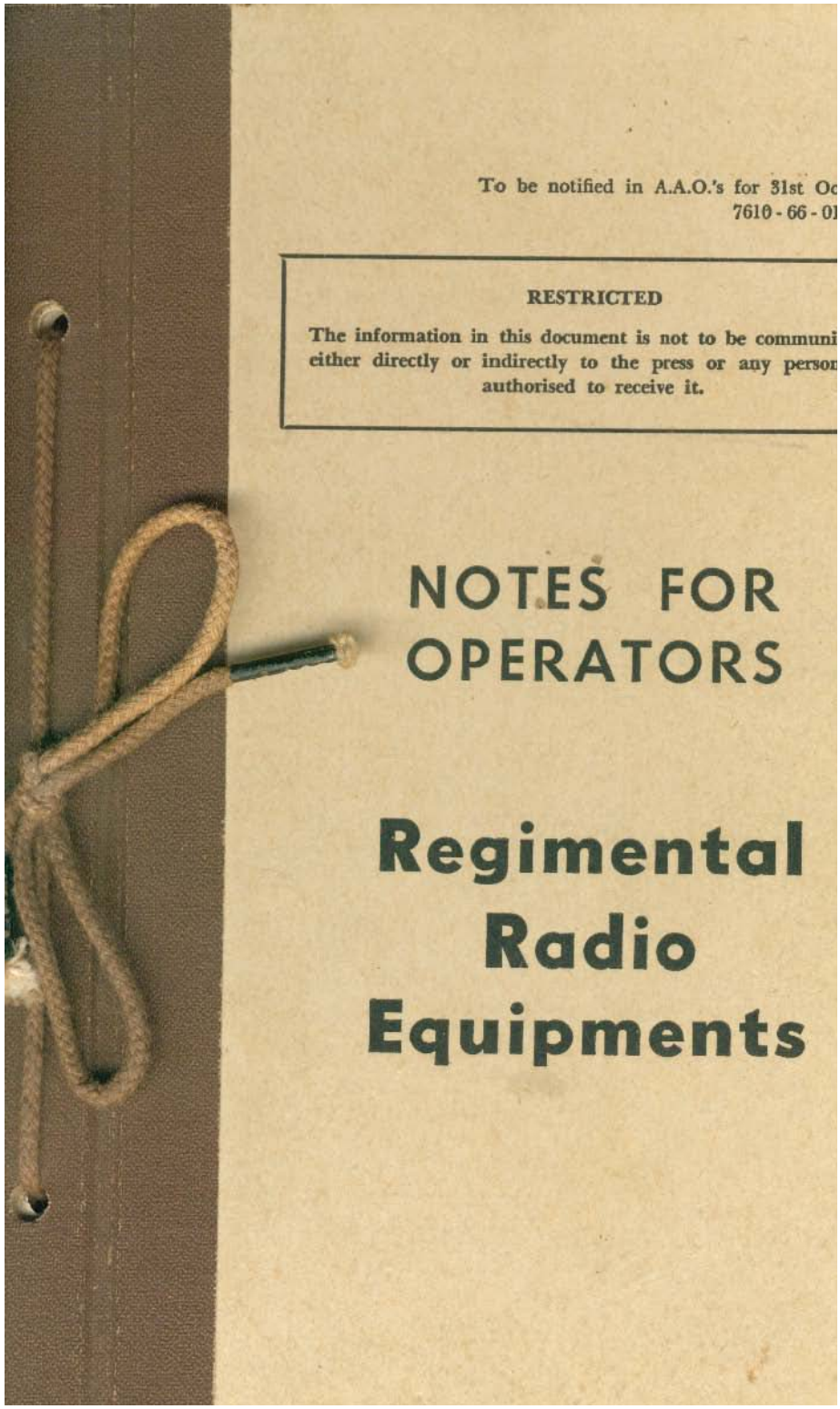

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NOTES FOR OPERATORS

Regimental Radio Equipments

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NOTES FOR OPERATORS

Regimental Radio Equipments

MILITARY BOARD

Army Headquarters,
Canberra.
1/10/61.

Issued by command of the Military Board.

Secretary to the Board.

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CHAPTER FIVE
WS 510

CHAPTER SIX—

AERIALS FOR LOW POWER FIELD WIRELESS OPERATION

ILLUSTRATIONS

CHAPTER 1

Introduction

1. This pamphlet has been prepared to meet the need within the Australian Military Forces for a consolidated reference for the three current low power portable field wireless sets. It is not a replacement for the equipment handbooks issued with the sets. Technical maintenance data is available in the equipment handbooks and relevant Electrical and Mechanical Engineering Instructions.

Frequency Characteristics HF - VHF

2. To gain the best results from the sets a knowledge of the main characteristics of the frequency bands used, is required. The C PRC 26 and AN PRC 10 sets use frequencies classed as **"Very high"**. These VHF sets have different characteristics to the WS A510 which is a **"High"** frequency set.

3. The VHF sets work on signals which follow a more or less different path between stations than HF. An ideal position is a "Line of Sight" path. However, they will work well over an indirect path at short ranges (Up to 3 miles for AN PRC 10 and ½ mile for C PRC 26).

4. The WS A510 operating in the HF band puts out signals on TWO paths to a distant station. The HF radio wave divides itself into:—

(a) **Ground Waves.** These spread over the surface of the ground for a short distance only. (About 2 miles for WS A510)

(b) **Sky Waves.** These go upwards into the sky and are reflected back to the earth from the ionosphere. With the WS A510 the distance to the point at which they return may vary from 5 to 500 miles depending on the type of aerial used. Information on sky wave aerials for WS A510 is contained in Chapter 9 of this pamphlet.

The Noise Factor

5. Atmospheric noise level varies with frequency and the time of day. It is an important factor in communication on the WS A510 but has no appreciable effect on the VHF sets. In NORTHERN AUSTRALIA and SE-ASIA atmospheric noise is greatest between 1600 hours and 2200 hours daily.

It may blanket communication entirely during this period on the HF band. Therefore it can be taken as an operating rule that, **"The period from 1600 hours to 2200 hours is the worst time of day for the WS A510".**

Radio Signal Interference

6. Radio Signal Interference may come from:—

(a) **Adjacent Sets.** A separation of 2 Mc/s in frequency is required between adjacent VHF sets and 1 Mc/s between adjacent HF sets. If interference still persists the only cure is physical separation. HF sets must **not** use a frequency of 4.3 Mc/s as this is the intermediate frequency used by the VHF sets.

(b) **Distant Stations.** This is most unusual on the VHF sets. It can be cured by changing frequency. On the WS A510 it will be found that interference of this nature becomes severe during darkness. So a **"clear channel on the WS A510 in daylight may be subject to interference at night".**

Summary

7. The frequency characteristics of the sets may be summarised as follows:—

(a) **C PRC 26**

(i) Range about 1 mile in open country
(ii) Signal unaffected by atmospherics
(iii) No change in signal between day and night
(iv) Severe ground obstructions in signal path may prevent communication

(b) **AN PRC 10**

(i) Range about 5 miles in open country
(ii) Signal unaffected by atmospherics
(iii) No change in signal between day and night
(iv) Severe ground obstructions in signal path may prevent communication

(c) **WS A510**

(i) Minimum Range about 2 miles
(ii) Works on both **ground** and **sky** waves
(iii) Subject to atmospheric interference
(iv) Signal varies greatly between day and night

CHAPTER 2

THE CPRC 26 — TYPE D

Introduction

8. The radio set C PRC 26, type D is a low powered VHF equipment operating over the frequency band of 50 - 51 Mc/s. The 6 individual frequencies in this band, selected by a selector switch are:—

(a) Channel 1	—	50 mcs.
(b) Channel 2	—	50.2 mcs.
(c) Channel 3	—	50.4 mcs.
(d) Channel 4	—	50.6 mcs.
(e) Channel 5	—	50.8 mcs.
(f) Channel 6	—	51 mcs.

9. Easily manpacked in its own special basic pouch, this equipment weighs 11 lbs. 14 ozs. (including battery). Battery life is normally between 18-20 hours. Amongst its other uses, this radio set is capable of handling platoon/company communications within an infantry battalion efficiently.

Figure 1 — Radio Set C PRC 26, complete station

Setting Up

10. (a) Remove the radio set from its carrying pouch.

(b) **Removing battery case.** Push down on the arms attached to the tightening cams situated in the centre of the front and rear surfaces of the set. Now release the spring clamps from the tightening cams, taking care not to use excessive force. The bottom of the set, which is the battery case, will now drop away.

(c) **Inserting Battery.** Taking battery BA-289/U, remove the waxed cellophane covering the plug holes in its top. Make such that no cellophane is forced into the holes, as this may prevent the battery from doing its job.

Note: Most batteries are a tight fit in the battery case and are thus very difficult to remove. To overcome this, place a piece of tracing tape or similar material around the battery (like a sling) so that it extends 2 to 3 inches each side of the battery's top. This will allow the battery to be removed by pulling on the tape. When placing the battery in its case, be careful to fold the ends of the tape over the battery so that the tape neither protrudes to the outside of the set or fouls the battery terminal holes.

(d) **Replacing Battery compartment.** Place radio set on top of the battery compartment engaging the power pins in the battery holes. Push down firmly. Swing the spring clamps up and over the tightening cams. Lift the cam arms up, thus placing tension on the spring clips and fastening the battery compartment to the radio set.

(e) **Replacing set in pouch.** The set is placed in the pouch in such a way that the silver coloured aerial base on the set is under the large hole in the pouch top flap.

(f) **Handset and headset.** Remove the handset from the long side pocket of the pouch. Pass the plug end through the loop on the outside of the pouch and plug into 5 hole uncovered socket. The single earpiece type headset, when removed from the short sidepocket of the pouch, has its plug end passed through the loop on the outside of the pouch and is plugged into the 5 hole covered socket. This metal cover lifts against a spring.

(g) **To assemble antenna.** Remove one of the rod antennas (aerials) from the inside pocket of the pouch. To assemble, hold the small knob on the end of the wire at the antenna top and slide the antenna sections together.

(h) **To connect antenna.** Holding the antenna in the vertical position, grasp it by the **knurled collar,** between thumb and forefinger. **(Do not hold by the gooseneck).** Place the **knurled collar** over the aerial base so that the 4 slots on the circumference of the **knurled collar** correspond to the 4 lugs on the aerial base. Push the **knurled collar (not the gooseneck)** down hard and lock by twisting the **knurled collar (not the gooseneck)** in a clockwise direction.

Testing

11. (a) Place a tested battery in the set. (Refer to Chapter 7 "METHODS OF TESTING DRY BATTERIES IN THE FIELD").

(b) With the antenna disconnected, connect the handset and headset. Turn the OFF - QUIET - LOUD switch to QUIET. A rushing noise should be heard if the set is operating correctly. Turn switch to LOUD. The noise should increase.

(c) Press the pressel switch on the handset; speak into the microphone. **"Sidetone"** that is, an echo of the operator's voice, should be heard in the handset and headset.

(d) Set the channel selector switch to each channel in turn, and repeat the above tests to make sure the set is working correctly in all channel positions.

(e) If the set does not operate properly:
(i) try a new battery
(ii) try another handset

(f) If the set still does not operate satisfactorily, report the matter and replace the set.

TO OPERATE

12. (a) Set the selector switch to the ordered channel.

(b) Set "OFF - QUIET - LOUD" switch to "LOUD".

(c) **To transmit.** Press the pressel switch of the handset. Speak into the microphone in a normal manner. Do not shout.

(d) **To receive.** Release pressel switch and listen.

(e) **Control panel and components.** The control panel and the components which are attached to it are shown in figure 2.

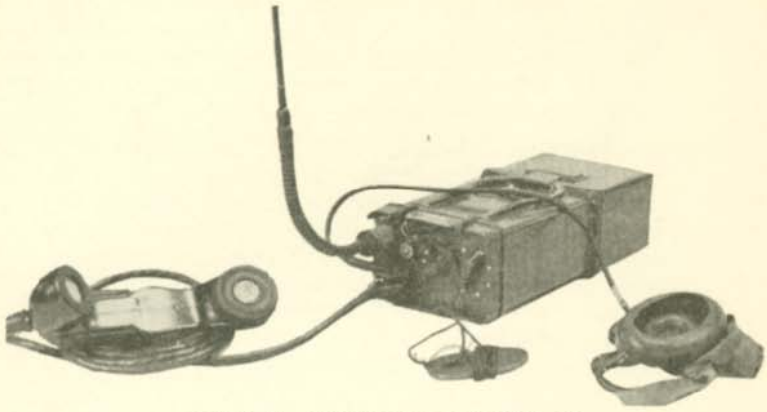


Figure 2 — Control Panel C PRC 26

Dismantling

13. (a) Set "OFF - QUIET - LOUD" switch to "OFF".

(b) Handset and headset. Removeing the plugs of the handset and headset from their sockets, wind their leads around each of them. Replace them in their pouch pockets.

(c) **To remove antenna.** Grasp antenna by its **gooseneck (not the knurled collar).** Lift the **gooseneck** and, while maintaining the lifting tension, turn the **gooseneck** in an anticlockwise direction.

(d) **To collapse antenna.** Shed antenna sections from the top, and replace the antenna in its inside pocket.

(e) **Removing battery.** Release battery case from the radio set (see para. 3, sub-para. (b) above). Hold the battery case in one hand and by grasping **both** tails of the tracing tape in the other hand, ease the battery out of its case.

(f) Replace battery case on the radio set (see para. 3 sub-para (d) above). Return the set to its basic pouch.

Counterpoise Antenna

14.This is carried in the small pocket on the underside of the basic pouch top flap. It can be used to increase the range of the set when working with the rod antenna OR instead of the rod antenna when working in difficult terrain. **Using it in the place of the rod antenna will normally shorten the working range of the set.**

(a) **To increase the working range.** Leave the rod antenna plugged in. Plug the counterpoise into the counterpoise socket (see fig.2). Tuck the counterpoise tab into the operator's boot-top.

(b) **Use in place of rod antenna.** Remove rod antenna. Plug the counterpoise into the hole in the centre of the silver coloured aerial base. Tuck the counterpoise tab into the boot-top.

Maintenance

15. This radio set is a sealed unit. The operator must not attempt to remove the chassis from the case. Operator's maintenance should be carried out as follows:—

(a) Keep the set and its accessories clean and dry.

(b) Examine the case for dents and holes. Report damage immediately.

(c) Check that all switches are secure and operate correctly.

(d) Ensure that the handset and headset sockets are clean and dry.

(e) Replace headset and earpiece should their leads become frayed, their pins become bent or their bakelite casings become cracked or broken.

(f) Replace rod aerial should its aerial sections become damaged.

(g) Examine counterpoise antenna for torn insulation.

16. Report faults and losses at once. Keep the set complete and in good condition.

Range

17. Normal operating range for this equipment may be up to $1\frac{1}{2}$ miles in open country. This range is decreased by thick scrub and timber, hills, etc. In a bad case, such as operating in wet secondary jungle, ranges may decrease to 200 yards.

Siting

18. Being of limited power, and operating in the "very high frequency" band (see Chapter 1), efficient operation of this equipment will only result from correct siting (For more detail on this siting problem, consult Chapter 6.)

19. When siting this radio set, keep the following points in mind:—

(a) Try to work from high ground, not in valleys or creek beds.

(b) Try to work on slopes facing the other stations on the net.

(c) Do not hesitate to move around the operating location to find the best receiving and transmitting position. Moving only 2 or 3 feet from an originally selected site may make all the difference between good and bad communications.

(d) Keep right away from water tanks, bridges, buildings, large trees, telephone and power lines, wire fences, etc., if at all possible.

Successful Operating Hints

20. The following points will aid in the successful operation of this set:—

(a) Do not allow the rod antenna to touch foliage.

(b) **Speech Distortion**

(i) The microphone of this equipment is very sensitive, hence curb the temptation to speak too loudly into it. Speech distortion will result.

(ii) Remember that a **quiet** voice produces best results.

(c) **OFF - QUIET - LOUD SWITCH.** The NORMAL operating position of this switch is the LOUD position. Do not use the QUIET position unless the set is being operated in a **location where the sound of the operator's voice may reveal his position to the enemy,** in which case he will speak **softly** but distinctly. Excessive use of the QUIET position will considerably shorten the life of the battery.

Conclusion

21. This radio equipment has proved itself to be reliable under most service conditions. The efficiency of communications, using this set, will depend on a practical appreciation of its limitations (as regards power and siting) as well as a skilled use of its advantages. It will give reliable service in the hands of a trained and conscientious operator.

CHAPTER 3

THE AN/PRC 10

Introduction

22. The AN PRC 10 (figure 3) is a portable, battery powered, VHF equipment which may be operated on a man's back, in a vehicle, from an aircraft, or as a semi-permanent ground station. This radio set, weighing 23 lbs. 12 ozs. complete operates over a continuously tuned frequency band of from 38 - 54.9 mcs. Its battery, the BA-279/U, has an operating life of about 20 hours.

23. To increase its performance, it also makes use of other equipments known as "ancillaries". These are discussed at length in Chapter 4 "ANCILLARY EQUIPMENTS FOR USE WITH AN PRC 10".

24. The detail given in this chapter (with the exception of frequency references) apply equally to two other similar radio set types, the AN PRC 8 and the AN PRC 9.

List of Components

25. These may be checked against the components shown in figure 3.

Figure 3 — Radio Set AN PRC 10

Setting Up

26. (a) **Removing the battery case.** Lay the set flat on a firm surface. Power SWITCH at OFF. Locate the two lower spring clips of the sides of the case. Press out and downwards with the forefingers. Ensure the other fingers are not in the way of these spring clips as they release, otherwise personal injury may result. Remove the battery case from the bottom of the radio set.

(b) **Inserting and connecting battery.**

(i) Remove the wax sealing from the socket on the top of the battery ensuring that no sealing enters the socket holes.

(ii) Place the battery in the battery case, socket exposed.

(iii) Grasp the power plug hanging from the bottom of the radio set. Ensure that the ring clip on this power plug is folded back on the top of the power lead. Making sure that the key on the power plug matches with the key way in the centre of the battery socket. Push the plug firmly into the socket.

(iv) Bring the battery case to the bottom of the radio set and engage the spring clips. These will now attach the battery compartments to the radio set itself.

(Note: When pulling the clips up, use the forefingers. Ensure that the other fingers are clear as the spring clips engage).

(v) **Warning.** Remove the battery when the equipment is not being used for periods of 4 days or more.

(c) **Connecting Handset** (Figure 3). Remove the handset from the bag. Insert the plug on the handset cable into the AUDIO output socket on the operating panel, and turn gently. When the plug drops into its guides, push down and turn in a clockwise direction as far as it will go.

(d) **Connecting the Antennas**

(i) If short range working only is required, remove the short antenna (antenna AT-272 PRC see figure 3) from the bag. Screw this antenna (aerial) into the control panel socket marked **"Short Ant"** (See figure 4).

Figure 4 — Control Panel AN PRC 10

(ii) For maximum range working on a rod antenna, remove the long antenna (antenna AT 271 PRC) and its antenna spring section from the antenna bag. (See figure 3). Screw the spring section (a rubberised conductor 8 inches long) into the antenna socket marked **"Long Ant".** Hold the thick end of the antenna in one hand and allow the remaining sections to rest on the ground. By shaking out gently, the antenna sections should be pulled together. Should the spring loaded wire in the antenna not pull the sections together, this will have to be done by hand. Screw the long antenna into the top of its spring section.

(iii) The elevated antenna RC-292 and any local pattern antennas for this set are connected to the **"Aux Ant"** socket by using the adaptor UG 255U. (For connecting detail, consult Chapter 4, section 4, para 9 "THE RC 292 ANTENNA")

Controls and Their Uses

27. The following table lists the controls and their uses. The **Pointer Adjust** is located just above the panel. The **Dial Lock** is located just below the panel.

Control

(a) **Power Switch** — In **On** position, turns the set on. In **Remote** position. Allows the radio set to be turned on and off remotely. (See "REMOTE OPERATION of AN/PRC 10 in Chapter 4). In **Cal** and **Dial Lite** position, allows set to be calibrated. Turns dial light on.

(b) **Tuning** — Tuning set to required frequency.

(c) **Vol** — Adjusts the loudness of signals heard in the handset earpiece.

