the shielding effectiveness of cable armor is overestimated. While the shielding effectiveness of various types of cable armor varies considerably, the greatest radio frequency attenuation that can be expected from types now in use is approximately 40 db. Expressed as a voltage ratio, the maximum attenuation is approximately 100 to 1. It can be easily seen that considerable leakage of radio frequency energy can be expected through cable armor, especially from armored cables which are carrying high levels of radio frequency energy or radio interference.

Interference currents and voltages in armored cables can affect other circuits in two ways:

1. By direct radiation penetration of the interference through the armor itself, which of course is attenuated by an amount dependent on the effectiveness of the armor as a shield.

2. By radio frequency leakage currents which travel on the *outside* surface of the cable armor instead of on the inside as they would if the armor acted as a perfect shield. These currents, flowing along the outer surface of the cable, can develop voltage drops along the armor by virtue of the radio frequency impedance of the armor itself, which can be considerable at radio frequencies. These voltage drops along the cable armor can then cause the armor to act as a radiator or antenna. This interference radiation can be particularly severe at certain frequencies if the armor length is such that it is resonant at those frequencies. Thus it can be seen that the proper grounding of cable armor is important. By providing a low impedance path to ground at both ends of a cable length, the leakage currents which would ordinarily flow along the outer surface of cable armor can be at least partly short circuited, and radiation of interference from the cable armor minimized. It is vitally important that ground connections have as low an impedance as possible. Important features in ground strap installation are short length, large continuous surface area, and good metallic connection.

The following instances of mutual interference between electronic equipments caused by improper placement of high and low level cables will illustrate several ways in which this type of interference coupling manifests itself. Although all of the following cases occurred aboard submarines, the principles involved apply equally well to all types of ships.

1. The first case concerned mutual interference between WFA–1 sonar and SS radar equipments. When the two equipments were operated simultaneously, the pulse repetition frequency of the SS radar could be heard in the output of the WFA–1 sonar. Neither

equipment chassis was grounded, nor was the cable armor on any of the cables leading to the equipments grounded. Loop probe investigation with the AN/PRM–1 Radio Interference Field Intensity Meter disclosed high levels of SS radar pulse interference on each of two cables: one leading to the SS equipment and the other leading to the WFA–1 equipment. Lifting of several deck plates, beneath which the cables were run, revealed the source of coupling. The two cables were run side by side for about four feet in the same cableway. Physical separation of the two cables to opposite sides of the cableway, a distance of about six inches, reduced the interference to an almost negligible amount. In this case, complete elimination of the interference could be effected by proper grounding of equipment cases and the armor of the cables leading into them.

2. The second case concerns mutual interference between a TCZ transmitter and an SV–1 radar equipment. When the two equipments were operated simultaneously, a bright flash would appear on the PPI scope of the SV–1 radar each time the TCZ transmitter was keyed. It was found that the video cable installed between the SV–1 receiver and console had been run through the radio room very close to the TCZ antenna transmission line. TCZ transmitter energy was being coupled into the low level video cable at this point. After the video cable had been rerouted so that it ran around, not through, the radio room, it was found that the interference between the two equipments had been eliminated.

These examples indicate, in part, the relatively simple precautions and corrective measures that are to be resorted to in improving performance by the reduction of electronic interference. It is becoming more apparent, as the Electronic Interference Reduction Program progresses, that proper utilization of cable armor in eliminating and confining interference resolves itself predominantly into a matter of good workmanship and "good housekeeping." Consistent attention to this will materially improve performance of the installed electronic equipment and render the vessel more secure from detection by further reducing the chances of spurious radiation. *1/1/51*

ANTENNA DISCONNECT SWITCHES

It is suggested that, when any bar type antenna disconnect switch (Drawing RE 66F 311) presently installed in many 9″ x 11″ radio transmitting antenna trunks in Navy vessels is in need of repair, it be replaced by the installation of a Type 24270 antenna switch as an *alteration equivalent to repair.*

The Type 24270 antenna disconnect switch is essentially a section of a 9″ x 11″ transmitting antenna trunk containing a single-pole three-position switch and a blanking off plate. It has been tested and approved by NRL, Anacostia, D. C., and is obtainable through ESO, Great Lakes. The essential information necessary to obtain this disconnect switch is Navy Type No. 23270; Standard Navy Stock No. 17–S–5341–877; ESO Stock No. N16–S–12100. *1/1/51*

