RADIO NEDERLAND

Give your antenna some air!

Why an outdoor aerial

Is an aerial really necessary these days? The question seems justified because most modern portable transistor radio sets operate without, or with only a simple telescopic aerial. However, for short wave reception, an aerial is a must. The ferrite aerial of a portable is only suitable for medium wave (broadcast band) reception, and the built-in rod aerial may give satisfactory FM reception, but for short wave a portable must have an external aerial connection. Domestic receivers have one, and using it will greatly improve the reception of short wave stations, especially those operating weak transmitters. A good aerial also makes reception less sensitive to local interference, and the receiver will give better results with less effort.
It is important to select the right type of aerial, and this requires some knowledge. We have collected this knowledge for you in this booklet. In view of the widely differing local circumstances and possibilites for erecting an aerial, we have selected some of the most popular types, which will be described later on.
First, some general considerations. The short waves penetrating to your area have probably covered some thousands of miles. On the way, the waves were reflected by ionized layers high above the surface of the earth, and also by the earth itself. What remains at the end of the journey is only a fraction of the original strength. The signals therefore need careful handling. Losses in the aerial and in the feed line must be limited as much as possible. The following will serve as pointers in this respect.

Insulation

The insulation of an aerial must be very good to cope with high frequency signals. High-glaze porcelain insulators of a ribbed construction are recommended, because they provide a long leakage path and freedom from moisture absorption. If necassary, more insulators can be applied at one point. This is recommended if "egg"-type strain insulators are used.
If a tree is used to support one end of the aerial, take care to avoid signal loss in wet weather by keeping the aerial itself well away from the foliage. An insulator will afford the possibility of keeping the entire aerial outside the crown, while a suitable spot on the trunk can be used for the suspension of a guy wire.

Height

The higher an aerial is erected, the better it will perform. Similarly, the more free-standing an aerial is, the better it will perform. Try to choose a location in which shielding by trees, buildings etc. is reduced to a minimum. An aerial running over a wet roof will only be at a relatively low altitude above this artificial "ground", and its performance will fall short of expectation. So give your aerial some air!

Length

A short aerial is unable to "catch" enough signal, but an excessively long aerial will show clear directional properties, so the saying "the more the merrier" only holds good up to a certain point. The total length of the outdoor part of the aerial should not exceed 25 metres (80 feet). Where the span is of necessity greater, the introduction of an insulator can provide a solution.

Materials

The best type of wire for an aerial is bare hard-drawn or siliconbronze nr 16 or 18 wire (about 1 mm in diameter). This posesses excellent conductive properties and also high mechanical strength. This type of wire is available in many countries. Other suitable materials are copper (tinned or otherwise) and brass, insulated or bare.
Naturally, when choosing the material account must be taken of the prevailing winds and the resistance of the wire to local weather conditions. In many cases, insulated wire of the type employed for domestic wiring will be adequate. Care must be taken when choosing the diameter as too thin a wire will possess higher electrical resistance and will also prove mechanically weak.

Situation

The actual location of the aerial is decisive for the quality of reception. The vast majortiy of "extraneous noises" which your receiver reproduces enter it via the aerial — for example mutual interference between stations, jamming transmitters, etc. — are difficult to overcome. However interference created by electrical apparatus, ignition systems, and so on can largely be eliminated. Ignition system interference stems from passing cars and buses, tram and trolleybus collectors and similar sources. This type of interference is not only encountered at street level; it forms a kind of blanket rising to rooftop level. At that point, however, it diminishes rapidly and at a point about 5 ft above the average house roof little of this interference will remain. At the back of the house this type of nuisance is practically non-existent.
It is hard to avoid interference from overhead power lines, particularly when high voltages are involved. Keep your aerial as far away from the wires as possible, and don't run the aerial wire parallel to them.
Thus, erect the aerial as far from the street as possible and at right angles to any overhead lines.
Signal loss can also be caused by the aerial being close to, or running parallel with, larger metal objects, like metal roofs or gutters. The best way to eliminate gutter trouble is to cross it perpendicularly, allowing 8 or more inches space.