(d) **Squelch** — Cuts out background noise. It will click between its off and on position.

(e) **Audio** — A socket providing connection for the headset, remote control ancillary or the relay ancillary.

(f) **Long Ant** — Connects long antenna to set (see para 26, sub-para (d) above)

(g) **Short Ant** — Screws short antenna to set (see para 26 sub-para (d) above)

(h) **Aux Ant** — Bayonet type jack to connect coaxial cable from the housing or elevated aerial ancillaries.

(j) **Lite Cap** — Holds dial lamp in place. Dial lamp can be changed without the set being removed from the case.

(k) **Pointer Adjust** — Varies position of pointer on **Tuning** dial to provide accurate dial frequency calibration.

(l) **Dial Lock** — Locks **Tuning** control so operating frequency cannot be changed accidentally.

Operating The An PRC 10

28. **Tuning and Calibrating.** To calibrate the AN PRC 10, the following steps are necessary:—

(a) Place **Dial Lock** to the left

(b) Turn **Power** switch to **on**

(c) Turn **Vol** to '10'

(d) Turn **Squelch** completely off.

(e) By means of the **Pointer Adjust,** place the pointer on the tuning dial to the centre of the **tuning dial** window.

(f) Vary the **Tuning** control until the pointer on the dial is at the whole number mc point nearest the desired operating frequency. For example, if it is desired to operate at 43.6 mc, set the dial to read 44 mc.

(g) Hold the **Power** switch in the **Cal** and **Dial Lite** position, and while listening on the handset, slowly turn the dial (by means of the **Tuning** control) past the whole number MC point at which the dial was set in (f) above. A high pitched whistle should be heard with the pitch dropping until it is inaudible then rising until it is again audible. Set the **Tuning** control at the point where lowest pitch (zero beat)

is obtained. Release the **Power Switch** (which is spring-returned) to the **on** position. Figure 5 illustrates this calibrating method.

Turn **CAREFULLY** about required frequency on dial scale until whistle is heard. Reduce to ZERO BEAT, or "SILENT POINT" as in the diagram below.

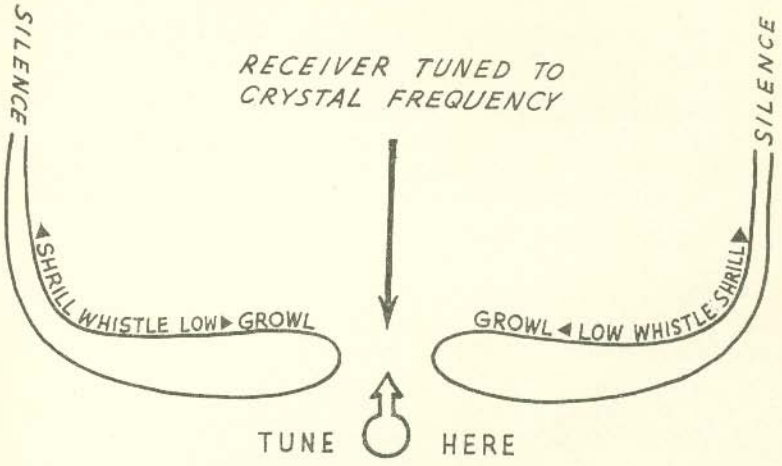


Figure 5 — Tuning to Zero Beat

(h) The AN PRC 10 has now been calibrated to the nearest whole mc to the ordered frequency. By means of the **Pointer Adjust**, place the pointer over the whole mc number appearing in the tuning window. Using now the **Tuning** control, set the ordered frequency under the pointer.

(j) Swing the **Dial Lock** to the right to lock on frequency.

(k) Summary of calibrating AN PRC 10, using an actual frequency:

(i) Required frequency is 43.6 mcs.

(ii) Adjust pointer to centre of tuning dial

(iii) Turn the dial until the figures 44 appear under the pointer.

(iv) Tune to zero beat as detailed in para 28, sub-para (g) above.

(v) Turn pointer, using **Pointer Adjust**, till it rests directly over the figure 44.

(vi) Turn dial with **Tuning** control until 43.6 rests directly under pointer.

(vii) Lock.

29. **Squelch.** Turn the SQUELCH control clockwise until the rushing noise in the earpiece of the handset disappears. Do not take the SQUELCH control beyond this point.

30. **Volume.** For best results, the volume should be kept as low as possible comparable with a readable signal in the earpiece. For normal operation, the VOL is usually at the 5 or the 6 position, though where the incoming signal is weak and barely readable, the VOL may advance right up to 10 if necessary.

31. **Transmitting and Receiving**

(a) To transmit, hold the handset to the ear, press the pressel switch, wait several seconds and talk into microphone. **Do not shout into the microphone.**

(b) To receive, hold the handset to the ear and listen.

Testing

32. The tests which an operator can carry out in the field are few and simple. These are:—

(a) **Battery.** The battery should be tested as outlined in Chapter 7 "METHODS OF TESTING DRY BATTERIES IN THE FIELD".

(b) **Transmission.** To test whether the radio is transmitting when the pressel switch is depressed, carry out the following procedure:—

(i) Remove cover marked **"Lite cap"** and extract the dial lamp.

(ii) Remove the cover from the **"Aux Ant"** socket. Short the lamp across the centre post and outside wall of the **"Aux Ant"** socket.

(iii) Press the pressel switch on the handset. If the set is transmitting, the lamp should glow brightly.

(iv) **Caution.** Care must be taken not to cause the lamp to glow for too long, otherwise it may be blown.

(c) **Handset.** Only by using the handset to transmit to and receive from another set can the handset be tested.

(d) **Final test.** In practice, it will often be noted that while a particular AN PRC 10 appears to work satisfactorily to similar sets in its proximity, at a distance it may fail completely. This may be due to several causes, one of which is a weakening battery. Before moving away from other sets in its vicinity, never fail to test each at ranges of at least 150 yards.

Maintenance

33. As this radio is a sealed unit, the operator maintenance will be confined to the following procedure, carried out daily:

(a) Keep the set and its accessories clean and dry.

(b) Examine the case for dents and holes

(c) Check that all switch control knobs are secure

(d) Examine handset for cracked or broken bakelite casing and its lead for fraying.

(e) Examine antennas for damaged antenna sections or strips.

(f) Check the condition of the battery BA-279/U by the position of the **Squelch** control. The further clockwise the control must be turned for proper squelch control the weaker the battery.

34. Report faults and losses at once. Keep the set complete and in good condition.

Ranges

35. Ranges are generally restricted to line of sight distances. However, keeping in mind the bearing that the terrain and vegetation, siting and to some degree wet or dry conditions have on this equipments practical range, the following distances may be obtained:—

(a) Average rolling country — up to 5 miles

(b) secondary jungle — 1 - 1½ miles

(c) Hilltop to hilltop in — 10 - 40 miles
mountainous terrain

Siting

36. Since this equipment operates on frequencies in the VHF band (see Chapter 1), the choice of its operating site is of prime importance. Remember these points:—

(a) Strive for **"line of sight"** between stations on a net. While this set will work to others not in line of sight to its antenna, the closer these equipments are in line of sight, the less difficulty will be experienced in communicating.

(b) Go for high ground. Avoid operating from valleys, depressions, creek beds, reverse slopes if at all possible.

(c) Keep away from buildings, water tanks, steel bridges, intervening hills, power and telephone lines.

(d) Do not operate under large trees.

(e) Keep clear of heavily travelled roads, and their associated unsuppressed vehicles.

37. Often, it will not be possible to abide by all the above rules. Use the ancillary equipments (see Chapter 4) to assist solving siting problems.

Some Practical Hints

38. The following hints are based on practical operating experience with the AN PRC 10. Remember and use them.

(a) **Antenna.** Do not let the antenna touch foliage.

(b) **Moving a Site.** Do not hesitate to move round an operating site if communications are unsatisfactory. 3 or 4 feet often makes all the difference.

(c) **Distortion.** Do not shout into the handset microphone. The receiving station will only receive a distorted jumble. Speak softly and distinctly.

(d) **Transmitter Delay.** It is normal to have a delay of 2 or 3 seconds between pressing the pressel switch and transmitting. Anything said by the operator in this delay period will **not be heard.** Failing batteries often prolong this delay. The time of delay for any particular radio set can be established by a test count to another station.

(e) **Calibration.** Even though all stations on a net use their own calibrators to come on frequency, this may vary slightly from set to set. The control station must use normal operating procedure to bring all his sub-stations on net. Report any equipment which does not calibrate accurately.

Conclusion

39. The AN PRC 10 is a trustworthy, low powered equipment which, while giving excellent results, relies to a great extent on its operator for efficient practical performance. In the hands of a skilled operator, it will carry out its allotted tasks in a most reliable manner.

CHAPTER 4

ANCILLARY EQUIPMENTS FOR THE AN/PRC 10.

40. Ancillary equipments are those which are designed to extend the working efficiency and range of the AN/PRC 10. Except for frequency ranges the same equipments may be used with the AN/PRC 8 and AN/PRC 9.

41. The ancillary equipments considered in this chapter are as follows:—

(a) Section 1 — Remote Control Group AN/GRA 6

(b) Section 2 — Cords Assembly Special Purpose (relay cable assembly)

(c) Section 3 — Amplifier Power Supply AM-598/U.

(d) Section 4 — Antenna RC 292

(e) Section 5 — Homing Antenna AT-339/PRC.

Section 1 — Remote Control Group AN/GRA 6.

42. This group allows one or two radio equipments (AN/PRC-10) to be operated up to a distance of about 2 miles, remotely, from the operator. Consisting of two units,

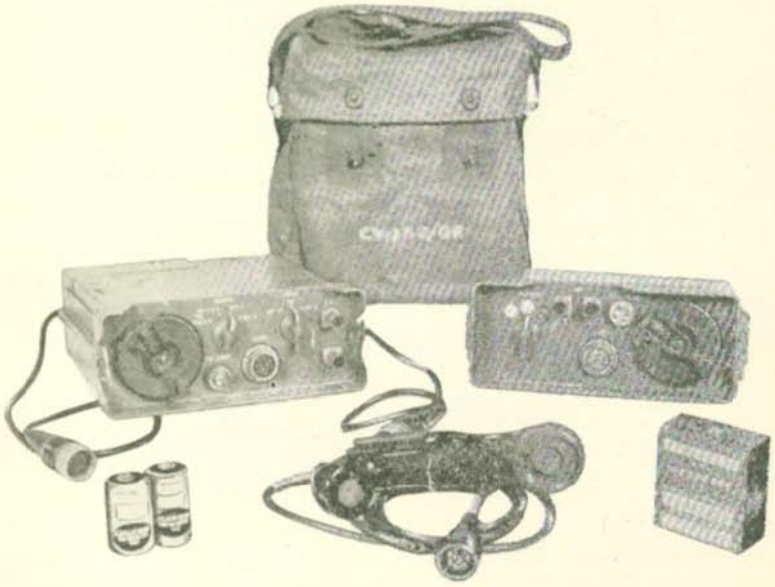


Figure 6 — Remote Control Group AN/GRA 6 complete

the remote control unit C-443/GRC and a local control unit C-434/GRC this group permits telephone communication between the operator at the remote unit and the radio set site at the local unit.

43. The proper use of this remote control equipment solves many of the siting problems associated with VHF equipment to be overcome (see Chapter 1). Permitting the radio set to be sited in a satisfactory transmission location, its use allows the operator to be concealed or be tactically sited up to 2 miles distant from the radio equipment itself.

Components

44. The list of components, the total weight of which is 20 lbs. 12 ozs., may be seen in figure 6.

Additional Components Required

45. To install and operate the control group AN/GRA 6 the following will also be required.

(a) Four one and a half volt dry cells, batteries BA-30 (two each for the local and remote control units)

(b) One 45 volt dry battery BA/414/U (remote control unit only)

(c) Telephone Line

(d) An additional hand set H-33/PT may be required for field telephone use.

Carrying of Main Components

46. It can be seen from figure 6 that the group components being lightweight, compact and suitable for portable use, may be stored or carried in the carrying bag CW-189/GR. This bag is equipped with a carrying stray. An additional carrying strap is provided for attachment to the remote control unit.

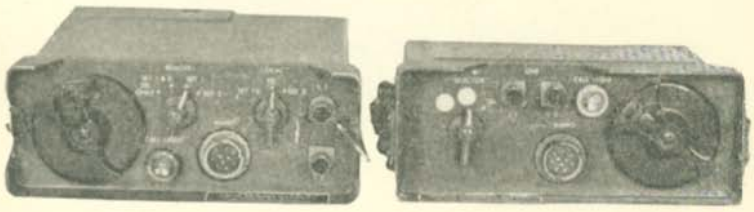


Figure 7 — Control Panels C-443/GRC; C-434/GRC

Remote Control C-433/GRC (see figure 7)

47. This lightweight immersion proof unit which may be carried on a shoulder strap has the following controls (see figure 7):

(a) Crank handle of the ringing generator

(b) Two line terminals marked L2 and L1.

(c) Hand set connection marked **Audio.**

(d) **Selector** switch. The two white discs associated with the **Selector** switch **are called 'write in'** positions, permitting the operator to mark in the designation of each switch position.

Local Control C-434/GRC

48. This lightweight unit, which contains two cables stored in a compartment at its rear end to allow the AN PRC/10 to be connected to it, has the following operating controls (see figure 7).

(a) Crank handle of the ringing generator

(b) Neon call lamp fitted with a dimmer

(c) **Remote** and **Local** control switches

(d) Handset connection marked **Audio**

(e) Two line terminals marked L1 and L2

Setting Up

49. **Remote Control C-433/GRC**

(a) Set the panel mounted SELECTOR switch to the TEL position

(b) Release the two snap catches which hold the outer case to the panel and chassis assembly. Remove inner unit from case.

(Caution: Release the two catches with the fore-fingers ensuring that the remaining fingers are kept clear as the snap catches open)

(c) Turn the inside unit upside down. Place the side of the unit with the bell visible at the left hand and remove the tape which secures the battery compartment cover to the sides of the unit. Remove the battery compartment cover by sliding it back slightly to clear the tab on one side. Lift the cover off.

(d) **Installing Batteries.** The battery compartment on the right hand side of the chassis frame holds two one and a half volt batteries (BA-30). Install one battery in the compartment so that the bottom of the battery outer case (negative electrode) rests

over the spring contact on the battery compartment floor. The second battery is installed so that the centre post (positive electrode) of the battery rests on the flat contact on the battery compartment floor.

(e) **Inserting Battery BA-414/U.** This 45 volt battery sits in the large battery compartment in the chassis frame so that the eight pin battery socket faces towards the rear of the unit. Matching the key on the eight pin male plug on the end of the battery cable with the keyway on the battery socket, press plug home into socket. Do not twist the battery cable excessively to accomplish this.

(f) **Restoring the Battery Compartment Cover.** Inserting the two cover projections at one edge of the cover under the bracket angles at the chassis frame side, press the cover down and slide it forward until the lip (or tab) at the other side of the chassis frame slides over the corresponding notch in the cover. Release the pressure, checking to ensure that the tab is properly locked and that the batteries are properly positioned.

(g) **Bell-Lamp Switch.** If a lamp indication of the ringing signal is desired set this switch in the **Lamp** position. If the ringing indication is desired set this switch in the **Bell** position.

(h) **Pilot Lamp.** When checking to see that the pilot lamp is installed in its hole, access to this lamp will be gained from the rear of the panel by pulling the lamp socket (white knurled plastic socket) out of its holder. Pull straight towards the rear of the unit.

(i) Restore panel and chassis assembly to the case, fastening it to the control panel by means of its snap catches.

50. **Local Control C-434/GRC.**

This unit is used next to the radio set with which it is to be operated, being connected by its stored cable to the **Audio** socket on the AN PRC/10. Prepare the unit for operation as follows:—

(a) **General Preparation**

(i) Loosen the thumb screw fasteners on the front panel and remove the panel and chassis assembly from the case.

(ii) Place the panel and chassis assembly bottom side up (so that the front panel when facing the operator will have its controls upside

down) and release the catch holding the battery compartment cover in place. Remove the cover.

(iii) Install one one and a half volt battery so that the outer metal base of the battery rests on the spring on the floor of the container.

(iv) Install the other one and a half volt battery so that its base faces up. The centre electrode should rest against the flat battery contact on the compartment floor.

(v) Replace the compartment cover ensuring that the portion of the cover away from the catch is pressed home first.

(vi) **Bell-Lamp** switch. This switch is set in the same manner as for the remote control unit (para 49 sub-para g above).

(vii) Replace the panel and chassis assembly in the case and tighten thumb screw fasteners.

(b) **Connecting the Local Control Unit to the ANPRC/10**

(i) Press the snap catch to open the hinged door at the right of the plug at the rear of the control unit. Extend the two cables with their terminating connector plugs, stored within the compartment, to the rear.

(ii) Attach the cable, labelled SET 1 inside the cable compartment, to the **Audio** socket on the front of the radio set.

(iii) If two set working is required, attach the second cable in the same manner to a second radio set.

(iv) When one set working only is used, restore the other cable to the compartment. Under these conditions always connect the cable marked SET 1.

(c) **Connecting the Hand Set H-33/PT.** Hand sets are attached to the AUDIO socket of either unit in the usual fashion.

(d) **Telephone Line.** Two line binding posts **(Line L1 and L2)** are provided on each of the two control units for the connection of the telephone line wires. To make the connection, strip the insulation off the two wires about three quarters of an inch from each end and clamp them in the binding posts on each of the two control units.

Operation of the AN GRA 6

51. **Telephone Operation.** Telephone operation allows direct two way operation between operators at the local and remote control units.

(a) At the local control unit, set the **Remote** switch to the **Tel only** position and the local switch to the **Tel** position.

(b) At the remote control unit, set the **Selector** switch to the **Tel** position.

(c) Press the hand set pressel switch at either the local or remote position and talk into the microphone. Release to listen.

(d) **Caution.** The voltage caused by the generator across L1 and L2 may be as high as 60 volts.

52. **Operating The AN PRC/10 From The Local Control Unit**

(a) Put the AN PRC/10 in operation with its **Power** switch to **Remote.**

(b) At the local control unit, set the **Remote** switch at SET 1 and 2 position. Hold the **local** switch (spring return) at the **Set 1** position. Press pressel switch on the hand set and speak into the microphone to transmit. Release this switch to the **Tel** position when receiving.

(c) Turn the **Power** switch on the radio set to **off** when the set is not in use.

Caution. Do not crank the ringing generator handle at either the remote or local units, when transmitting or receiving from either unit; this handle may only be cranked when the units are used for inter-unit telephone operation as described in para 45 above.

53. **Operating the AN PRC/10 From the Remote Control Unit.**

(a) Put the AN PRC/10 in operation with its **Power** switch to **Remote.**

(b) At the local control unit, set the **Local** switch at the **Tel** position and the **Remote** switch at the **Set 1** position.

(c) At the remote control unit, set the **Selector** switch at the left **'write-in'** position.

(d) Momentarily press the pressel switch on the hand set at the remote control unit. If the terminals L1 and L2 are not reversed the power will be turned on in the radio set. If the radio set does not operate, reverse the leads at L1 and L2.

(e) Using the hand set, press the pressel switch to talk and release to listen, remembering that when using the AN PRC/10 two or three seconds delay will be experienced upon pressing the pressel switch before the transmission goes out on the air. (Refer Chapter 2 — AN PRC/10).

(f) To turn off the power at the AN PRC/10 from the remote control unit, turn the **Selector** switch to the right write-in position and momentarily press the pressel switch on the hand set.

Note: Operators at the local and remote control units should communicate with each other over the telephone facilities to check whether the operation of the remote control facility is satisfactory.

Maintenance

54. Operators should carry out the following simple daily procedures:—

(a) Clean the exterior of local and remote control units and hand sets.

(b) Check the operation of the ringing generator bell, and call light by transmitting a ringing signal from one end and receiving it at the other, with the internal switch set first in the **Bell** position and then in the **Lamp** position.

(c) Check the operation of the telephone circuit by operating the control group as a field telephone.

(d) Operators should check the state of the control group batteries (see Chapter 7 METHODS OF TESTING DRY BATTERIES IN THE FIELD). Discard the 45 volt battery (BA-414/U) if the terminal voltage is 30 volts or less. Batteries BA - 30 should be rejected when their terminal voltage falls below 1 volt.