PROTECTION OF EXPOSED R. F. CABLE AND CONNECTORS

The following notes are being added to installation plans which contain instructions for installing exposed radio frequency solid coaxial cables (except teflon) and should be followed where no other specific instructions are issued:

1. A smooth, thin and uniform film of dielectric compound should be used only on—
   - (*a*) Cable plugs and jacks
     - (1) on gaskets
     - (2) outside the cable jacket where the clamping nuts will seize cable.
     - (3) all threads exposed during assembly
   - (*b*) Adapters—only on exposed threads.

CAUTION: DO NOT fill voids with dielectric compound unless specifically called for in the installation instructions. To do so will adversely affect the electrical characteristics.

2. Electrical Insulating Varnish—JAN-V-1137 Grade CA should be painted on the outside of all *assembled* connectors to a point at least 4 inches from each connector after wiping off any excess dielectric compound.

3. After the varnish has dried cover the entire varnished area with several layers of type VF (vinyl) Synthetic Resin Tape with 9–50% overlap between turns.

4. For teflon cable installations see RA 62F 2000—Shipboard Installations Teflon Cable High Temperature Use (included in NAVSHIPS 900, 153—Standard and Guidance Plans).

Material, specification, grade, or class	Obtain from—	Ordering information	
		Standard Navy Stock No.	Size
Insulating Varnish; JAN-V-1137;[1] Type X; Grade CA.	GSSO	G52-V-1240	1 pint can.
		G52-V-1245	1 quart can.
		G52-V-1255	1 gallon can.
		G52-V-1260	5 gallon can.
Dielectric Compound; AN-C-128; (Dow Corning No. 4).	ESO	N52-C-3096-790	8 ounce cartridge.
	ASO	ASO Stock No.:	
		R52-C-3109-110	8 ounce cartridge.
		R52-C-3107-125	10 pound can.
Synthetic Resin Tape; 17-T-28; Type VF; (Vinyl).	GSSO	G17-T-1745-60[2]	¾ inch width.[2]
		G17-T-1745-200	1 inch width.
		G17-T-1745-250	1¼ inch width.
		G17-T-1745-300	1½ inch width.

[1] Formerly 52-V-13.
[2] Preferred size.

Attention is again invited to the necessity of using Armor Clamp MX-564/U with the UG-21/U, UG-22/U and UG-23/U series connectors when installed on armored cable.

The latest types of connectors shall be used especially in critical applications. *1/1/51*

GROUND CONNECTIONS

Ungrounded electronic equipment cases create an unnecessary hazard and frequently produce electronic interference. This has been called to the Bureau's attention on several occasions during recent reactivations. It is recommended that special attention be paid to:

(*a*) Checking for and installing missing ground connections.

(*b*) Making sure that all ground connections are less than .005 ohm d. c. *1/1/51*

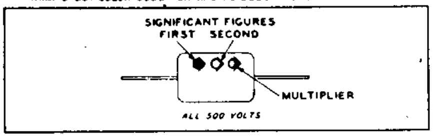
→ CAPACITOR AND RESISTOR CHART

The chart reproduced below in miniature is being distributed to all persons and activities who receive the Electron. Anyone else wishing a copy may request it through the nearest District Publication and Printing Office under NavShips 900,128. *4/1/51*

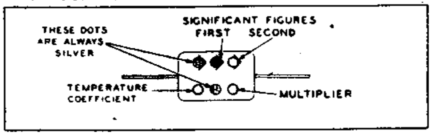
NavShips 900,128

CAPACITOR COLOR CODES

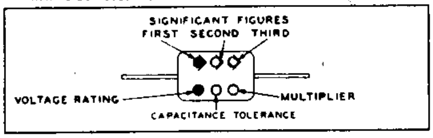
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



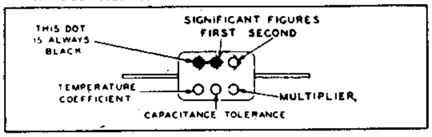
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



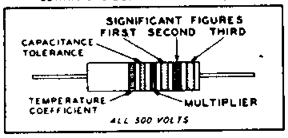
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