The lead-in

Of primary importance is the insulation of the lead-in where this enters the house. Special feed-throughs are sold for this purpose, but where these are not available you can make up a suitable unit from plastic, glass or an old ballpoint-sleeve. Once the lead-in has entered the building (for example through a window frame) it should be insulated on the outside and taken to the receiver by the shortest possible path.
Where the lead-in is required to run along a wall, suitable stand-off insulators should be used. A check should be make to see whether domestic wiring has been run in the wall(s) concerned; if so, the lead-in should run at right angles to such wiring, and be kept at a distance from it.

Connecting the aerial to the receiver

Since the introduction of FM techniques, many receivers are eqquipped with more than one aerial input socket, and thus reference should be made to the instruction book to determine which is the AM aerial input socket. The lead-in is connected to this with the aid of a suitable plug, care being taken to see that good contact is made. Where the receiver is provided with an earth socket, this should preferably be used. Further reference to this will be made later in this booklet.

Matching the aerial to the receiver

This is something of a problem owing to the multiplicity of types of receiver on the market and in use. In many cases, fortunately, matching is not critical because the design of the circuit is such as to permit various aerials to be used. At the same time, each and every receiver type has an optimum matching i.e. the transfer of energy from the aerial to the receiver input stage takes place with the least possible loss. It is thus necessary to ensure that the matching of aerial and lead-in, and the matching of the lead-in and the receiver are the best achievable. For the more technically minded, we can say that the aerial attains maximum efficiency when the impedances of aerial, lead-in and receiver input are equal. This will become clearer when we deal with the various types of aerial which can be successfully employed for shortwave reception.

Interference

Among the numerous sources of electrical interference are washing machines, spin driers, fluorescent tubes, electric razors, power tools, etc. The intensity of the interference emanating from these will, of course, depend largely on their proximity to the receiver. Many such types of apparatus are fitted with interference suppressors at the time of manufacture, either to meet existing laws or by voluntary action on the part of the manufacturer. But separate suppressors are available on the market and any piece of apparatus which emits this type of interference can be dealt with cheaply and effectively. The suppression of the sparking not only benefits nearby radio listeners but also prolongs the life of the apparatus!
Interference from television receivers stems mainly from their horizontal sweep circuit. Harmonics of the line frequency are radiatad via the wiring, unless it has been adequately screened. The best protection against this kind of interference is to keep the radio receiver and the aerial well away from the TV receiver.
Interference from other transmitters is usually caused by their operatiin on frequencies which are so close together that the receiver is no longer able to separate them. Circuit modification is the only way out of this trouble.

Screening

There will, of course, be instances in which the only path for an aerial lead-in is through an interference field. In such cases, the lead-in can be made from coaxial cable. This consists of an inner conductor surrounded by a screening braid (the two being insulated, naturally) and covered with a plastic or similar material. The shield is connected to a good earth at the lower end and serves to carry away interference signals, thus preventing them from reaching the signal-carrying inner conductor to which the aerial is, of course, connected at the upper end, the braiding being left unconnected there.
To prevent excessive signal loss, the 120 or 135 ohm types are to be preferred, but, even then, keep the length of the cable as short as possible.
The inner conductor has to be soldered to the aerial, while measures are to be taken to avoid breaking due to the mass of the coaxial cable.
Guiding the coaxial cable along walls is very easily done with hooks, nails or staples. No insulation measures are necessary as long as the insulation is kept undamaged and rain is prevented from penetrating from above.

Lightening protection

Local thunderstorms can cause severe damage to the initial stage of a radio receiver, particularly to the coils, if a sufficiently high voltage is passed to the aerial by a flash of lightning. The best protection against this hazard is to ground the aerial or to pull the aerial plug from the receiver at the approach of a thunderstorm. Another solution is the lightning arrester. This is usually a rare-gas cartridge connected between the aerial and the earth. Under normal conditions the gas is non-conducting, but it becomes conductive when the voltage rises above the ignition voltage of the gas, and the cartridge then acts as a conductor. These so-called overload protectors are available as flat-line arrester, coaxial lightning arrester, tubular line arrester, or single line protector.
A satisfactory home-made lightning arrester can be built from a neon lamp. ~~A 110 volt, ¼ watt type is sufficient~~. It should be connected as indicated in fig. 1, preferably outdoors. A (knife) switch is provided to give more security. It should be closed as a thunderstorm approaches.
The conventional overload protector may not be adequate for a transistor receiver, because the circuitry is more sensitive to voltage transcients. In this case, the only true protection is to disconnect the aerial.