(e) **Caution.** Remove all batteries from control group when cleaning the area surrounding the line binding posts.

(f) Inspect hand set cords and plugs for evidence of damage.

(g) Check the control action of switches by performing each of the operational procedures pertinent to each switch.

(h) Report faults and losses at once. Keep the control groups complete and in good condition.

Siting Problems of the AN/PRC 10

55. The correct use of this control group will alleviate many of the siting problems which arise when the AN PRC/10 is

being used. When time allows, the AN PRC/10 may be sited at high points to produce line of site communication with other VHF sets on a particular radio net. The operator, by using this control group may be up to two miles away from his radio equipment.

56. For example, many locations chosen for a Battalion headquarters may not allow line of sight communications with the sub stations on the Battalion Command net especially when a Battalion is operating in a mountainous terrain. The AN PRC/10 with the local control unit may be placed at a high point suitable to communicate with all the sub stations on the net while the operator can operate from the tactically sited Battalion Headquarters position through his remote control set.

Conclusion

57. This control group is one of several ancillaries which increase the performance and range of work of the AN PRC/10. Used in static and semi-static locations, it will materially assist an operator to overcome many of the VHF siting problems which arise when he uses his low power field equipment.

SECTION 2

CORDS ASSEMBLY SPECIAL PURPOSE

Relay (Rebroadcast) Operation

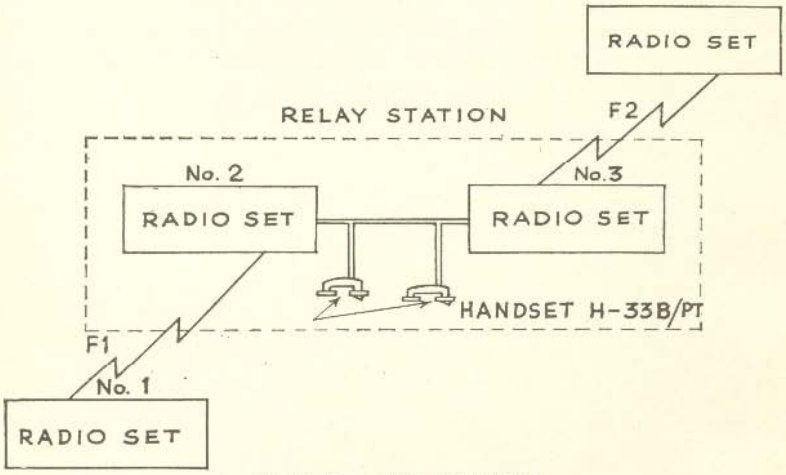


Figure 8 — Relay Operation

Introduction

58. The relay cables allow two radio sets to be operated as a relay station. By using this relay facility, many difficulties met in the operation of VHF wireless equipment may be overcome. For example, where sub-stations are shielded from each other by terrain or vegetation, thus preventing direct communication, a relay station sited at some high point will often allow these sub-stations to communicate with each other by automatic relay (rebroadcast).

How The Relay Station Operates

59. Figure 8 shows how two AN PRC 10s operate as a relay station. Set No. 2 is tuned to the same frequency as Set No. 1, while Set No. 3 is tuned to the same frequency as Set No. 4. The frequency of Sets No. 1 and 2 must differ from the frequency of Sets No. 3 and 4 by several mcs. Be careful, if possible, not to have the frequencies differing by 3.8 to 4.1 mc/s, as difficulty may be experienced in getting stable operations at the relay station.

60. With this arrangement, signals transmitted by Set No. 1 (out of direct communication with Set No. 4) are received by Set No. 2 and passed through the relay cable to Set No. 3 which re-transmits the signal to Set No. 4. Similarly signals transmitted by Set No. 4 are re-transmitted by the relay station to Set No. 1.

How To Connect Up The Relay Station Components

61. Attach the connectors on the ends of the relay cable to the **Audio** sockets on the two radio sets which are being used as the relay station. Attach two handsets to the connectors which are spliced to the relay cable.

62. Place Set No. 2 in operation, using the handset which is near it. Tune to the required frequency. Repeat this procedure with Set No. 3, remembering that this set is tuned to a different frequency (as described in paragraph 50 above). The two sets can now operate unattended as a relay station.

Checking The Relay Station Operation

63. Before leaving the relay station site, check whether it is operating properly by listening on the handsets attached to the relay cable. The handset near Set No. 2 receives signals transmitted by Set No. 1 while the handset near Set No. 3 receives signals transmitted by Set No. 4. Each of these handsets can also be used to transmit over the radio set nearest to it.

64. Do not use both handsets at once without realising that neither reception or re-transmission is possible at the relay station while either handset is being used to transmit. Only transmit simultaneously over both handsets where no response is required or where the time saved by simultaneous transmission is urgently needed.

65. Remote control of the relay station is possible, using the AN/GRA 6 control group (cf section/ para 42 - 57).

Hints for Successful Operation

66. Successful operation of the relay station is dependent upon the accurate and proper tuning (including the correct use of the SQUELCH control) of the radio sets which are the components of the relay.

67. The VOL controls on the relay station AN PRC 10s should normally be positioned at their half way marks if the set batteries are satisfactory.

68. Gross distortion will result if the operators on the radio sets working through the relay stations, shout, or speak too loudly into their microphones. A high pitched voice using volume slightly lower than normal is ideal. This will produce crystal clear transmissions.

69. The relay station may be left unattended during the normal working life of the batteries in the AN/PRC 10s. Indication of a collapsing battery will be given when the background noise breaks through the squelch control.

70. The usual time delay experienced between pressing the pressel switch, and transmitting, when using the AN PRC 10 (See Chapter 3, para. 38 and sub-para. (d), will usually be extended to about 8 seconds, when speaking through the relay station from one of the substations.

Conclusion

71. The relay station facility solves many of the problems involved in siting low powered VHF equipment. For maximum performance, however, a reasonably experienced operator will be needed to erect and test the relay station.

72. Practical experience has shown that two relay stations will function together, so that each substation relays through two relay stations instead of one, as described. The time delay may be around 15 seconds. This considerably extends the VHF working range in close country.

Section 3

Amplifier Power Supply — AM-598/U

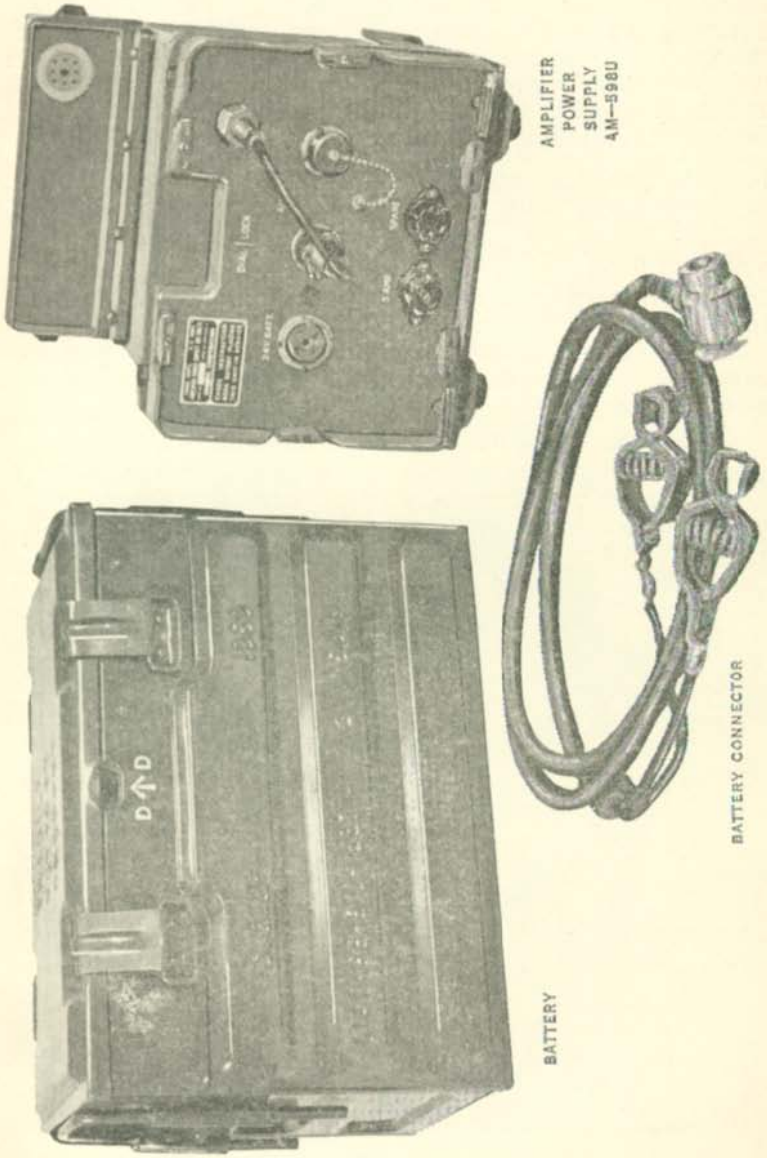


Figure 9 — Amplifier Power Supply AM/598/U

Introduction

73. The amplifier power supply, AM-598/U, itself powered by a 24V DC supply is an ancillary equipment to the AN/PRC 10, designed to allow this radio set to be operated efficiently in a vehicle. Not only does the amplifier power supply do away with the dry battery BA 279/U in the AN/PRC 10, but also provides the facility to allow a loud speaker to be used to monitor the reception of this radio equipment. This loud speaker (which comes as a separate item) is most useful for command post work.

74. As with the other ancillaries, the amplifier power supply will work with the radio set AN/PRC 9A.

Setting Up

75. The amplifier power supply is mounted in a vehicle for normal use. Local conditions will decide just what vehicle mounting should be used. To set up the amplifier power supply to work with the radio set AN/PRC 10, proceed as follows: (figure 9).

(a) Remove the battery case from the AN/PRC 10

(b) Orient the amplifier power supply unit so that its front panel, right way us, is facing the operator. Lay the AN/PRC 10, minus its battery case, on the

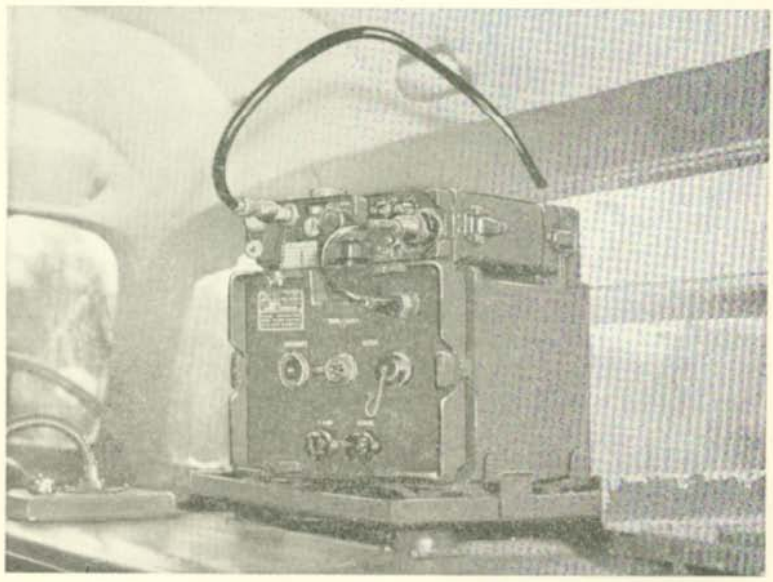


Figure 10 — Connecting AN/PRC 10 to Amplifier Power Supply AM/598/U

amplifier power supply top so that the radio set battery plug is to the rear and to the right hand of the operator.

(c) Matching the key on the AN/PRC 10 battery plug to the key way on the socket situated on the front face of the vertical flange at the rear of the amplifier power supply, push the plug home into the socket.

(d) Hook the spring clips on the AN/PRC 10 over the lugs on each end of the vertical flange. Lock by pushing the spring clips to the rear.

(e) Grasp the plug on the end of the lead protruding from the top right hand of the front face of the amplifier power supply. Engage this plug in the **Audio** socket on the AN/PRC 10. (Figure 11)

(f) Ensure AN/PRC 10 **power** switch is in the **off** position. Push the power lead (figure 11), plug into the 24V batt socket on the control face of the amplifier power supply unit. Screw the hinged wing nut clockwise to lock. (figure 11).

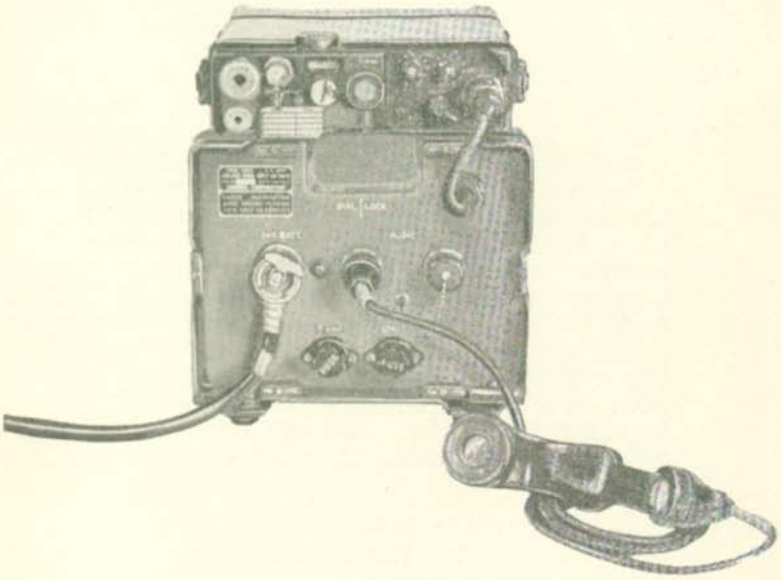


Figure 11 — AN/PRC 10 Connected to Amplifier Power Supply AM/598/U

(g) The terminals at the free end of the power lead are connected to a 24 volt DC supply.

(h) Connect a handset from the AN/PRC 10 to either of the two **audio** sockets on the amplifier power supply unit control face (figure 11). When the monitoring speaker is used, plug this in to the other **audio** socket.

Vehicle Installation

76. The mounting base, affixed to the bottom of the amplifier power supply unit, is removed by turning the outside wing nuts, at the bottom of the control face, anti-clockwise, until the mounting base disengages.

77. Notice that each of the four rubberised shockproof "legs" on the mounting frame has a hole through its centre. Bolts found in the bolt kit attached to the unit are passed through these holes into the vehicle mounting. The silver coloured earthing strap, attached to the side of the mounting is also bolted to the vehicle.

78. **Suggested methods of temporary mounting**

Until a correct mounting frame for this equipment is produced, temporary mounts may be carried out as follows:—

(a) **To the Frames Mounting (Aust.) No. 1**

Fit the frames mounting (Aust.) No. 1 to the vehicles in the normal manner. Place the amplifier power supply, fitted with the AN/PRC 10, on the radio set tray, passing the locking strap between the amplifier power supply and the AN/PRC 10. Lock in the normal manner. A local pattern antenna lead, plus adaptor will have to be devised to allow, not only the antenna for the AN/PRC 10 to fit the antenna base (aerial base) on the frames mounting, but also to allow the AN/PRC 10 to be connected to the antenna base. (Figure 12 shows such an adaptor and lead. These normally **cannot** be manufactured at unit level). The antenna lead will be fitted to the Aux Ant position of the AN/PRC 10.

(b) Bolt the amplifier power supply mounting base to the vehicle so that the amplifier power supply and AN/PRC 10 control panels are vertical. When operating in an open vehicle, the long antenna may be fitted to the **Long Ant** position of the radio set.

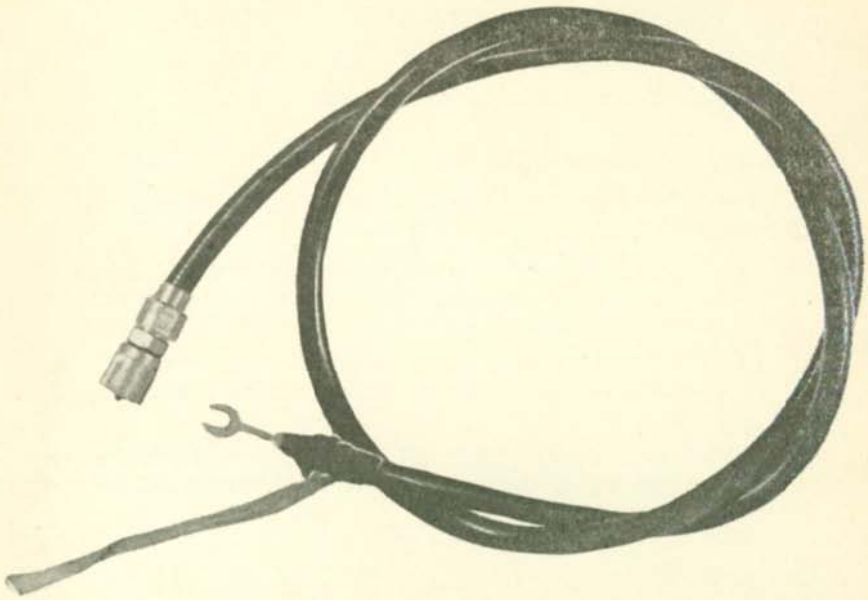


Figure 12 — Local Pattern Antenna Lead and Adaptor

Operation.

79. The combined amplifier power supply and AN/PRC 10 is operated in the following manner:—

(a) Set **Squelch** control so that it just clicks from the **off** position.

(b) Set **Vol** to position '10'

(c) Turn **Power** switch to **On.** Allow 30 seconds for equipment to warm up. Background noise should be heard.

(d) Adjust **Vol** to a comfortable level

(e) Adjust the **Squelch** control to its correct position. (If the incoming signals are weak, it may be desirable to minimise the squelch action by turning the **Squelch** control back to the position **just before it clicks off.**)

(f) Proceed with normal calibration and operation of the AN/PRC 10.

Maintenance

80. The maintenance of the amplifier power supply unit by a regimental operator will be limited to the following procedure:—

(a) Keep the unit clean and dry.

(b) Examine and report on any external damage to the unit case or mounting

(c) Examine the power lead

(d) Keep the **Audio** sockets clean

Hint for Successful Operation

81. If the unit does not function after its 30 second warm up period:—

(a) Check the fuse behind the cover marked 5 Amp. If necessary replace with the fuse in the holder marked **Spare.**

(b) If the unit still does not function, reverse the polarity of the power lead terminals at the DC source.

(c) If this fails, check all connections, turn **Power** switch to **off,** disconnect power lead from DC source and report the matter.

Conclusion

82. The amplifier power supply AM-598/U allows the AN/PRC 10 to work efficiently in a vehicular role, as well as supplying a monitoring facility. Local improvisation may be necessary to mount this unit in a vehicle until a standard fitting appears for regimental use.

83. As this unit weighs 38 lbs. 12 ozs., without its attached radio set and its DC source (often accumulators) it will be difficult to use it in any other role except in a vehicle or at a headquarters served by vehicles.

Section 4

Antenna RC — 292

Introduction

84. The antenna RC-292 is designed to operate with and extend the range of radio sets AN/PRC 9 and AN/PRC 10.

85. Weighing 48 lbs. complete the antenna RC-292 comes packed in a carrying bag 35 inches by 12 inches by 8 inches. As can be seen when these dimensions are considered, in its carrying bag it is an awkwardly shaped load when man-packed.