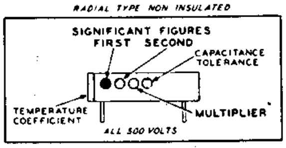


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

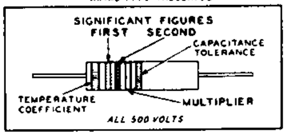


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON INSULATED



AXIAL TYPE INSULATED

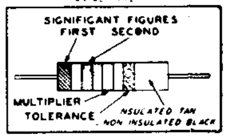


RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

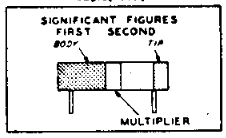
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

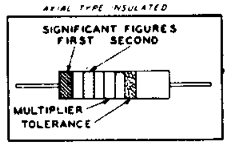


RADIAL TYPE

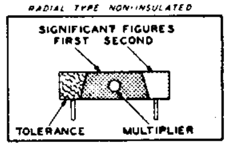


JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED



RESISTORS				CAPACITORS				
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1000	3	ORANGE	1000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1000,000,000	9	WHITE	1000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

ARMED FORCES CROSS INDEX OF ELECTRON TUBE TYPES

The Cross Index of Electron Tube Types—NavShips 900,119 and its supplement—NavShips 900,119-1, have been superseded by the Armed Forces Cross Index of Electron Tube Types which is published as Section 16-820 (BuShips Section, Part II) of the Catalog of Navy Material.

This section of the catalog has been distributed separately to all holders of NavShips 900,119. Those activities which have not received a copy and have need of one may address their request to the Bureau of Ships. *4/1/50*

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INSULATION RESISTANCE OF COAXIAL LINES ON SHIPBOARD

The insulation resistance of solid dielectric or air dielectric coaxial lines as installed and not terminated by any equipment (but including connectors attached) should be over 100 megohms as measured with a 500 volt megger or megohm meter such as Navy Model OCW or Type P (Standard Navy Stock Number G17-I-702). *4/1/51*

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ENVELOPES FOR ELECTRONICS FAILURE REPORTS

In the past, special franked envelopes, NavShips 383A, have been used when submitting electronics failure reports, NavShips 383. Stocking of this type of envelope has been discontinued, but it will be issued until the present supply is depleted. When submitting failure reports, personnel should utilize the standard envelopes as found in the supply system. These failure reports should be submitted to the Bureau of Ships; Attention Electronics Division. *1/1/52*

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→ AVAILABILITY OF KY–44(XN–2)FX INSTRUCTION BOOKS AND PARTS LISTS

The twenty (20) facsimile keyer adapters, which were manufactured at NAVSHIPYD MARE and given the nameplate nomenclature, KY–44(XN–2)FX, were shipped without instruction books. NAVSHIPS 91441, to be available shortly from the Publications Office, applies except for the parts list which is included in Plan RM67J–137. This drawing can be obtained from NAVSHIPYD MARE. RM–67J–138, the schematic and wiring diagram for the KY–44(XN–2)FX, is also available from NAVSHIPYD MARE. *7/1/52*

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INSPECTION OF SPARE ARMATURES FOR RADIO MOTOR–GENERATORS

A recent inspection of spare armatures for the Models TBS and TBL motor-generators aboard ships of the Cruiser-Destroyer Force Pacific Fleet, indicated that the wrong type of armatures were being carried as spares. Armatures of the DC input type used with DC motor-generators were carried on board ships having AC type motor-generators. In addition it was found that some of these armatures had been damaged and would require repairs before they could be used.

The Bureau of Ships requests that all spare armatures for radio transmitters be inspected for correctness of type for the equipment installed, and to determine that they are apparently free of mechanical defects or damage. Although packing instructions state that the packing seals should not be broken until the spare is required for use, it is desired that each armature be visually inspected. Armatures found to be of a type not suitable for replacement in the motor-generator installed should be exchanged at the earliest opportunity.

Technical personnel making this inspection must remember that stock numbers alone should not be used to judge the correctness of the type. Standard Navy Stock Number assignments are subject to changes, therefore, a careful check of symbol and manufacturing part numbers should be made with the instruction book to insure having the right armature for the particular motor-generator installed.

Care should be taken in unpacking armatures so that the moisture-proof packaging may be resealed. *7/1/52*

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