Various types of shortwave aerial

Sound as the advice given above may be, it is often difficult to apply it in practice. Fortunately, however, there are quite a number of types of aerial from which to choose, depending upon the conditions and requirements encountered. We shall deal with several of these and explain their specific characteristics.

The indoor aerial

This is the last recommended for the simple reason that it is substantially less sensitive than any of the outdoor types. Should the receiver be situated in a wooden house with a non-metal roof, an indoor aerial may give satisfactory results, however in normal brick-built houses a short-wave signal reaching it is already substantially weakened. And in modern apartment buildings in which large quantities of reinforced concrete are used, the cage formed by the reinforcing rods virtually eliminates reception.
Many listeners, however, have no alternative to an indoor aerial and thus for their benefit we give a few hints on rigging.
If you live in an apartment building containing reinforced concrete, your aerial should be run parallel to the window since this is the point at which a signal will penetrate the room. A spiralized wire, well insulated and as high as possible, is the best method to tackle the problem of getting the signal in. Moreover, a matching unit as mentioned later is recommended.

The rod aerial

Although this title may remind you of a car aerial, the type in question is, in fact, designed for mounting on a window ledge and is between 12 and 15 feet in length. Where a proprietary metal rod aerial is not available, a suitable type can be made from wire supported on a bamboo or similar carrier.
The apex of a metal rod should not be pointed but rounded or flattened (as shown in fig. 2). The indoor section of the lead-in should be kept as short as possible, and should be run into and round the room in accordance with the instructions given earlier.
It is a relatively simple matter to make a "matched" aerial from one of the rod type. This merely involves matching the length of the rod to the wavelength desired. If the aerial is required to cover the 19 metre band, the length must be one quarter of the wavelength less 6% = 4.60 metres (15 ft.). The impedance of this type of aerial is 50 ohms, and thus the most suitable material for the lead-in would be coaxial cable of 50 ohms impedance. The inner wire of this is connected to the aerial rod and the screening braid is earthed.
The impedance referred to is, alas, somewhat low for the average receiver input circuit. There is, however, a variation of this type which possesses an impedance of 300 ohms and which can thus be connected to the receiver by means of the (flat) twin lead commonly used for television and FM aerials. This type of rod aerial is shown in fig. 3 and consists of three wires or rods running parallel to, but at a distance apart from, each other. This distance is not critical. Where 300 ohm flat twin line is used, one lead is connected to the aerial input of the receiver and the other to the earth socket.

The ground plane aerial

This is, in fact, a matched rod aerial fitted with an artifical "ground" as shown in fig. 4. This type is very suitable for erection on a flat roof. It has an impedance of 30 ohms and is more sensitive than a normal rod aerial. The artificial ground consists of four wires, each of one-quarter wavelength and stretched out at right angles. Coaxial cable can be used to connect this aerial to the receiver, the screening braid being connected to the intersection of the ground wires.
If it is required to cover the whole of the shortwave bands, 300 ohm twin lead may be used to link aerial and receiver.
If the wires of the artificial ground are made to slope downwards from the intersection so that the angle between them and the vertical rod is approx. 120°, the impedance of the array will be 50 ohms.

The "L" aerial

This type of aerial is the most popular among shortwave listeners, and with good reason because it is sensitive, easy to construct, all-band and omnidirectioned. It is reproduced schematically in fig. 5. In practice, it consists of a horizontal member of reasonable length and a lead-in, the latter being taken to the receiver input in the most expeditious manner possible under the circumstances, but with regard to the general rules set out earlier under "lead-in".