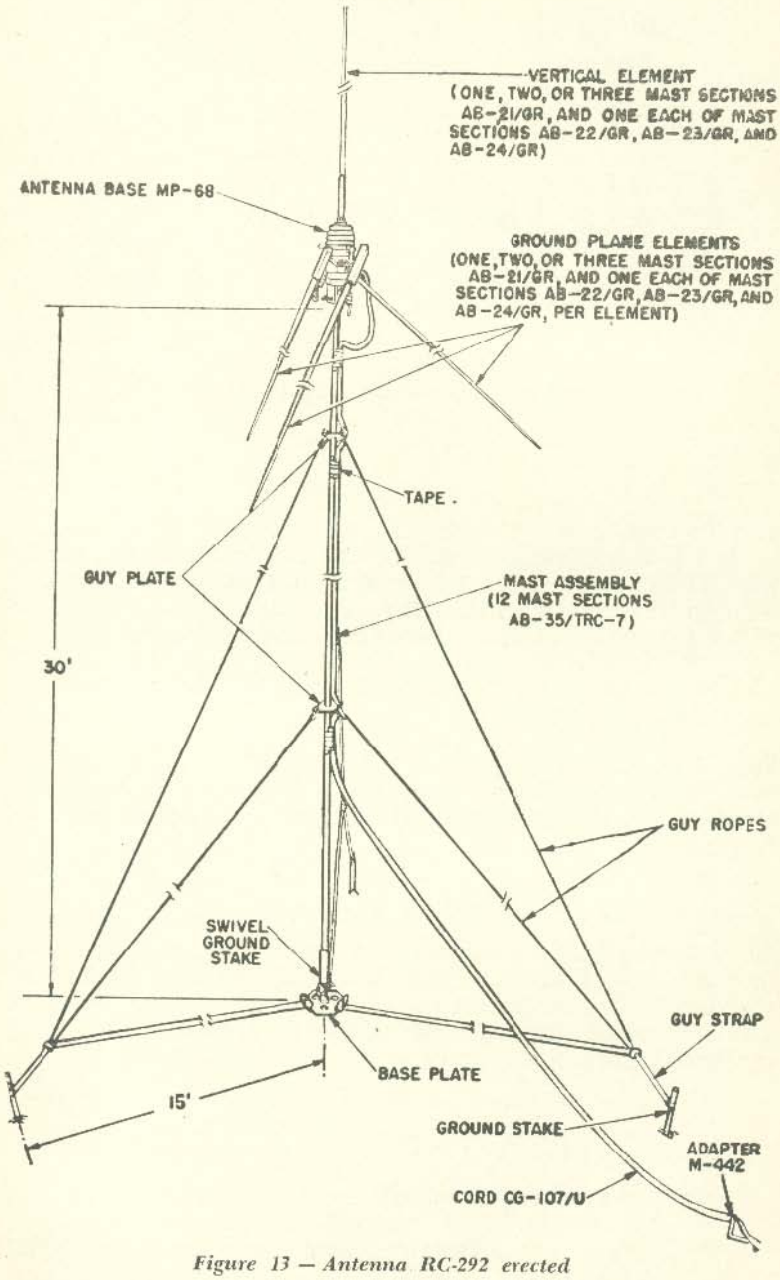


Figure 13 — Antenna RC-292 erected

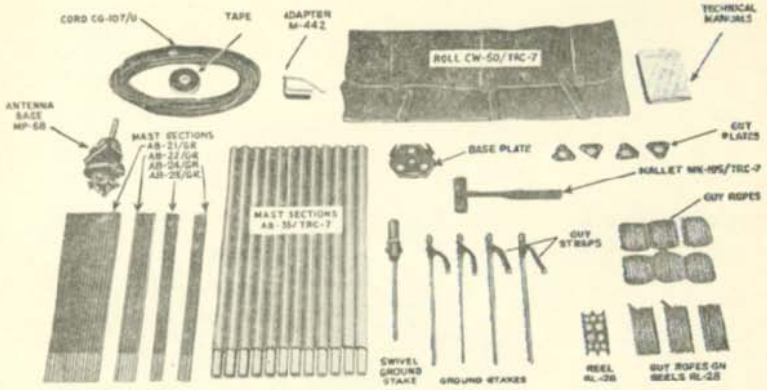


Figure 14 – Antenna RC-292 Components

Siting

86. To obtain best results, the antenna should be sited at a high point. Buildings in its immediate vicinity, densely wooded areas, steel bridges, power and telephone lines all tend to interfere with its efficiency. Care should be taken to see that the antenna elements do not touch foliage.

87. Hill tops, rises, flat open terrain constitute the best sites for this antenna.

88. When selecting a site, ensure that the coaxial cable (68 feet long) CG-107/U (figure 14) will reach the radio set location. This cable should be protected from cuts or fraying.

Erecting Antenna RC-292 by Two Men

89. An essential for the aerial to be erected by the 2 man method is a clearing of approximately 40 feet by 30 feet which will ensure an all round clearance for the building and raising of the antenna. Having selected a site, carry out the following procedure:—

(a) Drive the swivel stake through the centre hole of the base plate ensuring the cleats on the base plate face upwards.

(b) Drive 3 ground stakes 15 feet from the centre of the cleats on the base plate. A good measuring stick is 6 mast sections fitted together which equal 15 feet (See Figure 15).

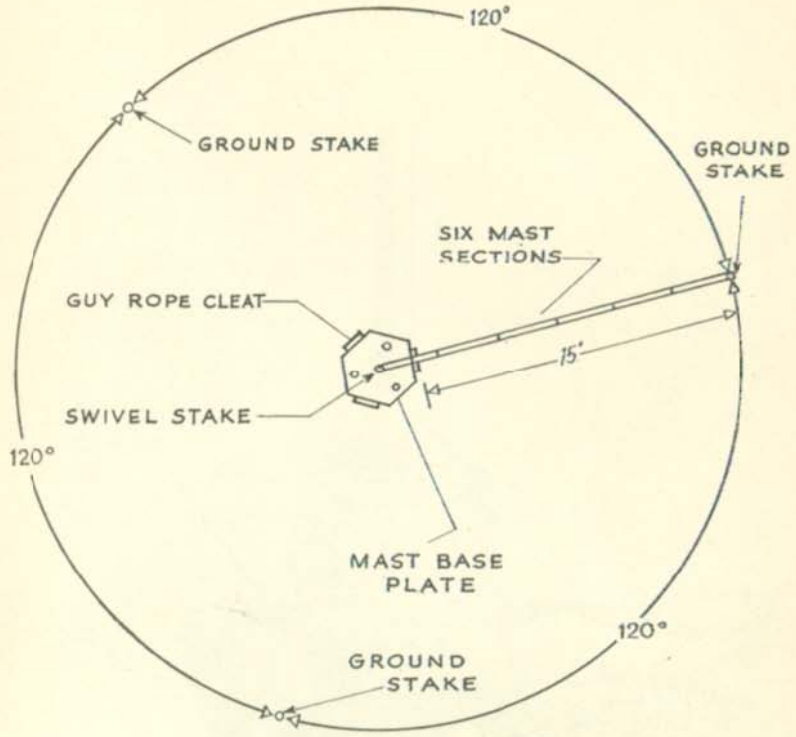


Figure 15 — Positioning Ground Stakes

(c) Tie guy straps to ground stakes as indicated in figure.

(d) With the 6 mast sections that have been used to measure 15 feet for the ground stake, place the bottom section over the movable portion of the swivel ground stake. Place the guy plate on the end of the sixth section. Place on 5 more mast sections and a second guy plate. Then add the last mast section. The total length of mast is 30 feet.

(e) Rotate the mast sections until positioned halfway between any two ground stakes.

(f) Taking the vertical element mast sections as detailed in table below, screw firmly together. Carry out same procedure for 3 ground plane elements.

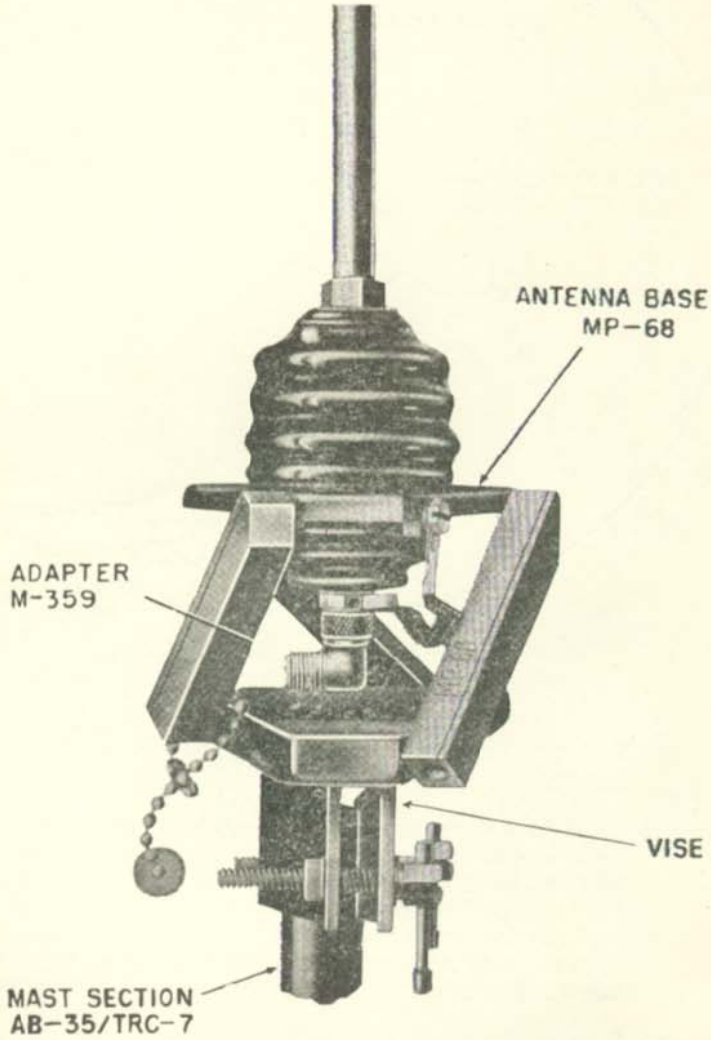


Figure 16 — Antenna Base, details and method of mounting on mast

Type of Set	Vertical Element Sections Used				Ground Plane Elements Sections Used			
	AB-21/GR	AB-22/GR	AB-23/GR	AB-24/GR	AB-21/GR	AB-22/GR	AB-23/GR	AB-24/GR
AN/PRC 9A	1	1	1	1	2	1	1	1
AN/PRC 10	1	1	1	–	1	1	1	1

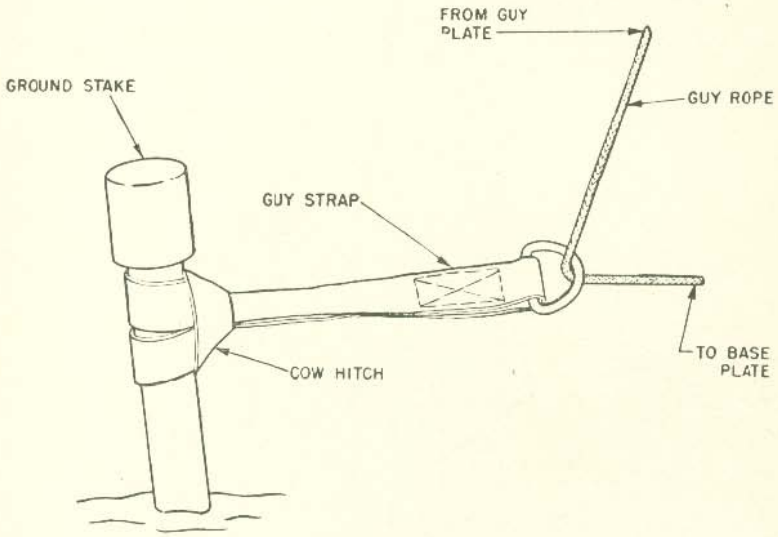


Figure 17 — Attaching Guy Strap to Ground Stake

(g) Screw the assembled elements into the sockets of the antenna base. Place the antenna base over the top mast section and tighten vise.

(h) Connect coaxial cable to adaptor on antenna base (shown in figure 16). To relieve strain on the fittings, the cable must be taken to mast at 5 foot intervals.

(j) Attach guy ropes to the two side holes of the upper and lower guy plates. Pass ropes through respective side guy stake strap rings and secure on appropriate base plate cleats. Allow a little slack. The

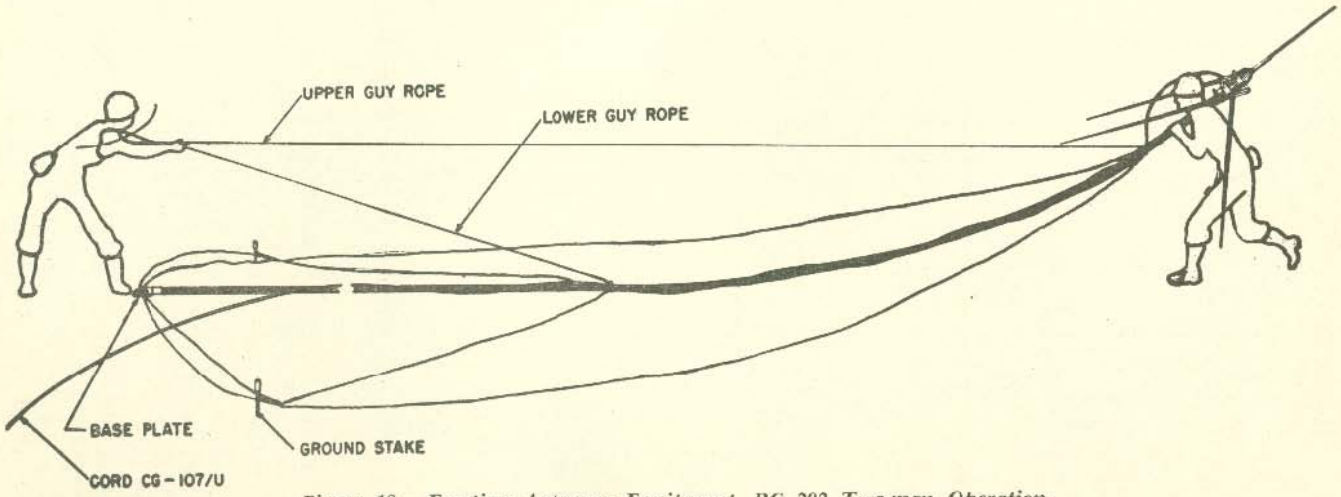


Figure 18 — Erecting Antennas Equipment, RC 292 Two-man Operation

remaining two ropes are then attached one each to the remaining hole in the upper and lower guy plates and laid in line with the third stake.

(k) To raise the mast to a vertical position requires the combined effort of the two men. One man, positioned at the top of the mast and one at the base passes the guy ropes under his right arm, around his back under his left arm, and then in front of his body, holding the four thicknesses of rope in a double handed grip. By pulling the guy ropes taut, the mast will bow; at the same time the man at the top of the mast raised it shoulder high and starts to walk towards the base plate. The man at the base walks backwards to the ground stake. The mast should erect slowly and uniformly.

(l) When the antenna is in the vertical position, adjust the guy ropes and tighten them.

Lowering Antenna

90. To lower antenna, release under control one set of guy ropes (upper and lower). With one man with the rope around him as described in para 89(k) and one man with his shoulder under mast the antenna is lowered under strict control to avoid damage to mast sections, ground plane elements and the ceramic antenna base.

Attaching Coaxial Cable to AN/PRC 10

91. To attach the coaxial cable to the set, it is first necessary to fit an adaptor UG255U to the end of the cable. To do this, place the hole in the centre of the larger end of the adaptor over the pin protruding from the end of the coaxial cable. Push down firmly and screw up the large knurled collar found on the end of the coaxial cable. Remove cover from **Aux Ant.** Place the Adaptor on and push down firmly. Lock by turning clockwise.

Erection of Antenna by 3 Men

92. A clearing roughly 15 feet square is all that is required in which to erect the antenna, using the three man method.

(a) Carry out the tasks detailed in paragraph 89(a), (b) (c).

(b) Using the table in paragraph 84(f), and the method described, build a vertical and three ground plane elements.

(c) Place on antenna base (paragraph 89(g)). Stand the antenna assembly upright on its three ground plane elements.

(d) Connect the coaxial cable to the antenna base.

(e) Place guy plate on and fit next mast section.

(f) Attach guy ropes to guy plate and pass through appropriate ground stake. These ropes are held by one member of the team.

(g) The mast is then erected by the remaining two men using the hand over hand method.

(h) One man, holding the mast and aerial sections, raises them sufficiently to allow the second man to build the mast section by section; the mast being held steady by the man with the guy ropes. As one section is fitted, the man holding the mast raises it again allowing another section to be fitted underneath. Five mast sections down from first guy plate, a second guy plate is fitted. Fit guy ropes as detailed in (f) above, the ropes being held by third man. Tape every five feet.

(i) This method is used until twelve mast sections are erected and the bottom section place over movable portion of swivel ground stake.

(j) Guy ropes are now securely tied on their respective base plate cleats.

Dismantling Antenna

93. To dismantle antenna, using three men, reverse the procedure detailed in paragraph 92.

Raising Radiating Elements Only

94. It has been found that by raising the radiating elements only, satisfactory results can be achieved. The method suggested is as follows:—

(a) Assembly the vertical and ground plane elements as already described. Screw into the antenna base.

(b) Connect coaxial cable to antenna base

(c) Select a tree limb about thirty feet from the ground. By using a throwing line, pass a guy rope over the limb.

(d) Attach the other end of the guy rope to the ceramic base and affix a loop of the guy rope to the top vertical element. This will keep the antenna vertical. By pulling on the free end of the guy rope, raise the antenna elements to the desired height.

Maintenance

95. Check the following maintenance points:—

(a) Remove all knots in guy ropes

(b) Inspect ceramic antenna base for cracks

(c) Keep the threads and threaded recesses on the elements and the antenna base clean.

96. When Returning antenna to carrying bag, check the following points:—

(a) Roll the coaxial cable without twists or kinks to prevent damage to its insulation
(b) Rewind the guy ropes one at a time onto their plates.
(c) Make sure mast sections are clean and unbent.

Ranges

97. (a) RC-292 to RC-292 up to 12 miles.
(b) RC-292 to AN/PRC 10 long rod, up to 8 miles

Points to be remembered

98. (a) Ensure the parts of the antenna, not in actual use are replaced in the carrying pack.
(b) If erecting the antenna in a strong wind, raise the mast **with the wind,** to prevent the possibility of snapping the antenna mast.
(c) Mark the antenna guys with tracing tape so that personnel will know its location at night. This will minimise damage to the antenna.
(d) Check tension of the guy ropes after rain or heavy dew. If they tighten, out of control, they will cause buckling of the mast.

Section 5

The Homing Antenna — AT-339/PRC

Purpose

99. The antenna AT-339/PRC when used with the radio set AN PRC 10 acts as an effective homing device, allowing the radio operator to find the direction of a transmitter tuned to the frequency of his radio set and to proceed in that direction.

100. A similar antenna AT-340/PRC supplies the same facility when used with the radio set AN/PRC 9A.

101. Accurate bearings on the distant transmitting stations may be had, if required, by using a compass in conjunction with the antenna.

Components and Weight

102. The antenna itself, with its arms folded, is carried or stored in a canvas bag (Bag CW-258/PRC). A small handset clip (MX-1367/U) is also supplied. This clip allows the

operator to affix the radio handset to the American Army helmet, thus leaving both hands free to operate the antenna.

103. Total weight of antenna, bag and clip is 4⅛ lbs.

Siting

104. The antenna, when used with the AN PRC 10 is most successful when operating over unobstructed paths. Hence maximum efficiency will be expected only when the antenna is used in locations away from intervening obstacles such as hills, thick timber, reinforced concrete structures, steel buildings, water tanks, bridges, etc. These obstacles will deflect the signals from the distant transmitter to the antenna, thus making homing difficult, if not impossible. Do not use the antenna in the vicinity of high tension wires or telephone wires.

105. **Best Sites.** The best sites are in unobstructed country or on hills or rises.

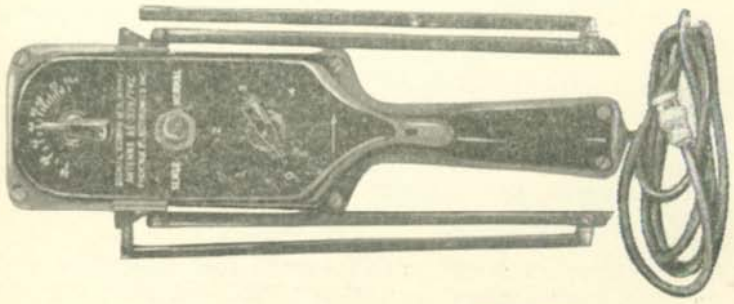
Erecting the Antenna

106. (a) Remove the equipment from the carrying bag

(b) Erect the collapsed loop antenna (figure 19) by extending the two arms (figure 20) as far as they will go. Fit the two sections together to complete the diamond form as shown in figure 21.