The "L" aerial is capable of giving highly satisfactory results and, moreover, is suitable for a wide range of erection conditions. It is accordingly to be preferred above the indoor or rod types. It is not directionally sensitive, nor does it belong to the category of matched aerials.
The performance of a given aerial can be improved by the use of a matching unit, the function of which is to match the aerial to the receiver. Fig. 6 shows the circuit of such a device. It consists of a coil and two varible condensers. The coil can be made at home. The core — which can later be removed — should be 1″ (2.5 cm) in diameter; wound with nr 18 or 20 copper wire (0.8 to 1 mm dia.). The number of turns varies according to the waveband desired, for example the 49 m band requires 15 turns and the 16 m band only 4 turns. Optimum matching for each of the shortwave broadcast bands can be obtained by winding a single coil covering the range of wavebands and making tappings for each separately. With such an arrangement, it is necessary to include in the circuit a rotary waverange switch (single pole seven positions) connected to the tappings of the coil, these being:

for the 49	metre	band	15	turns
41	"	"	12	"
31	"	"	9	"
25	"	"	7	"
19	"	"	5	"
16	"	"	4	"
13	"	"	3	"

The two variable condensers should each have a capacity of 350—500 picofarad (micro-microfarad). The fixed plates are connected to the aerial side of the circuit and the movable plates to the earth side. The condensers and coil are connected as shown in the diagram. The components can be mounted on an aluminium base or chassis which is then earthed and accordingly makes contact with the chassis of the receiver via the earth wire.

N.B. Should your radio employ valves and NOT be fitted which an earth socket, consult your dealer before connecting the matching filter unit or you may find that this becomes "live".
Operating the variable condensers is a simple task, and you will rapidly establish which positions produce the best results. You may also find it necessary to experiment with the coil, since varying the spacing of the turns by compressing or elongating the coil, can alter its characteristics and, consequently, its effect.

The Windom aerial

A fairly popular type among radio amateurs, this is a matched aerial of which the horizontal member (see fig. 7) measures half the wavelength minus 5 %. The point at which the lead-in is attached is 0.36 of the length measured from the receiver end. The aerial coupling unit mentioned above can also be used with a Windom aerial.
This type of aerial has the added advantage that it produces also optimum results on wavebands which are approximately half or one-quarter of that for which the aerial is designed. Thus, a Windom constructed for the 49 metre band will also produce excellent results on the 25 and 13 metre bands, and one constructed for the 31 metre band will perform well on 16 metres.

Dipole aerials

The dipole is a tuned aerial with a clear directional function, and is most sensitive to signals arriving at right angles to it. The single dipole and the folded dipole, illustrated in figures 8 and 9, are both widely used. The folded dipole, which is commonly applied for FM and television reception, has in most cases a higher efficiency than the single dipole. For both types, the optimum length between the insulators is 6% less than half the wavelength for which the aerial is designed. This means that for, say, the 19 metre band, the length of the dipole is about 9.2 metres, or 30 feet (1 metre = 3.28 ft).

As some stations do not mention wavelengths, but only frequencies, the conversion formula can be used:

$$\text{wavelength (metres)} = \frac{300}{\text{frequency (MHz)}}$$

A frequency of 10 megaHertz will thus correspond with a wavelength of 30 metres. Although the dipole is principally designed for one frequency band only, it will give reasonable performance on other frequency bands as well.
The construction is relatively simple. The folded dipole is a closed loop, connected between the aerial and ground terminals of the receiver. The 240 or 300 ohm twin line, or tubular line, is connected to the dipole proper. The central insulator is positioned exactly halfway between the outer insulators, and acts as a binding post for the ends of the wire. The upper conductor runs parallel to the lower one, and is of the same size. The mutual distance is not critical: 10 to 25 times the wire diameter will be convenient. Home-made spacers of insulating material will come in useful, here.
It will be easy to start building the aerial with one wire, running from the central insulator to the right one, back to the left one, and ending at the other end of the central insulator. The correct position of the central insulator is thus easily determined, and the aerial will show no weak spots caused by soldering joints. What should be soldered, however, are the connections between the aerial and the feed line. This ensures a lasting joint, especially if protection from the weather is given by a coating of paint.
For the single dipole, 75 ohms twin line is recommended. Although the construction of this aerial is somewhat simpler than the folded type, the latter is preferred because receivers usually respond better to it. However, if the input impedance of the receiver is about 75 ohms, use the single dipole for optimum results.
The feed line is guided to the receiver, taking into account the general information given earlier. In countries where FM and/or television are in general use, special stand-off insulators are available to facilitate this job. Indoors, small wall insulators can be used.
A globe is absolutely necessary to determine the direction in which the dipole should be stretched. A map is too distorted for this purpose, due to the method of projection. The positions of the transmitter and the receiver should be linked on the globe with a piece of string. The direction from which the signals arrive at the receiver can then be ascertained. You might, for instance, be surprised to find Europe situated northwest of Australia. The aerial must now be stretched perpendicular to this direction; that is northeast-southwest in our example for a listener living in Australia.
Deviations from the correct direction are permissible, if suspension possibilities are restricted, as the sensitivity of the dipole will only decrease gradually, but they must not exceed 30 degrees. It is, however, important to realize that, theoretically, a dipole cannot receive signals coming from the directions, to which the dipole wire points. This opens up the possibility to suppress signals from an undesired or interfering station by pointing the aerial exactly in its direction. Care should be taken to locate the correct transmitter site in each case, particularly as an increasing number of short wave stations are operating relay transmitters near the equator.
A multiband dipole aerial as sketched in fig. 10 has a number of dipoles, all connected to the same central insulator, but each tuned to a different frequency. An aerial of this type is usually combined with a 120 or 135 ohm coaxial cable feed line, although its symmetry will allow the application of twin line.
Finally: in cases where aerials are used that are connected to both the aerial and the ground terminals of a receiver, the original earth line can be omitted. These aerials are recommended for extremely dry areas, where the efficiency of single wire aerials is adversely influenced by the low conductivity of the soil. In all other cases a good earth connection is recommended, though not strictly necessary. A short, thick wire connected to the water mains or a copper pipe driven deep into the soil will do.

Note on 300 ohm feeder line

Reference has been made to 300 ohm cable for lead-ins on a number of occasions in this publication. In the majority of cases, twin feeder line of the type common in TV and FM aerial lead-ins will suffice. However coaxial cable — screened and unscreened — having the same impedance may also be used. Where neither is available, a suitable 300 ohm line can be made up on the spot. For this, two lengths of identical wire are required; this may be insulated or plain, and should be of reasonable thickness, With the aid of spacers made from plastic or a similar material, twin cable can be assembled. It is important that the space between the members be six times the diameter of the wire (itself) used. Care should be taken to ensure that the two feeders cannot touch, even when tossed about by winds.

Indirect aerial connection

There may be cases in which difficulty is experienced in connecting an outdoor aerial directly to the receiver. For instance if it has a built-in rod or frame antenna. It is frequently not necessary for a direct, metallic connection between aerial and receiver to exist, but merely a means of feeding the signal from a point at which it possesses adequate strength with a minimum of interference (thus outdoors, and at an adequate height) to the receiver. Satisfactory transfer of energy will result from the creation of a loop consisting of a number of turns of wire linking the lead-in of the aerial and earth, inside which, or in front of which, the receiver is placed. It will be necessary to experiment with the area of the loop and the number of turns in order to achieve the best results from this arrangement. Also it may be found sufficient to place the built-in rod antenna in close proximity to some existing vertical conductor. Rainwater pipes and vertical steel pillars have given amazing results, however it must be added that the weather will often influence such solutions. For certainty, thus, we strongly recommend that a sound, well-erected aerial be employed and connected directly to the receiver.

The frame aerial

Generally speaking, this type is not suitable for shortwave reception and accordingly it falls outside the scope of this booklet. For medium wave reception, on the other hand, a frame aerial can afford good results. Its directional sensitivity enables certain interference signals to be eliminated, and in this respect it may be compared to the ferrite rod aerials built into many modern receivers. One major disadvantage of the frame aerial is its size, viz. approximately 3½ ft square (or equivalent area), however against this it does produce good results indoors in many cases.
Should you be interested in receiving further details of this aerial, we shall be pleased to supply them.