(c) Connect the plug at the end of the transmission line to the **Aux Ant** socket of the radio set AN PRC 10.

(d) Check to see that the joints of the loop have firm and smooth connection.



Section 19 — Homing Antenna AT-339/PRC

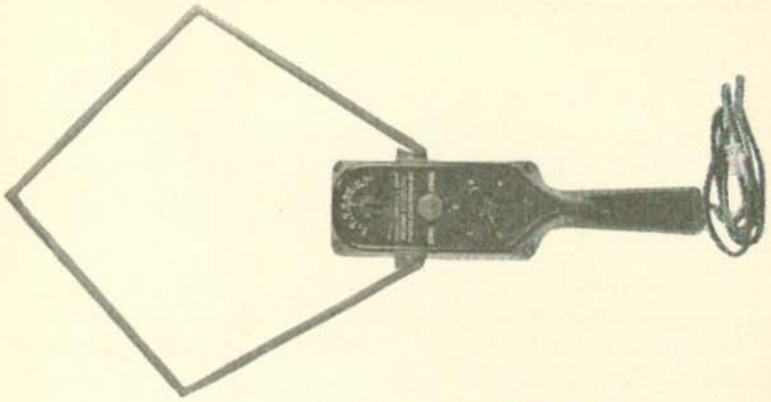


Figure 20 — Assembly of Antenna AT-339/PRC

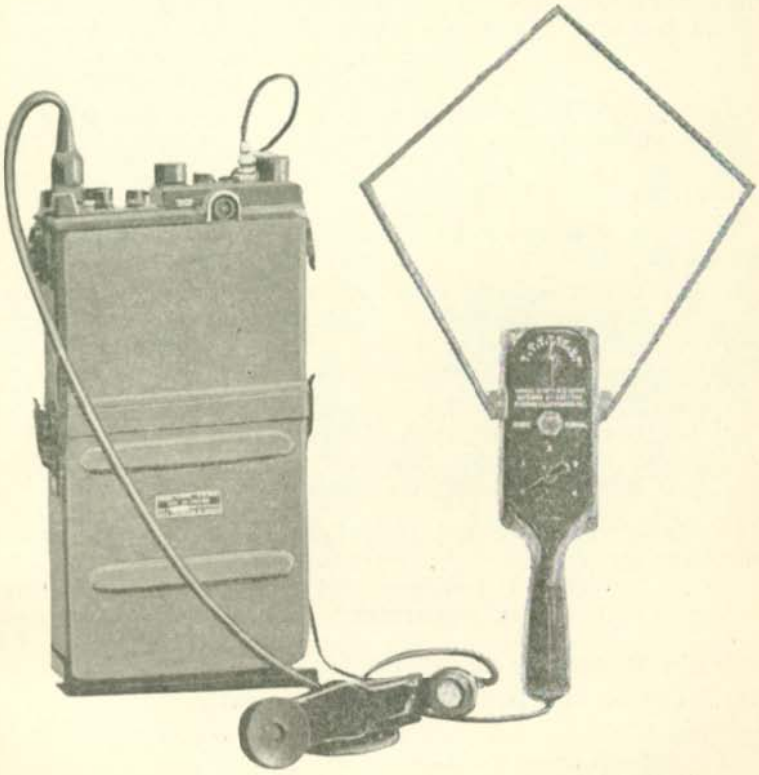


Figure 21 — Antenna AT-339/PRC attached to AN/PRC/10

Antenna Controls

107. **General**

(a) Do not force the operating controls because this may damage the antenna.

(b) Remember, the antenna is a receiving antenna only. It may be damaged if used for transmitting.

108. The following table lists the controls and their use. Refer to figure 19.

Control	Use
Frequence control calibrated in mc/s	Controls the operating frequency of the antenna
Sense — Normal switch	In the **normal** position, a signal will give two bearings in opposite directions. In the **sense** position, bearings are obtained in only one direction.
Attenuator control marked 0, 1, 2, 3, 4	Decreases strength of signal fed to the receiver from the antenna, when the attenuator is set to a higher number.

Note: In **sense** position, arrow points towards transmitting station.

Operating

109. The following paragraphs (109-114) explain the operation of the antenna step by step when:—

(a) The transmitting operator speaks in a continuous tone at a constant volume to allow the antenna operator to hear on his station. This is called the "modulated signal" method.

(b) The transmitting operator merely presses his pressel switch, thus allowing the antenna operator to hear on his carrier only. This is called the "unmodulated signal" method.

110. It is recommended that both the above mentioned methods be taught. At least 8 hours training will be required before the antenna will be handled in a satisfactory manner by any operator.

Using a Modulated Signal

111. **Tuning and Initially locating Signal**

(a) Check to see that the **Sense - Normal** switch is in the **Normal** position.

(b) Turn the **Vol** on the AN PRC 10 to 10.

(c) Set the frequency control as close as possible, to the desired frequency. (These settings are approximate).

(d) Set the attenuator switch to position 0.

(e) Hold the antenna straight up and down with the handle slightly above eye level.

(f) Rotate the antenna until a signal is received. Adjust the frequency tuning control until the signal is loudest.

(g) For greater accuracy, tuning to a weak signal is preferred. If the received signal is too loud reduce it by advancing the attenuator from 0 to a higher number.

(h) Rotate the antenna $\frac{1}{4}$ turn, first to the left then to the right of the received signal position. The signal in the earpiece of the handset may fall off in strength or disappear completely. These two positions of weakest signal are called the "null", positions.

(j) Hold the antenna in one of these null points, throwing the **sense-normal** switch to **sense.**

(k) Rotate the antenna $\frac{1}{4}$ turn in one direction and note the strength of the received signal. The signal should be louder.

(l) Rotate the loop $\frac{1}{2}$ turn, from this last position and again note the strength of the received signal. Compare this signal strength with the other signal (as in (k)).

(m) Orient the loop in the position that produced the strongest received signal. The arrow on the case (figure 21) will now point in the direction of the transmitter.

(n) When the direction of the signal is determined, throw the **sense-normal** switch back to **normal** and use the null for homing operation. Though using the antenna in this null position means moving with the antenna loop broadside to the direction of movement the null will give a sharper and more accurate bearing indication than moving with the loop giving the loudest signal. In the presence of a strong signal, the null will be quite narrow. On a weaker signal, the null may increase to 30° or 40°. The centre of this null area is the correct bearing.

112. **Homing**

To summarise the above procedure, carry out the following steps when homing on a signal:—

(a) Find the null and take a bearing

(b) Determine the sense

(c) Proceed in the direction indicated by the arrow on the antenna frame when the loop is producing the loudest signal.

(d) After the proper sense has been obtained and the **sense-normal** switch returned to **normal,** the antenna loop must be turned back to the broadside position and the null again obtained. If the null is particularly broad, rotate the loop back and forth a few times. Select the centre of the null. Proceed on a line through the centre of this null until the transmitting station is reached.

(e) As the transmitter is approached, successive bearings can be taken with increased accuracy because of the narrowing null area which results from increasing signal strength.

Using an unmodulated signal.

113. **General.** Operators will have noticed that as they turn across a carrier being received from another station, the background noise in their headsets tends to fall off into a zone of quiet when they are tuned to the other station's carrier. This tendency is called here "quieting action".

114. Using the homing antenna on a transmitter sending out an unmodulated signal is the same as detailed above in paragraph except that instead of comparing two signals for relative loudness (as detailed in para 111 sub paras (k) and (l), now the position of "maximum quiet" is chosen, with the **sense-normal** switch to **sense,** and rotating from one null position (discovered by the point of maximum background noise) one "quiet" position will be found to be quieter than the other. This position of "maximum quiet" is used to indicate the direction of the transmitter by looking along the arrow as before.

Hints for successful operation

115. When finding a null, hold the loop in vertical position with the handle at eye level. When sensing, hold the loop as high as possible. In both cases, the loop must be held vertically. It is not necessary to hold the loop as high as possible continuously, especially when following a well defined null, but frequent checks should be made to assure the correct path of travel.

116. It is possible that a signal has been bent or reflected (due to intervening obstacles) but using the loop as instructed will lead the operator to the source. In wooded

areas or in blind spots, the signal may well become weak or perhaps die away. If this happens, seek a relatively clear site and take a bearing.

117. **False Bearings.** False bearings may result if they are taken near natural or artificial obstacles. Do not operate under power or telephone lines, or near fences, railway tracks, cliffs or buildings.

118. Always tune for maximum signal at each operating frequency. Check the tuning whenever in doubt or when using the attenuator.

119. To facilitate collapsing the loop, gently tap the loop arms at the hinge joints to loosen the tension on the apex connection.

Conclusion

120. The AT-339/PRC provides an efficient homing device when used in suitable terrain.

CHAPTER 5

The W.S. A510

Introduction

121. The A510 wireless set is a crystal controlled, low power light-weight transmitter-receiver, designed primarily for use by long range infantry patrols. It can be used as a man packed station on the move, in a vehicle, or as a ground station. For the ground station role, improved aerial systems are provided to achieve greater range.

122. Carried in two special pouches on the standard webbing equipment, its operation can be either **voice** or CW in the frequency range 2 - 10 mcs. Thus it is an HF wireless equipment (see Chapter 1).

123. Operated by dry batteries giving 24 hours working, it provides efficient transmission on either ground wave (rod) or sky wave (horizontal aerials). See Chapter 1.

Components

124. Figure 22 shows all the components required for a complete station A510.

Setting Up

125. The WS A 510 consists of two units, a transmitter and receiver both housed in a light, hermetically sealed, cast aluminium alloy case. The setting up is carried out as follows:—

(a) **Transmitter Battery (HT Battery — 90 Volts)**

(i) Remove the transmitter from its pouch.

(ii) Turn the transmitter upside down. Note the two large locking wheels, one on each side of the case. Turn each locking wheel in the direction of the arrow marked on it. This allows the cover of the battery compartment to be removed.

(iii) Remove the large battery from its wrapping. Take the sealing from the socket on the battery top in such a manner as to insure no sealing remains in the socket holes.

(iv) Noting the position of the holes in the battery socket and the position of the pins on the three pin battery plug attached to the battery lead coming from the base of the set, fit the plug into the battery socket. Ensure that the small removing clip attached to the battery

Figure 22 – Complete Wireless Station A 510

plug is not between the battery lead and the top of the battery. Push the battery into the battery compartment. The plug must be down inside the walls of the compartment.

(v) Turn the locking wheels on the battery compartment cover so that their open segments are facing up. Place the battery cover on the transmitter body so that the projection on each side of the body passes through the open segment. Exert pressure downwards firmly on the cover. Turn the locking wheels in the direction of the arrows until the cover is locked to the transmitter body. (Turn in the direction of the arrow).

(vi) Replace the transmitter in its pouch, in such a manner that the silver covered aerial base on top of the transmitter appears under the hole in the lid of the pouch.

(b) **LT Battery**

(i) Remove the receiver from its pouch, turn it upside down and remove the battery compartment cover.

(ii) Unwrap the smaller battery and remove the sealing from the pocket at its top, insuring that no sealing remains in the holes.

(iii) Insert the battery plug into the battery socket in such a way that the large and small hole in the socket correspond to the large and small pin on the plug. Make sure the removing clip is not between the battery cable and the top of the battery. Place the battery into the battery compartment.

(iv) Replace the battery compartment cover and return the receiver to its pouch.

(c) **Connecting Transmitter and Receiver Together**

The transmitter, carried on the left, and the receiver on the right of the man, appear to be separate units but neither will operate until the inter-connecting plug and socket are securely joined. Matching the thick black lead coming from the right side of the transmitter and the shorter black lead from the left side of the receiver, so that the key on the outer rim of the receiver lead plug fits into the key way in the rim of the transmitter lead socket, push plug and socket together and secure by screwing the largest knurled ring until it is tight.

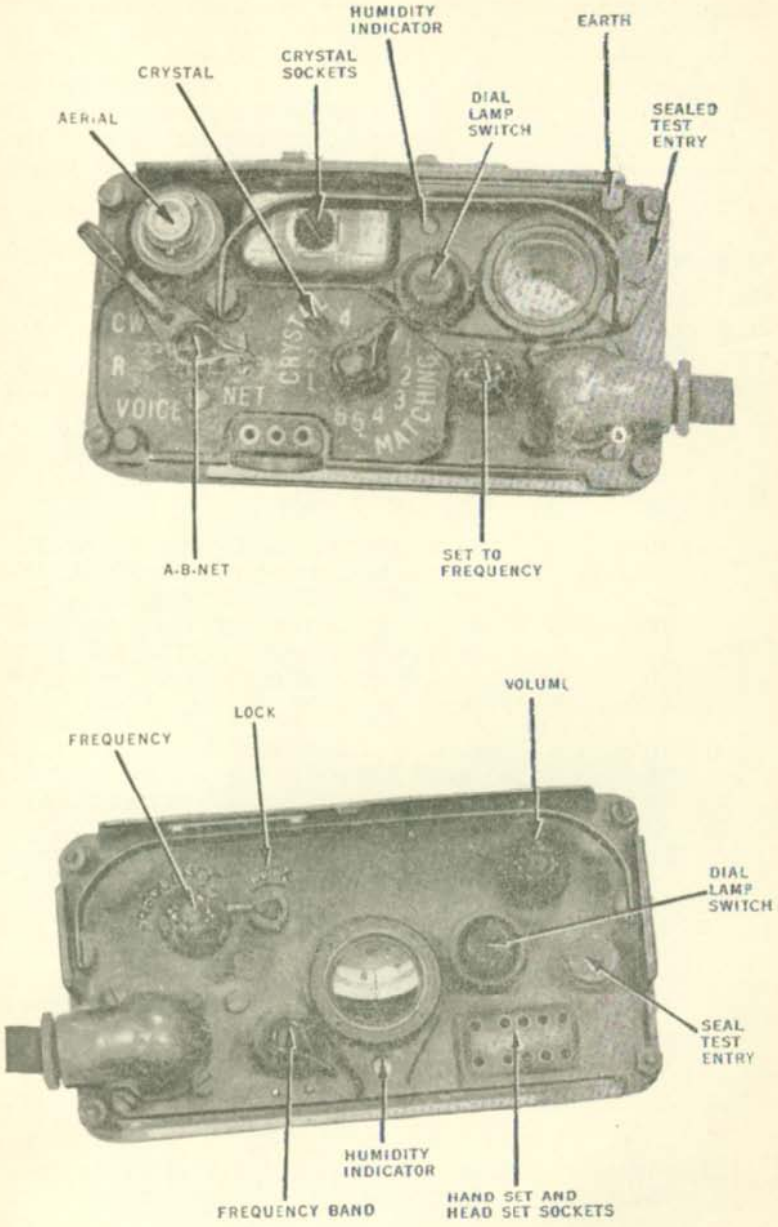


Figure 23 — Transmitter and Receiver Controls Panels WS A 510

(d) **Hand Set and Head Set.** Remove these items from their carrying pouch. On examination, it will be seen that the plugs on each of these units are identical. Each has four pins set close together with the fifth pin spaced away. These plugs fit into the double socket at the bottom right of the receiver control panel. It does not matter which unit goes into which socket.

Receiver Controls

126. The receiver controls as marked on the panel (shown here in capitals), and other items on the receiver are explained below and illustrated in figure 23.

(a) **Frequency Band.** This switch selects the blue band (2 - 4.5 mcs), or the orange band (4.5 - 10 mcs). The colours are clearly marked, and correspond with the colours on the frequency dial scale. The switch has a wide arc of travel.

(b) **Frequency.** This is the frequency control knob, the position of which can be fixed by rotating the LOCK lever anti-clockwise through 90 degrees. The frequency is indicated on the dial scale which is located in the centre of the panel. The dial scale shows the blue band (2 - 4.5 mcs) and the orange band (4.5 - 10 mcs).

(c) **Humidity Indicator.** Immediately below the frequency dial scale is a humidity indicator which is normally a blue colour, but turns pink when moisture has leaked in to the receiver, in which case the set should be replaced and repaired when possible.

(d) **Dial Lamp Switch.** The rubber cap near the frequency dial scale, marked press, covers a press switch which, when pressed, actuates the pilot lamp when the function switch on the transmitter is set at R.

(e) **Volume.** This control is situated in a corner of the panel opposite the frequency control knob. It increases and decreases the sound to the ear.

(f) **Five-pin Sockets.** These accept the handset or the head gear assembly plugs, or one of each, as required.

(g) **Seal test entry.** The hexagonal bolt on the right of the dial lamp switch seals the entry for leak testing (by R.Aust. Sigs. or RAEME personnel).

Transmitter Controls

127. The transmitter controls as marked on the panel (shown here in capitals), and other items on the transmitter are explained below and illustrated in figure 23.

(a) **Aerial.** The position of this terminal was chosen in order to keep the rod aerial as far away as possible from the operator's body when the set is carried on the man. The three radial pins at the top of the terminal form a plug on which the bayonet type socket in the base of the aerial tuning inductor, ("rod tuner") is mounted when a rod aerial is used. In the centre of this plug is a spring loaded button which when depressed, clears holes in the aerial terminal for insertion of dipol or end-fed aerial leads. (With these aerials the rod tuner is not used.)

(b) **Off-CW - R - Voice.** This function switch, operated by a lever knob exercises complete control of the station when on the air. When switching from R to **voice**, pressure on the knob must be maintained until speech is finished, its return spring returning the lever knob to R when pressure is relaxed. When holding the lever knob to **voice**, the operator's hand must be kept as far as possible from the aerial terminal.

(c) **A-B-Net.** This control is mounted on the same spindle as the function switch. The three positions are:—

(i) **A** — long wire end-fed aerial

(ii) **B** — long wire aerial, rod aerial, and dipole

(iii) **Net** — To net receiver to transmitter

(d) **Crystal Sockets** To the right of the aerial terminal is the sealed multiple socket, protected by an easily removed cover, for four miniature crystals.

(e) **Crystal.** This switch is mounted on the same spindle as the **matching switch,** and selects the required crystal.

(f) **Matching.** This switch is used, in the main, only for long wire aerials.

(g) **Set to Frequency.** This control sets the transmitter to the ordered frequency.

(h) **Humidity Indicator** } As for receiver para 126
(j) **Sealed Test Entry** } (c) and (g).

(k) **Dial Lamp Switch.** This is identical with the switch (marked **press**) on the receiver but operates under different conditions. The switch functions when

the transmitter function switch is on **CW or voice,** and the **AB - net switch** is in any one of the three positions. To enable the transmitter to be tuned at night under conditions of wireless silence, the dial lamp switch will also function when the function switch is on R and the **A-B-Net** switch is on **net.**

(l) **Aerial Tuning Meter.** The frequency dial scale, and meter scale (marked **Aer Tune**) are seen through the one window, the frequency dial scale being off-set to enable the meter to be more easily read.

(m) **Earth.** On the outer flange near the aerial tuning meter is an earth terminal to which connection is made by **depressing** the leaf spring, inserting the earth wire through the counter-sunk hole in the outer flange, and then releasing the leaf spring.

Testing the Batteries

128. (a) Set the **A-B-Net switch** to **Net.**

(b) **To check low tension.**

(i) Move **voice-R-CW-Off** switch to CW.

(ii) Look down into meter well on transmitter and press dial lamp switch (marked **press**) on the transmitter.

(iii) Meter should read within the limits of the short thick red band on the meter scale. If the reading is below the short mark, replace the battery.

(iv) Turn voice **R-CW-Off switch** back to R.

(c) **To check high tension**

(i) Hold **voice-R-CW-off** switch on **Voice.**

(ii) Look down into meter well on transmitter and press dial lamp switch (marked **Press**) on the transmitter.

(iii) Needle should be within limits of long thin red mark. If the reading is below the long mark replace the battery.

(iv) Allow the **voice - R - CW - Off** switch to return to **R.**

Crystals

129. (a) Remove crystal socket cover by unscrewing the black knob.

(b) Insert the issued crystals in the crystal holders (numbered 1 to 4 on crystal socket cover). Ensure that the pins on the individual crystal holders are pushed between the two metal holding strips, which

constitute the socket, not between one of the strips and the rubber housing. **Failure to avoid this will push the two strips together and render that particular socket inoperative.**

(c) Replace the crystal socket cover and screw it down.