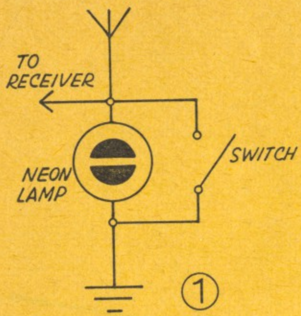
In conclusion

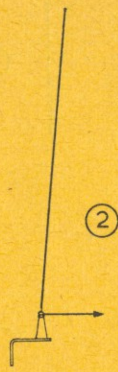
Although this booklet deals with only some of the very numerous aerials in existence, we are confident that it will afford a solution to many, many problems in this field. Should you experience any difficulty in interpreting the contents, or in implementing the advice given, please do not hesitate to write to us for further information.

The foregoing was compiled to facilitate the best possible short wave reception, but Radio Nederland also has available a number of publications for improving and extending the scope of the receiver. Ask for our DX Information Service Catalogue.

All these publications, and also our illustrated programme schedules, are obtainable free of charge from:

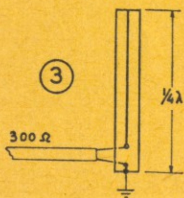
 RADIO NEDERLAND - P.O. BOX 222 - HILVERSUM

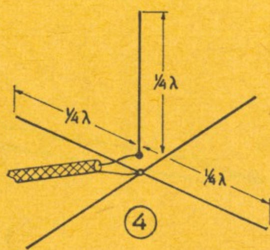


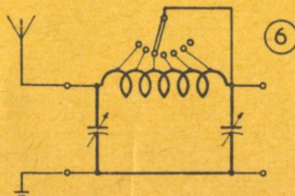


IMPORTANT

The neon lamp must be one without built-in series resistor.







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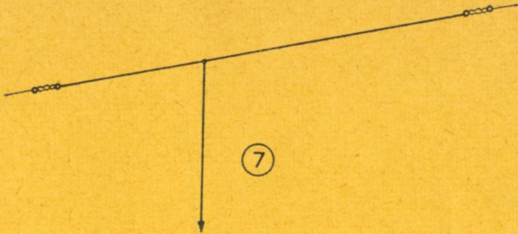

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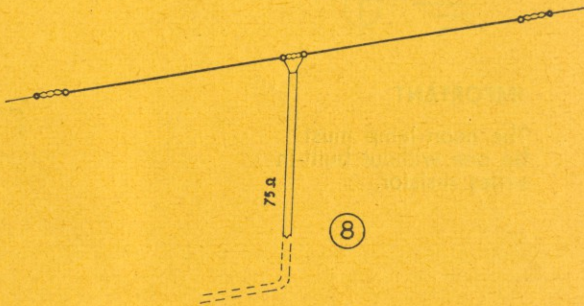

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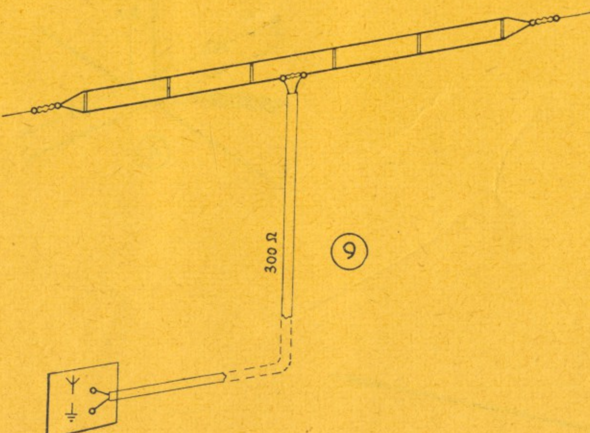

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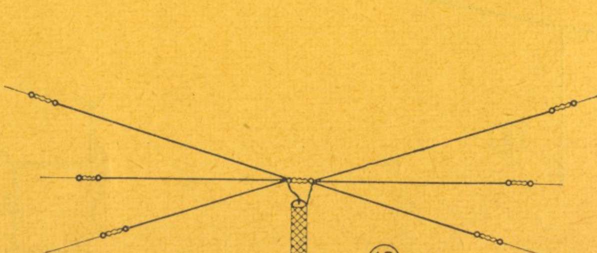

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