Hand Set and Head Gear Assembly Test

130. (a) Push the **voice-R-CW-off switch** (hereafter referred to as the function switch) to **voice** and speak into microphone. If these assemblies are operating satisfactorily, the operator will hear sidetone.

(b) Allow the switch to return to R. Background noise should be heard in the ear pieces.

Man Pack Rod Working

131. **Fitting Rod**

(a) Take the rod tuner from the pouch, and place in a vertical position on the aerial terminal. Turn the rod tuner till it drops over the three radial pins. Push down and turn anti-clockwise to lock.

(b) Take the eight foot rod from the pouch. Holding its thick end throw the aerial out along the ground. Pull on the button and shake the aerial. The nylon cord will pull the aerial sections together.

(c) Place the rod aerial in the hole in the top of the tuner.

132. **Switch Positions**

(a) Unlock the tuning knob on the rod tuner by moving the locking arm, situated under the rod tuner knob, to the right.

(b) Put the function switch to R.

(c) Put the **A-B-Net** switch to B.

(d) Switch the **crystal** switch to the desired frequency by selecting positions 1 to 4.

(e) Place the **matching** switch to 0.

(f) By means of the **set frequency knob,** set the transmitter at the approximately ordered frequency.

(g) Set the receiver **frequency band** switch to the frequency band in which the ordered frequency is. (blue and orange bands).

(h) Ensuring that the receiver frequency lock is in the twelve o'clock position, set the ordered frequency on the frequency dial.

(j) Set the **volume** control fully clockwise.

133. **Netting**

(a) Place function switch to R.

(b) **A-B-Net** switch to **Net.**

(c) Listening in head set, turn the receiver **frequency** knob gently moving the frequency dial around the ordered frequency.

(d) A high pitched whistle should be heard with the pitch dropping until it is inaudible and then rising until it is again audible (see figure 24). The receiver frequency is adjusted to that point of inaudibility (zero beat).

Turn Carefully about required frequency on dial scale until whistle is heard. Rcducc to Zero Beat, or "Silent Point" as in the diagram below.

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Turn CAREFULLY about required frequency on dial scale until whistle is heard. Reduce to ZERO BEAT, or "SILENT POINT" as in the diagram below.

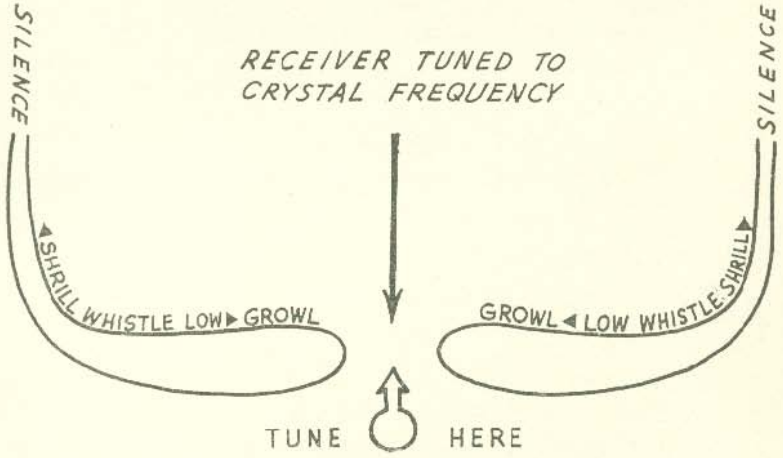

Figure 24 — Tuning the Receiver to Zero Beat

134. **Aerial Loading**

(a) **A-B-Net** switch to B

(b) Hold the function switch on **voice.**

(c) Adjust the rod tuner knob so that the meter needle is as far to the right as possible. Do this **Gently** otherwise the tuned point may be passed. The operator must keep his head as far as possible from the aerial otherwise he will produce a false reading.

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(d) If this reading is only slight, increase it by adjusting the **Transmitter** frequency knob.

(e) Allow function switch to return to R.

Ground Station Rod Working

135. (a) Carry out the procedure detailed above in paragraph (134).

(b) **Counterpoise.** Remove the counterpoise from the satchel and drive its spike into the ground. Spread the four black wires to form a cross. Connect the green lead to the Earth terminal on the rear face of the transmitter. Carry out the aerial loading as detailed in paragraph 134.

Long Wire Working

136. A long vertical wire may be used instead of the vertical rod to obtain greater efficiency when operating as a ground station.

(a) Set the wireless set up as for rod working but do not use the rod tuner.

(b) Suspend a vertical wire of approximately 30 feet length above the transmitter. (Use one of the 68 feet aerials and a cords aerial (throwing line)).

(c) Insert the end of the vertical wire into one of the holes in the side of the aerial terminal by pressing the centre of the terminal down.

Caution. Do not allow the long wire (Wire aerial) to touch its means of support.

(d) Load this aerial in the normal fashion, using the **matching** switch (0-6) and the transmitter **frequency** knob.

Sky Wave Aerials

137. Two ready made aerials, aerials adjustable 135 feet (an end fed aerial) and a dipole aerial are supplied with the set. To set up either of these aerials proceed as follows:—

(a) **End fed aerial.** Instructions for the erection of this aerial are shown on the front and back charts of the aerial spool. The aerial consists of 8 black leads and one orange lead. The black leads, numbered 1 to 8 are of varying calculated lengths, these numbers are stamped on the hook and eye at the end of each length. Instruction cards indicate the number of lengths to be coupled together for any particular frequency. The free end (the small insulator) is suspended to the required height by one of the aerial cords. The aerial is connected to

the aerial terminal on the wireless set by hooking the orange lead to the eye of the last length indicated.

(i) **The A-B-Net** switch is in the position nominated on the card.

(ii) **Aerial Loading.** Placing the function switch to **voice,** this is carried out using the **matching** switch.

(iii) A lack of aerial efficiency will result if this aerial is erected at too vertical an angle.

(iv) Site the aerial so that its length is at right angles to the distant station.

(v) The counter poise must be used with this aerial. Drive the spike through the hole in the aerial card, this will keep the aerial taut.

(b) **Centre fed Dipole Aerial.** This aerial may be erected either as an inclined or horizontal dipole. Erected in the horizontal, it is more efficient. The dipole comprises the following components:—

(i) Two aerials lightweight 68 feet.

(ii) One 70 ohm aerial feeder.

(iii) Two aerial cords

(iv) Method of assembling and details of the length of wire required for any frequency are shown inside the metal flaps of the aerial 68 feet.

138. **Successful operation of the Dipole Aerial**

(a) The distance between the red markers on the aerial wires is 12 ins. When re-winding the aerials, keep the lays of wire neatly alongside of each other.

(b) The laid down instructions concerning the connecting of the aerial to the 70 ohm feeder must be adhered to otherwise the aerial will detach from the feeder when strain is put upon it.

(c) Place the wireless set directly under the feeder. Unwind only as much feed as is required to reach the set.

(d) No earthing or counterpoise will be used with this aerial.

(e) Keep the aerial no higher than one quarter wavelength above the ground. (This is equal to half the length of the aerial.)

(f) Raising or lowering the aerial about this quarter wavelength height may improve its operation in a particular locality. This will be learnt by experience.

(g) Site the aerial so that its length is at right angles to the distant station.

(h) **To load.**

(i) Place **A-B-Net** switch to B.

(ii) **Matching** switch to O.

(iii) Hold function switch to **voice.**

(iv) Adjust the transmitter **frequency knob** for maximum aerial loading. If no meter reading results, try the other matching positions.

CW Operation

139. **To receive**

(a) Plug the lightweight key into its socket, situated below the **A-B-Net** switch.

(b) Place the function switch to R.

(c) **Note:** No CW signal will be received until the key is plugged into the set.

140. **To Transmit**

(a) Place the function switch to CW.

(b) **Note:** Always move function switch back to R at completion of transmission.

(c) Before returning to voice working, key plug must be removed.

Maintenance

141. The WS A 510 has been found in field use to be an efficient working radio set. If the operator uses common sense in the care of his equipment, there is little need for repairs under normal circumstances. Attention to the following detail will aid him considerably in keeping his wireless set working continuously.

(a) Keep the set and its components clean and dry.

(b) Inspect the set daily for dents and broken or loose switches.

(c) Keep all plug holes dry.

(d) Keep the aerial rods clean.

(e) Keep the hand set and head gear assemblies clean and dry. Look for frayed and damaged leads.

(f) Do not leave the batteries in the set when it is not being used.

(g) Check humidity indicators daily, should they turn pink replace the set as soon as posible.

(h) Ensure that the main housing of the rod tuner is tight on its ball socket. The ring clamp on the conical shaped holder must also be kept tight.

(j) Inspect the connecting leads from transmitter and receiver. Do not subject these to undue strain and twists. Undue strain will tear away the outside insulation where the leads come out of the housings on the top of the set. The connecting plug rings should be screwed hand tight.

(k) Before rewinding wire aerials or aerial cords, remove any knots or kinks.

(l) Do not carry spare crystals in the pocket. If the crystal compartment on the set is full use the spares box. Pack the crystals into the box with paper.

(m) Although the equipment is strong and will stand fair wear and tear, do not use it as a seat or a footstool.

Ranges

142. The following ranges are to be normally expected:—

	Expected Range in Miles	
	Voice	**CW**
(a) **Rod Working**		
(i) Manpack role	2	4
(ii) Vehicle	2	4
(iii) Ground station using counterpoise	3	6

	Ground Wave		**Sky Wave**	
	Voice	**CW**	**Voice**	**CW**
(b) **End Fed Aerial**	6	12	25	75
(c) **Dipole Aerial**				
(i) Inclined dipole	6	12	30	90
(ii) Horizontal dipole	4	8	40	120

143. When using the above range table, it should be realised that the terrain and vegetation will influence the ground wave working of the set. For example, when working in the manpack role using the rod aerial in secondary jungle, the working range may well drop down to the region of from a quarter to a half mile.

Siting

144. Ground wave and sky wave operation will follow the principles outlined in chapter six aerials for low powered HF and VHF radio sets.

Frequency Variations

145. It has been noticed in field operation of this wireless equipment that during extreme variations in temperature and as the batteries get towards the end of their working life, slight alterations will occur in the receiver operating frequency. It is therefore a useful operating drill once every 15 to 20 minutes, when operating in the manpack role on rod to check the receiver against the transmitter or better still against the distant station. Only constant use of any one particular wireless set will give the operator an intimate knowledge of its habits.

146. **Ghost Signals.** When the batteries start to fade, there is a tendency for the equipment to develop a "ghost" signal of its own transmitter signal while on **net.** This ghost appears about 30 kcs **above** the true frequency. Weaker ghosts may be found further along the band. Ghost signals may be identified by the fact that there is a background noise (hash) behind the netting signal whereas the true netting signal has no such noise.

Conclusion

147. This wireless equipment has proved itself to be robust and trustworthy in its field operation. However it appears to perform most efficiently when using skywave transmission. In its manpack role operating on vertical rod, experience has shown that the ranges given in paragraph 142(a) may be slightly in advance of its true performance.

CHAPTER 6

Aerials for Low Power Field Wireless Sets

Section 1 — General

Introduction

148. The study of simple aerial theory coupled with some practical knowledge of the erection of simple aerials is of prime importance to the Regimental Signaller to-day, who is using low powered wireless equipments, very often in close and difficult terrain. Failure to establish and maintain wireless communications may often be due to poor siting of the wireless equipments which the signaller is employing.

Aerials in General

149. An aerial is a conductor (either a metal rod or a wire) generally elevated above the ground. The aerial radiates energy (a signal) from a wireless transmitter into the atmosphere and at the receiving point another aerial collects the radiated energy from the atmosphere and passes it to the wireless receiver. In field equipment the same aerial is used to both radiate and collect energy. Thus a good transmitting aerial is automatically a good receiving aerial. Because of this, field aerials are normally designed for transmitting.

Wireless Waves

150. The energy sent out or radiated from an aerial is sent out in the form of waves. It is quite common to talk about wireless waves.

151. **Wave Length.** If the example of waves at the sea shore can be taken to represent in diagram form these waves of energy radiating from an aerial, some picture can be conjured up in the mind as to what is meant by a wave

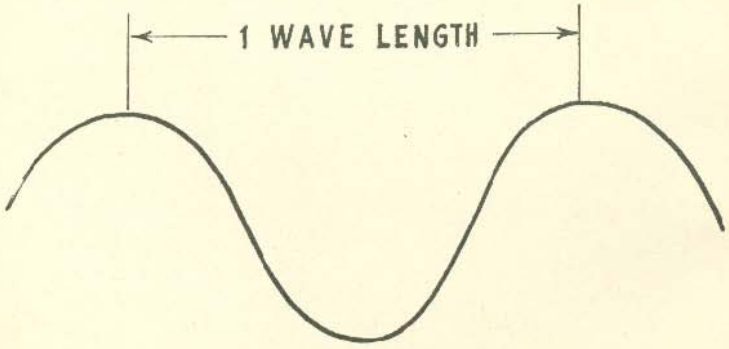


Figure 25 — The Radio Wave

of energy. The term "wavelength" then can be taken to mean the distance between the crest of one wave and the the crest of the next. Figure 25 will illustrate this.

Frequency

152. The word "frequency" is understood to mean something which is repeated at regular intervals. The frequency of a particular occurrence is the number of separate times it takes place in a given period. In dealing with wireless waves the frequency of a wave is understood to mean the number of complete wavelengths or "cycles" which radiate from an aerial in one second. For instance, if it happens that 10,000 waves of a certain length leave an aerial in one second then that wave is said to have a frequency of 10,000 cycles per second. For ease of reference, a wave which has a frequency of 1,000 cycles per second can also be said to have a frequency of 1 Kilocycle per second (kilo meaning 1,000) and this is written in abbreviated form as 1 Kc/s. Similarly, a frequency of 1,000,000 cycles per second is called 1 megacycle per second (mega meaning 1,000,000) and is written 1 Mc/s.

Converting Frequency to Wavelength

153. It has been found that aerials work best both for receiving and transmitting if their lengths bear some relationship to the length of the wireless wave which they will either receive or transmit. Depending on the type of aerial, they work best if they are cut or manufactured either 1 wavelength long or $\frac{3}{4}$ wavelength or $\frac{1}{2}$ or $\frac{1}{4}$ wavelength long. The type of aerial and the wavelength to which it is designed to work will determine this, as will be seen.

154. So it is necessary, when wanting to use a certain aerial to operate on a certain frequency, to be able to calculate the wavelength of the required frequency, in order to make the aerial the best length for efficient operation. Because it is known that:—

Wavelength $\times$ frequency = the speed of light

formulae have been worked out to allow the wavelength to be calculated if the frequency of a particular wireless signal is known. These are:—

(a) Full wave length = $\frac{935}{\text{Frequency (in mc/s)}}$ Ft.

(b) $\frac{3}{4}$ wave length = $\frac{702}{\text{Frequency (in mc/s)}}$ Ft.

(c) $\frac{1}{2}$ wave length = $\frac{468}{\text{Frequency (in mc/s)}}$ Ft.

(d) $\frac{1}{4}$ wave length = $\frac{234}{\text{Frequency (in mc/s)}}$ Ft.

155. **Typical Problems.** Thus an operator may be called upon to solve the following typical problems.

Calculate the length of a $\frac{1}{2}$ wave aerial to operate at a frequency of 4,875 kc/s.

(a) Step 1. Convert the frequency to Mc/s. (Refer para 152). So 4,875 kc/s = 4.875 mc/s.

(b) Step 2. Substitute the values in the $\frac{1}{2}$ wave formula (refer 154 (c) above);

$$\frac{1}{2} \text{ wave length} = \frac{468}{\text{Frequency (in mc/s)}} \text{ Ft} = 96 \text{ Ft.}$$

Frequency Spectrum

156. For the purpose of both classification and ease of reference frequencies of different wave-lengths have been broken up into definite frequency bands or groups. They may be classified as follows:—

(a) Audio frequencies (AF) = 16 c/s to 15 kc/s

(b) Very low frequencies (VLF) = below 30 kc/s

(c) Low frequencies (LF) = 30 kc/s to 300 kc/s

(d) Medium frequencies (MF) = 300 kc/s to 3,000 kc/s (i.e. .3 mc/s to 3 mc/s

(e) High frequencies (HF) = 3 mc/s to 30 mc/s

(f) Very high frequencies (VHF) = 30 to 300 mc/s

(g) Ultra high frequencies (UHF) = 300 to 3,000 mc/s

(h) Super high frequencies (SHF) = 3,000 to 30,000 mc/s

(j) Extra high frequencies (EHF) = above 30,000 mc/s

157. The above bands or groups of frequencies are called the 'frequency spectrum'. So if, in a certain case, a transmission is called a 'VHF' transmission, it will be seen that it is a transmission of a frequency between 30 and 300 mc/s (refer 156(f) above).

Classification of Radio Waves According to Path

158. Radio waves travel between the transmitting aerial and the receiving aerial following various paths depending on the type of aerial, the height of the aerial above the

ground and the frequency, as will be seen. Some waves are capable of travelling through space when they radiate from the aerial and so are called 'space waves'. 'Surface waves' can only exist along the junction of the ground and atmosphere. Figure 26 shows what is meant by the various types of radio wave and why certain of the 'space waves' can be classified as 'ground waves' (because they either travel along the ground or follow its contouring).

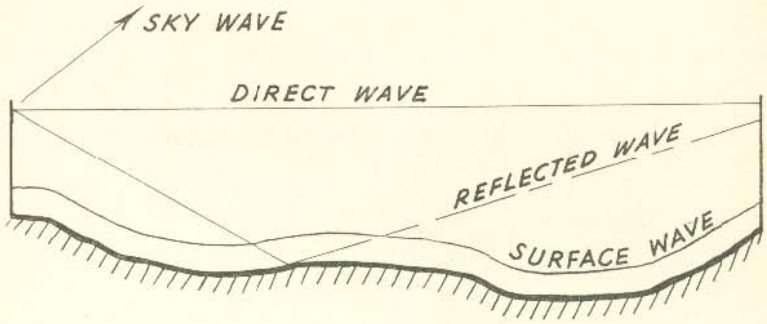


Figure 26 — Types of Radio Waves

159. Keeping figure 26 in mind, then radio waves may be classified as follows, depending on whether they take a path through space from the transmitting aerial to the receiving aerial, i.e., 'space waves' or whether they cling to the surface and contouring of the earth, i.e., 'surface waves'.

(a) **Space waves**
  (i) Sky wave
  (ii) Direct wave
  (iii) Reflected wave

(b) **Surface Wave**

160. It should be realised that several of the space wave types of radio waves, though they travel through space, tend to follow the surface of the earth; they do not shoot up into the atmosphere but tend to follow the surface of the earth from the transmitting aerial to the receiving aerial. Bearing this in mind, space waves may be classified into:—

(a) **Sky wave**

(b) **Ground wave**
  (i) Direct wave
  (ii) Reflected wave

161. Surface wave may also be included under the general heading of ground wave.

Relationship of Frequency to Path

162. **Surface Waves.** Surface waves are used mainly at VLF, LF, MF and in the lower end of the HF band (i.e., at frequencies below 20 mc/s).

163. **Direct waves.** Direct waves are used in the top part of the HF band (say above 20 mc/s) and VHF, UHF and SHF.

164. **Sky waves.** Sky waves are used chiefly in the MF and HF frequency band (i.e., 2-30 mc/s).

Section 2 — Ground Waves

165. Referring to figure 26, it should be understood that aerials designed to produce ground wave radiation, if not raised more than a $\frac{1}{4}$ wave length above the ground, will produce surface waves. If the aerial is placed more than $\frac{1}{4}$ wave length above the ground it will produce direct waves. Referring back to the formulae for wave length (section 1 paragraph 154) it is readily understood why Army aerials working at frequencies below 10 mc/s cannot generally be placed at a $\frac{1}{4}$ wave length or more above the ground. So now ground waves can be referred to as:—

(a) Surface waves (HF ground wave)

(b) Direct waves (VHF and SHF ground waves)

166. The quality of both these types of ground wave transmissions depends on a number of factors. They will be dealt with here so that the principles of siting ground wave aerials will be understood more readily.

167. **Surface waves — (HF ground waves).** The following factors will influence the siting and the selection of aerials to operate with the HF equipments at present being used by regimental signallers.

(a) **The composition of the ground over which the waves travel.** The range is greatest over a good conducting surface. Range is greatest, then, over water, and least over dry land.

(b) **Power radiated from the aerial.** As the regimental sets are low powered, they may not always operate at peak efficiency if the aerial is ill chosen or badly sited.

(c) **Contours of the path between stations**
Surface waves will follow the contours of the ground over which they travel. Hence they go a greater distance over flat ground. Over hilly ground, power and hence range will be lost at every hump or hill. Buildings, gullies, woods, etc., in the wave path will reflect, scatter or absorb the radiated power. An obstacle close to the set will effectively screen the set from radiating to its distant station.

(d) **Frequency.** When using the surface wave, the higher the frequency, the greater the ground absorption and hence the shorter the range.

(e) **Noise and interference at the receiver.** The range of the set will be decreased considerably if background noise or interfering signals make it impossible to understand or read weak signals.

(f) **Type of aerial.** With one exception (the ground aerial) only vertical aerials will produce surface waves.

168. **Direct waves — (VHF Ground waves).** Above 20/30 mc/s, the space wave predominate, any surface wave being rapidly absorbed by the ground. Because the shorter wave lengths above 20 mc/s make the aerial short, it is possible to raise the aerial more than $\frac{1}{4}$ wave length above the ground (refer para 165 Section 2) even of manpack sets, space wave predominating at these frequencies. In military communications, the most important part of the space wave is the direct wave. Reflected waves are usually absorbed by the ground. Beware, however, of the reflected wave when operating over a good reflecting surface, i.e., over a marsh or over water. The reflected wave may interfere with the direct wave and so weaken the signal. The following factors influence successful transmission of space waves:—

(a) **The transmission path.** An optical or almost optical path (line of sight) is important when using space wave transmission because these waves will not follow the surface of the earth as do surface waves. (See figure 2). Space waves can curve round obstacles, to a limited degree, particularly at the

lower end of the VHF band. Thus it may be possible to obtain contact between two VHF sets which are not strictly in line of sight.

(b) **The power of the transmitter.** Since this VHF ground wave is not absorbed by the ground to the same extent as the HF ground wave, even low powered transmitters (i.e., AN PRC 10 giving 0.9 watt) can give quite considerable ranges, since their range is effected by screening, not absorption.

(c) **Interference.** Interference is less than for HF transmission.

(d) **Day and night signal strengths.** There is no difference between day and night signal strengths and hence no need to change frequency, as for HF transmissions.

(e) **Fading.** This may occur when the stations are moving, due to the screening which may take place from time to time from hills, buildings, etc. Even a low flying aeroplane may cause fading by reflecting the signal from one set.

169. **Range of VHF equipments.** Any table of ranges would not mean very much except as a guide to how the VHF regimental sets behave in certain types of country where line of sight is not obtainable. Even with the low powered regimental equipments, if line of sight is attainable the range is almost unlimited.

Section 3 — Sky Waves

Sky Waves

170. Energy radiated from an aerial in directions other than along the ground travels up into space and, if the conditions are suitable, the path of the wave will be bent downwards, after having struck a reflecting layer, termed the ionisphere. Such a skywave may return to earth at great distances from the transmitter, and is the means of obtaining long range radio communication.

171. **The Ionisphere.** This is a layer of gases from between 30 to 300 miles above the earth which reflect radio waves of certain frequencies. This layer's construction changes by day and night and so will reflect waves in a different manner by night and day.

The Reflection of Radio Waves From the Reflecting Layer

172. It has been found that if the frequency of the radio wave is low enough, the radio waves will reflect from the reflecting layer back to earth. If the frequency is too high, the wave will go through the layer, whereas if the frequency is too low, all the radiated energy will be absorbed by the reflecting layer and so no energy will be returned to earth.

173. The angle at which waves strike the reflecting layer also determines whether they are reflected or not. Usually waves must strike the layer at an oblique angle to be reflected. As frequencies are raised from 12 to 30 mc/s the angle gets more oblique. Above 30 mc/s the angle is so oblique that any reflected waves are of no use at all because they strike the earth too far from the receiver to be of practical application.

174. **Night and day transmissions.** For ranges which interest the regimental signaller, when working on sky wave, frequencies between 4-7 mc/s are best by day while frequencies between 2-3 mc/s are best for night working. When regimental units are issued with a number of frequencies, the regimental signalling officer will have to make this adjustment from higher to lower frequencies as conditions vary. The varying conditions of the reflecting layer by day and night will have substantial effect on the quality of transmissions on HF frequencies.

175. Figure 27 below, should make clear what is meant by saying that the angle of reflection has a bearing on whether waves are reflected from the reflecting layer or whether in fact they continue on their path through this layer. It can be seen that given a certain frequency sent out by a certain equipment on ground (surface) wave transmission, as has already been shown, this type of transmission will only have a limited range. Should the same frequency be transmitted by sky wave, the reflected wave may come to earth a great deal further ahead of where the ground wave cuts out. The distance from the transmitter to where the first reflected sky wave comes to earth, is called the "skip distance". The term "skip zone" will be explained from figure 3. In this skip zone, it should be clear that no signal will be received at the receiver, because the range is too far for ground wave working but too short for sky wave working.

176. This may well explain, to quote a particular case, why, in fairly close country, the WS A510 will give ranges up to 1 mile, using ground wave transmission, (i.e., on rod) but may well give ranges up to 50 or 70 miles on sky wave

working. Yet a substation only 10 miles from the transmitter may not be able to receive either signal, because the equipment may well be situated within the skip zone of this transmission.

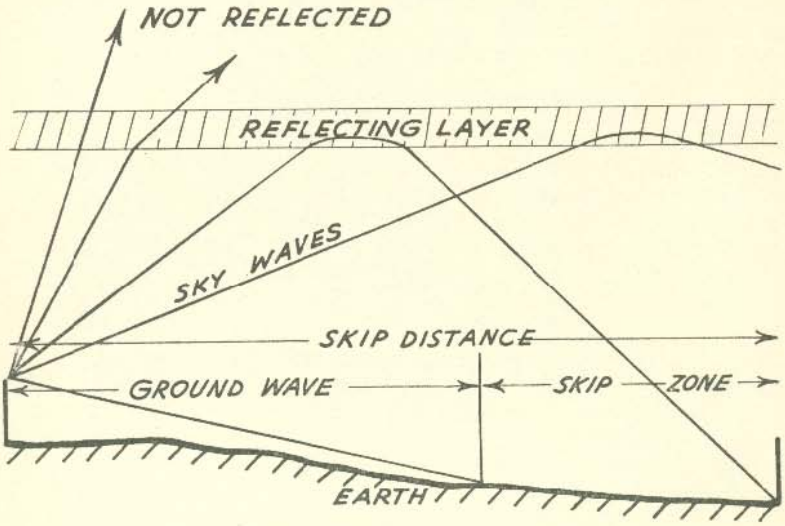


Figure 27 — Sky Waves

177. To sum up, there are three conditions which must be fulfilled to produce successful skywave transmissions:—

(a) The frequency of the radio wave must be low enough to return to earth at the receiver.

(b) The frequency must not be so low that the wave is absorbed into the reflecting layer.

(c) The wave must be transmitted from the transmitter at the correct angle of radiation.

How can the above three conditions be fulfilled?

178. The first two conditions above, will be fulfilled by careful selection of frequencies both in the Corps of Signals who allocate frequencies and on the part of the regimental signalling officer who must choose between the frequencies allotted to him. The third condition, i.e., angle of radiation, will depend on the type of aerial used. This will be discussed in succeeding paragraphs.

Fading

179. Fading is an important factor to be remembered in HF skywave communication. Because the constitution of the reflecting layer is constantly changing, sky waves may

well find two distinct paths from the transmitter to the receiver. This may well produce fading in the receiver. Fading may also occur if any one particular aerial radiates both sky wave and ground wave, assuming that both waves make their way to the receiver. This may well make adjustments to aerial necessary. This will be discussed when dealing with particular types of aerials.

Section 4 — Siting Wireless Aerials

180. **Types of Aerial.** The two basic types of aerial used with low power field wireless sets are:—

(a) Vertical aerials (short range working), usually metal rod types connected either directly to the set or by means of a connector.

(b) Horizontal aerials (long range working) wire aerials erected between trees or poles.

181. Both types must be sited correctly, because bad siting will drastically reduce the range of the set in use. Usually, best results will be obtained if stations working to each other use the same basic type of aerial.

Note: Wireless sets AN/PRC 10 and C/PRC 26 mainly use vertical aerials. Wireless sets A510 or 62 use either horizontal or verticals.

182. **Vertical aerials.** When siting the aerials try for:—

(a) An open space around the aerial, particularly in the direction of the stations with which you wish to communicate.

(b) High ground rather than a depression.

(c) The forward slope of a hill. If the actual situation precludes this try to locate the aerial within line of sight to the distant station.

183. **Avoid if possible**

(a) Electric power lines, overhead telephone lines or any large object that is a good conductor of electricity, such as a metal bridge or water tank.

(b) Other wireless stations.

(c) Electrical machinery, e.g., battery chargers and electric light plant.

184. When operating on the move in jungle terrain effective ranges will be reduced considerably due to undergrowth absorbing the wireless waves. In some cases communications may be lost completely. To avoid this, the following points must be remembered:—

(a) Make certain the aerial does not touch any vegetation — this may mean stopping until messages have been passed or,
(b) Moving to a good site in order to regain communications. In this case it is not always necessary to move to the rear as a good site may exist forward along the route.

185. **Horizontal Aerials.** Wireless waves leaving or received by a horizontal aerial are not affected greatly by surrounding objects. All that is necessary to avoid reduction of range is that the horizontal part be open to the sky. Little is gained by siting on high ground.

186. **When siting horizontal aerials try for:—**

(a) Damp ground
(b) An open space

187. **Avoid if possible:—**

(a) Telephone or power lines, steel framed buildings.
(b) Electrical machinery and unsuppressed motor vehicles.
(c) Other wireless sets.

188. If an open space can not be found it may be necessary to clear one, as good results will not be obtained if the horizontal point is not open to the sky. If the clearing is impossible use a vertical aerial.

189. Horizontal aerials should be sited with the horizontal part roughly at right angles to the distant station.

190. **Camouflage.**

(a) The important factor is to conceal the set and operators rather than the aerial.
(b) Remote control equipment should be used where possible to keep sets away from the headquarters and from each other. This is particularly so at battalion headquarters where several wireless sets may be located.
(c) If poles are being used in erecting the aerial, the shadows thrown by them should be broken up.
(d) If a station is going to remain at the site for more than a very short time, track discipline should be strictly enforced.

Section 5 — Practical Aerials

High Frequency Aerials

191. In constructing an aerial for use with an HF set the most important factor to be considered is the distance range required. If the distance is greater than the reliable ground wave range of the set then the communication will be by sky wave. This governs the type of aerial to be employed. From practical tests in jungle country (the worst possible conditions), the average ground wave working range of WS A510 for reliable voice communication is considered to be:—

(a) Day — 2 miles

(b) Night — 800 yards

192. The ranges quoted above will vary greatly with location of sets and type of country, but are conservative and provide a sound basis for planning. Distances in excess of these will require skywave working.

High Frequency Sky Wave Aerials

193. There are many different types of high frequency sky wave aerials which may be used for low power field sets. The most desirable types for field use, considering electrical efficiency and ease of construction are:—

(a) End fed horizontal aerial ($\frac{1}{4}$ and $\frac{3}{4}$ wavelength)

(b) Half wave horizontal dipole

(c) Half wave folded dipole

(d) Open Wire Shirley aerial

End Fed Horizontal Aerials

194. This is the most simple aerial in use for sky wave working. It is simply a long piece of wire arranged to provide the maximum amount of its length in the horizontal plane with a short vertical lead down at one end to the wireless set. The $\frac{3}{4}$ wavelength should be used whenever possible in preference to the $\frac{1}{4}$ wavelength. Figures (29) and (30) give diagrams of ideal constructions of end fed aerials. Lengths of the aerials for frequencies one megacycle apart are given in tables 1 and 2. Lengths for any particular frequency not given in the tables can be calculated from the formulae:—

(a) $\frac{1}{4}$ wavelength in feet $= \dfrac{234 \text{ Feet}}{\text{Frequency (mc/s)}}$

(b) $\frac{3}{4}$ wavelength in feet $= \dfrac{702 \text{ Feet}}{\text{Frequency (mc/s)}}$

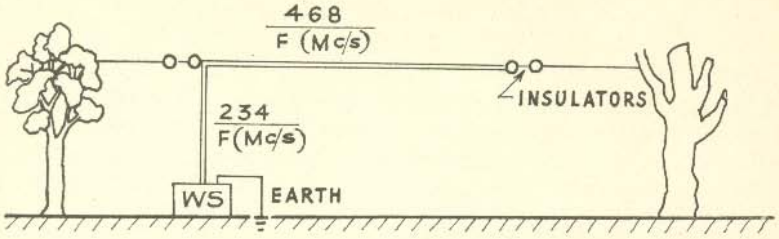


Figure 28 — Ideal ¾ Wave End Fed Aerial

Table 1 — ¼ wavelength in feet

Frequency	Length
2 mc/s	116 feet
3 mc/s	78 feet
4 mc/s	58 feet
5 mc/s	47 feet
6 mc/s	39 feet
7 mc/s	33½ feet
8 mc/s	29 feet
9 mc/s	26 feet
10 mc/s	23½ feet

Table 2 — ¾ wavelength in feet

Frequency	Length
2 mc/s	348 feet
3 mc/s	234 feet
4 mc/s	175 feet
5 mc/s	140 feet
6 mc/s	117 feet
7 mc/s	100 feet
8 mc/s	88 feet
9 mc/s	78 feet
10 mc/s	70 feet

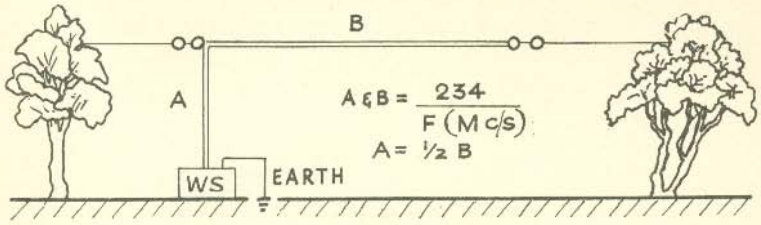


Figure 29 — Ideal ¼ Wave Horizontal End Fed Aerial

195. The end fed aerial issued with WS A510 (aerials adjustable 135 ft.) can be altered in length to make it fit the operating frequency. Full details are given on the bobbin insulator on which it is wound.

The Half Wave Dipole

196. The half wave dipole aerial is widely used because of its relatively high efficiency and its ease of construction and adjustment. Its main disadvantage is the fact that it is a single frequency aerial. Its length must be altered with changes in the operating frequency of the wireless set.

197. The half wave dipole consists of a wire half a wavelength long split at the centre by an insulator and connected to the wireless set by a "twisted pair" feedline which is NOT critical as to length. (It should be kept as short as possible.) It should be erected as high as possible and the ideal would be at least a ¼ wavelength in height. Figure 30 gives a diagram of this aerial:—

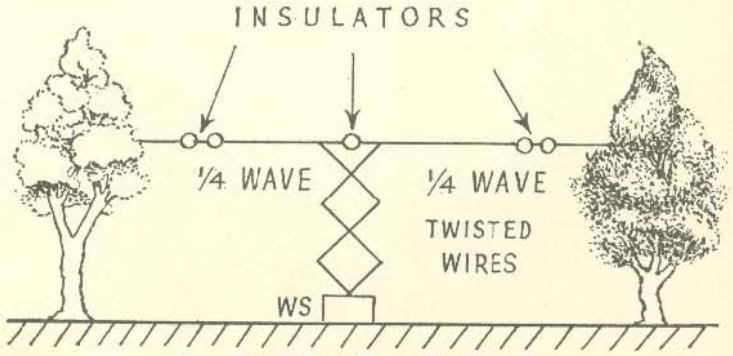


Figure 30 — Half Wave Dipole Aerial

198. **Construction points for the half wave dipole:—**

(a) The horizontal portion of the aerial can be constructed of either insulated or uninsulated copper wire.

(b) The twisted pair feed line must be made from insulated wire (see "Feeders aerial 70 ohms" issued with WS A510).

(c) The feed line connects to the wireless set with one wire on the aerial terminal and one on earth terminal.

(d) D10 field cable may be used but only as a last resort if no copper aerial wire is available. Never use the older D class cables such as D3 or D8.

(e) It is possible that co-axial cable may be available, and if so this can be used for the feeder. Connect centre conductor directly to one side of aerial and outer sheath to other. At the wireless set centre conductor goes to aerial terminal and sheath to earth.

(f) The dipole aerial may be made suitable for use on more than one frequency by the use of additional insulators and shorting straps.

The Half Wave Folded Dipole

199. By making the half wave dipole in a special manner called a two wire or folded dipole the main disadvantage of the simple dipole is overcome. The folded dipole has what is known as a "broad-band" frequency characteristic. This has a ratio of 1.25 to 1, which means that an antenna cut for say 5 mc/s would be quite efficient over the band from 3.75 mc/s to 6.25 mc/s. The folded dipole is shown in Figure 31 below:—

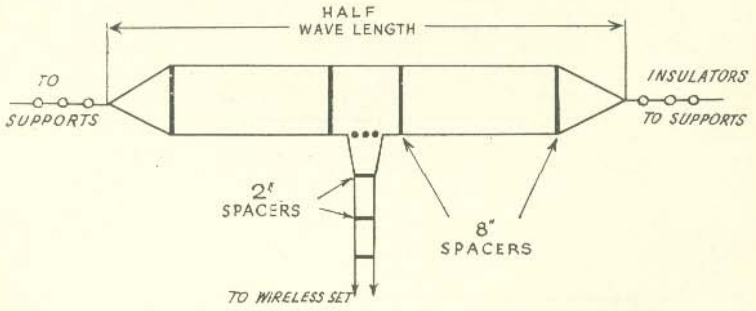


Figure 31 — Folded Dipole

200. Construction points for the folded dipole:—

(a) The aerial and feed line can be constructed of insulated or uninsulated copper wire. If no better wire is available separated D10 cable may be used.

(b) Spacers should be selected for lightness and good insulating qualities. In an emergency light dry wood may be used, but efficiency of aerial will drop in wet weather.

The Open Wire Shirley Aerial

201. The Shirley aerial is a comparatively large and difficult aerial to construct for regimental signallers. It is a very efficient aerial for sky wave communication over distances from zero to 200 miles. By concentrating nearly all of the energy radiated at a high angle into the sky it almost eliminates the skip zone. It can be of particular value in achieving sky wave communication in jungle country if time and space allow it to be put up at a patrol base or headquarters. A diagram of an open wire Shirley aerial is given in Figure 32 below:—

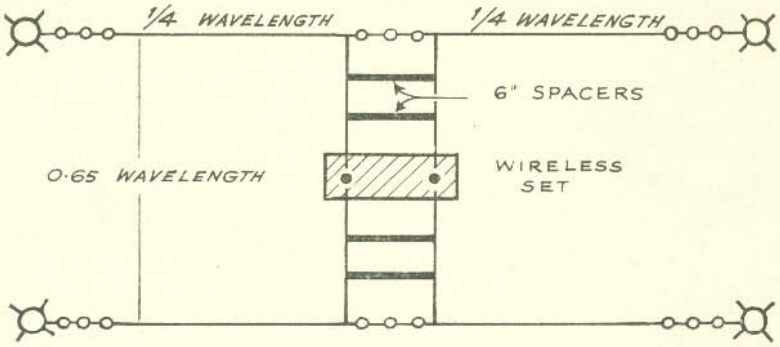


Figure 32 — Open Wire Shirley Aerial

202. Construction points for the Shirley Aerial

(a) Length of dipoles (feet) $= \frac{468}{\text{Frequency in mc/s}}$

(b) Height of dipoles should be between $\frac{1}{8}$ and $\frac{1}{4}$ wavelength of operating frequency.

(c) Distance between dipoles should be 0.65 of a wavelength.

(d) If set is not placed midway between dipoles, the feeders must still be of equal length, any slack being tied back under the aerial.

(e) If no better material is available separated D10 cable may be used.

High Frequency Ground Wave Aerials

203. When the situation requires the maximum amount of ground wave radiation then a $\frac{1}{4}$ wavelength vertical aerial should be put up. If the frequency is above 6 mc/s then the length of the aerial will be less than 40 feet and no great difficulty will be experienced in putting the aerial up. However, if the frequency in use is below 6 mc/s then the physical length of the aerial will be such that some variation of the straight vertical wire will be required. To cope with ground wave propagation beyond the capabilities of the rod aerials issued with WS A510 it is considered one of the three aerials illustrated below will give best results.

Quarter Wavelength Vertical Aerial

204. To get a wire aerial vertical requires two supports with a cross wire between them from which the vertical wire is suspended on an insulator. This arrangement is shown in Figure 33.

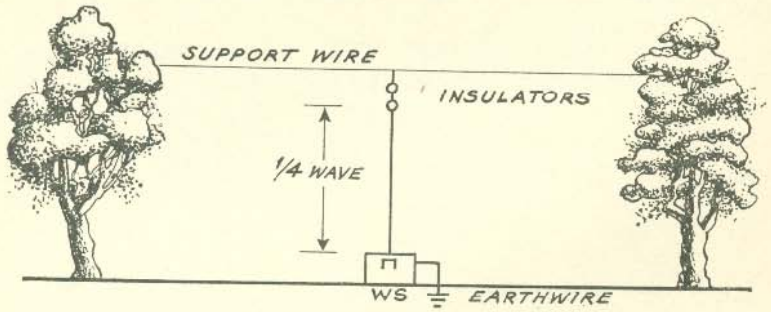


Figure 33 – Quarter Wave Vertical Aerial

205. Construction points for quarter wave vertical aerial are:—

(a) Keep vertical wire away from screening trees and buildings as far as possible.

(b) A good earth connection for the wireless set is essential.

(c) Use largest diameter copper wire obtainable for vertical aerial. D10 cable may be used if nothing better available.

Inverted L Quarter Wave Aerial

206. If the supports are not high enough to allow a full quarterwave vertical aerial the top may be bent over horizontally. The aerial then resembles an inverted L.

Because the nature of a quarter-wave aerial is such that it carries most current and radiates most strongly from the portion nearest the set it is better to bend over the top rather than increase the loading at the bottom.

207. It is important to keep the maximum possible length vertical. If too much of the aerial is bent into the horizontal plane it will commence to radiate skywaves and they may interfere with the ground wave at the receiving point. To minimise this point the horizontal portion directly at the receive point. The inverted L aerial is illustrated in Figure 34(a).

Quarter Wave T Aerial

208. The T aerial is an improvement on the inverted L aerial. It is slightly more difficult to construct but is a very efficient radiator of ground waves and should be used in preference to an inverted L whenever possible. If the horizontal portion of the T is exactly the same length either side of the junction the sky wave radiation from it is automatically cancelled out. A diagram of the T aerial is given in Figure 34(b).

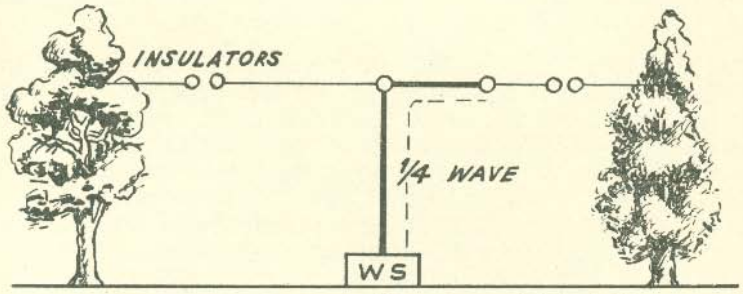
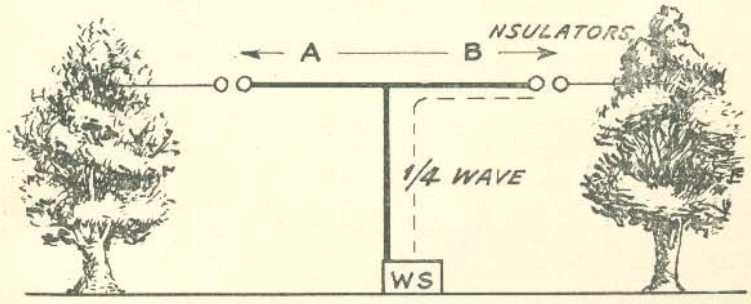


Figure 34 — (a) Quarter Wave Inverted 'L' Aerial



Note - A and B same length

(b) Quarter Wave T Aerial

Ground Aerials

209. A ground aerial is a length of insulated wire, attached to the aerial terminal of a wireless set and laid out along the ground pointing in the direction of the distant station. Although it is horizontal it normally radiates ground waves and is therefore an exception to the general rule that only vertical aerials are used for ground wave working.

210. Although not as good as vertical aerials of the correct lengths ground aerials are less conspicuous than rod aerials and because of their directional properties they pick up less interference. For the HF band an average length of about 40 feet of insulated wire laid on the ground will perform satisfactorily as a ground aerial.

VHF Aerials

211. Because of the shorter wavelength at VHF (10 - 1 metres) more compact aerial systems are possible. The aerials have relatively greater bandwidth than on the HF band and normally one size of aerial will give adequate coverage of the band used (38 - 55 mc/s). Adjusting the aerial length for each channel would make a theoretical improvement in aerial efficiency, but in practice the improvement is so slight as to be unwarranted.

212. Because of their size and the absence of any surface wave VHF aerials can be either vertical or horizontal. As at HF the vertical rod is the most suitable for working scattered or mobile nets since it gives all round coverage in the horizontal plane. The horizontal aerial gives best results at right angles to the plane of the aerial and poor results off the ends. In jungle country horizontal polarisation gives much greater range at angles broadside to the aerial than is possible with vertical polarisation. In open country all sets on a net should have similar polarisation for their aerials, but in jungle the wave angles are so distorted by the vegetation that mixed polarisation of aerials is acceptable. With weak signals in jungle country both types of polarisation should be tried when searching for the best possible signal.

213. When operating AN/PRC 10 or C/PRC 26 sets over distances which can not be spanned by use of the rod aerials issued with the sets the best available antenna to increase the range is the Antenna Equipment RC-292. If this is not available then one of the aerials described below may be constructed.

VHF Dipole

214. A lightweight 70 ohm co-axial cable connected to the centre of a half wave dipole which is tree slung in either

vertical or horizontal plane as required is probably the most simple method of improving the range of a field VHF set. This aerial is illustrated in Figure 35.

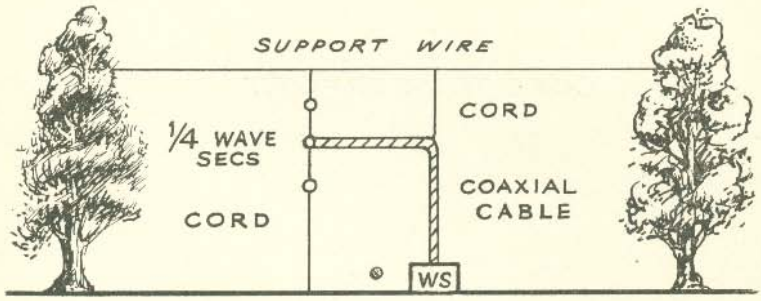


Figure 35 — VHF Vertical Dipole Aerial

215. **Construction points for the VHF dipole.**

(a) Keep as far as possible from the trunks of support trees. If slung to a single tree keep aerial below foliage.

(b) Co-axial feed line should run at right angles to aerial for at least 6 feet. If possible sling a cord from support wire to accomplish this.

(c) Co-axial feeder is not critical as to length and may be taken underground.

(d) Care must be taken to make a good joint at centre of dipole to co-axial cable. For temporary aerials the joint is best NOT soldered. Tight binds of light soft copper wire will make a good connection. Good quality polythene plastic tape may be used for insulation.

VHF $\frac{1}{4}$ Wave Ground Plane

216. A more efficient vertical radiator than the dipole described above is the $\frac{1}{4}$ wave ground - plane antenna. This aerial has a vertical element $\frac{1}{4}$ wavelength long. Below this it has a "ground plane" consisting of three copper wires each about 25 per cent. longer than the $\frac{1}{4}$ wave element and connected together just below the insulator at base of $\frac{1}{4}$ wave element. The ground plane wires are inclined down and outwards so that their bottom ends are 120 degrees apart and at about 45 degrees to the vertical. The feed line is 70 ohm co-axial cable as used for the dipole. The ground plane aerial is illustrated in Figure 36.

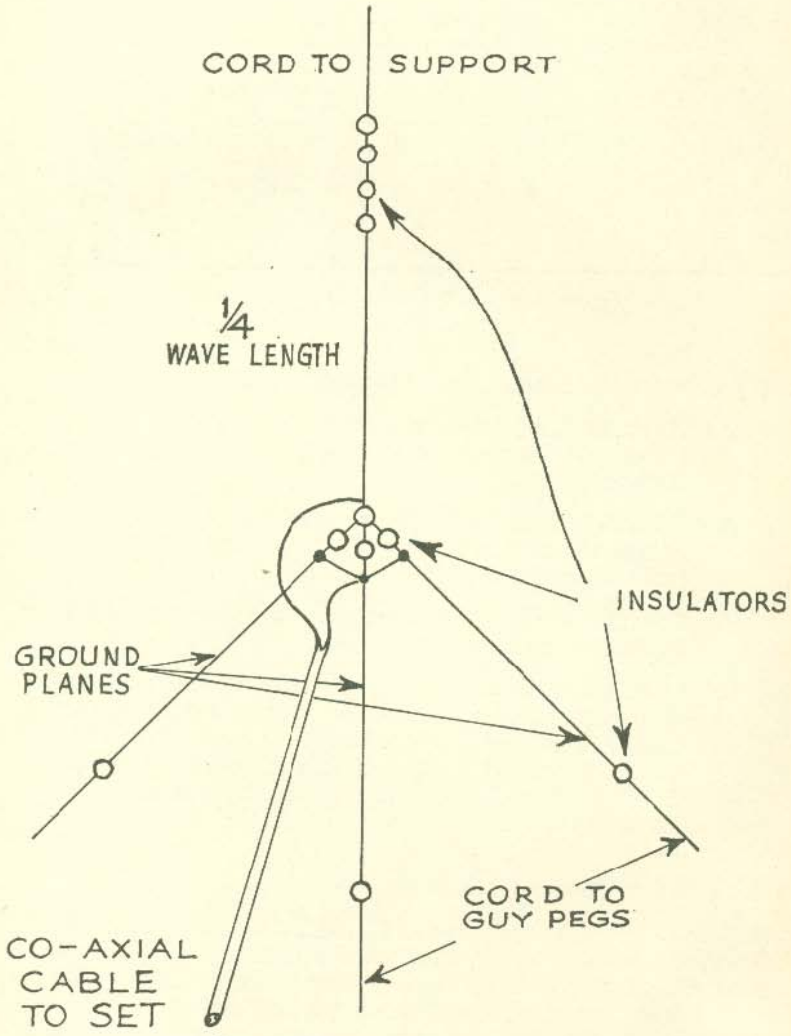


Figure 36 — VHF Ground Plane

CHAPTER 7

Method of Testing Dry Batteries in the Field

217. One of the most common problems associated with the operation of radio sets powered by dry battery packs is to determine the right time for a battery change and to accurately estimate the hours of life remaining in the used battery that is still "good". Battery packs are expensive items and re-supply to forward units is often difficult. It is vital that communications are not impaired by battery failure and excessive wastage of batteries is equally dangerous.

Testing by Operators

218. When using the WS A510 it is possible for the operator to carry out the battery testing procedure laid down in para 70 page 45 of "User Hand Book, A510 Wireless Station". The meter of the set gives an indication of the condition of the battery operating under load, and this provides a reliable test.

219. When using AN PRC 10 the operator has two methods available to give a rough indication of battery condition. These are:—

(a) Connect a spare dial light bulb between antenna output (centre at AUX ANT jack J3) and case of set. Switch to send and the dial lamp will glow. Brilliance of the lamp will indicate output strength of the transmitter, which is directly related to battery condition.

(b) The setting of the "squelch control" knob will vary as battery voltage drops. The variation is slight and an operator requires much practice and knowledge of his individual set to achieve results from this method. However, it is worth study by operators, and it is possible to achieve a reasonable standard of battery prediction by this method.

220. There is no possible method of determining battery condition on C PRC 26 whilst the set is in operation. The operator must change the battery when he suspects it of causing communication failure.

Testing by Regimental Storeman

221. Batteries issued from store must be in good condition. The date of expiration of "shelf-life" should be carefully watched and issues made in such a manner that a reason-

able margin of shelf life is always in hand. In addition all dry batteries should be tested before issue by the methods outlined in following paragraphs.

222. It is most important that dry batteries be tested "under load". The battery packs are made up from combinations of dry cells, each of which has a terminal voltage of 1.5 volts. After some hours of work the terminal voltage starts to drop, and when it goes below 1 volt the cell is considered to be completely exhausted. However, if left for some time and then re-tested the voltage will be found to be restored to 1.5 volts. This "restoration" effect is the danger which has to be taken into account when testing.

223. The only method of testing a dry cell is to put it under a comparatively heavy load for at least one minute and then read the terminal voltage. If the cell is still reading at least 1.4 volts it can be passed as suitable for radio power supply. For example, the HT battery of AN PRC 10 (BA-279/U) in its 135 volt section should deliver at least 126 volts under load.

Test Methods for BA-279/U (AN PRC 10)

224. The methods of carrying out the tests for BA-279/U battery pack is as follows:—

(a) Here is the wiring diagram of battery BA-279/U socket:—

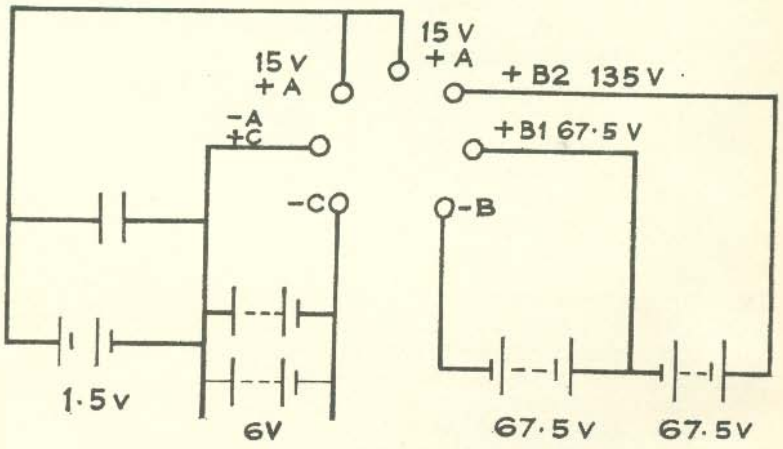


Figure 37 — Battery BA-279/U Wiring Diagram

(b) An examination of the above diagram shows that the battery splits up into:—

(i) **A battery.** This is of 1.5 volt potential and has its positive (+) terminal connected to the two top pins marked "Plus A". The negative (—) terminal is connected to the pin marked "—A — C".

(ii) **B Battery.** This is made up to two 67.5 volt sections connected in series to give a total potential of 135 volts. Negative terminal is marked "—B" and "+B1" is positive 67.5 volts with "+B2" positive 135 volts.

(iii) **C Battery.** The C battery is of 6 volt potential and has its positive terminal connected to the pin marked "—A + C". The negative terminal is connected to the pin marked "—C".

Testing the "A" Battery (BA-279/U)

225. The "A" battery has the voltage of only a single cell. The "Cell test" facility of a Mulimeter (Aust) No. 1 Mk 1 (ZA-WYA 431) is ideal for this test. By switching to "cell test" and applying test prods to the "A" battery for one minute the meter should read at least 4.5 if the A battery is in good condition.

Testing the "B" Battery (BA-279/U)

226. Both sections of the "B" battery can be conveniently tested as one battery. It is desirable to load the battery with the maximum current drain of the radio set plus fifty per cent. To do this it is necessary to connect a resistance of 2,200 ohms across the terminals of the Multimeter (Aust) No. 1 Mk 7, switch the instrument to the 250 volt DC scale and apply the test prods across pin "+B2" and "—B". The voltage reading after one minute should be at least 126 volts. (The 2,200 ohm resistance should be a "ten watt type". RAAOC stock "Resistors fixed WW-Z/AZ 0324 — low-2.2K ohms" and this resistor should be obtained and held for battery testing).

Testing the "C" Battery (BA-279/U)

227. If the "A" and "B" sections of the battery pack are both good the "C" battery will be invariably good also, as the current drain from this section is less than either of the others. A voltage check with Multimeter (Aust) No. 1 Mk 1 between pins "—A+B" and "—C" should show a reading of 6 volts. If there is still doubt about the "C" section a resistance of 100 ohm (1 watt rating) should be connected across the battery for one minute after which the reading should be at least 5.5 volts.

Test Methods for BA-289/U (C PRC 26)

228. The method of carrying out the tests for BA-289/U is as follows:—

(a) The wiring diagram of battery BA-289/U socket is:—

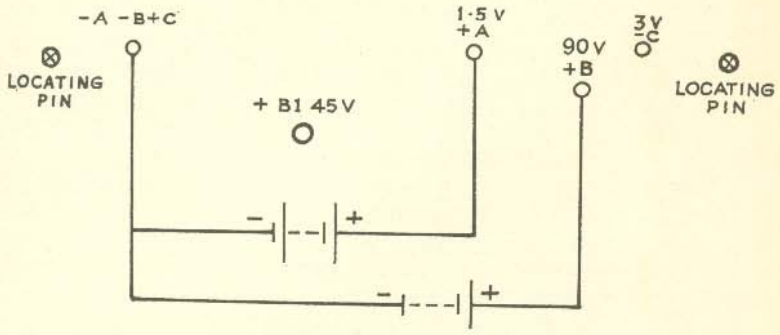


Figure 38 — Battery BA-289/U Socket

(b) An examination of the above diagram shows that the battery splits up into:—

(i) **A battery.** This is of 1.5 volt potential and has its positive terminal connected to the pin marked "+A". The negative terminal is connected to the pin marked "—A".

(ii) **B battery.** This is made up of two 45 volt sections connected in series to give a total of 90 volts. Negative terminal is marked "—B" and "+B1" is positive 45 volts with "+B2" positive 90 volts.

(iii) **C battery.** The C battery is of 3 volt potential and has its positive terminal connected to the pin marked "—A—B+C". The negative terminal is connected to the pin marked "—C".

229. **Testing the "A" Battery (BA-289/U)**

This battery has the voltage output of a single cell and may be tested by the "cell test" described in para (9) for the A battery of the BA-279/U.

230. **Testing the "B" Battery (BA-289/U)**

As with the BA-279/U "B" battery, both sections of this B battery can be tested as one. The 2200 ohm resistor described for the BA-279/U test will produce approximately

a 30 per cent. overload on the battery when connected between terminals "—A — B + C" and "+B 90V". To carry out the test the steps are:—

(a) Connect 2200 ohms ten watt resistor across the terminal of the volt meter.

(b) Apply the volt meter prods to the battery terminals (—A —B +C and +90V) for one minute.

(c) If after one minute the voltage reading has fallen below 82½ volts the battery is not suitable for issue.

231. Testing the C battery (BA-289/U)

If the A and B sections of the battery have been proved to be good it is most unlikely that there will be anything wrong with the C battery section. A voltmeter check to ensure that it is intact and supplying 3 volts is all that is necessary. The meter is connected between terminal (—A —B +C) and —C3V.

Test Methods for WS A510 Batteries

232. In addition to the tests for batteries installed in sets as detailed in para 70 of WS A510 User Handbook the following test should be carried out by storemen prior to issue of batteries.

(a) **A battery.** (Y3/YCA 0362 - LT 1.5V). This cell test procedure for use with Multimeter (Aust) No. 1 Mk 1 as previously described for battery packs BA-279/U and BA-289/U.

(b) **B battery.** (Y3/YCA 0395 - 90/7½V). This is the same voltage as the B battery of BA-289/U (90 volts). The current drain of the two batteries is similar, therefore the same test routine will apply. A voltmeter with a 2200 ohm ten watt resistor connected across the terminals should read at least 82½ volts after connection for one minute. If the reading falls below 82½ volts the battery should not be issued.

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