

Code of practice for

Reception of sound and television broadcasting —

(Formerly CP 1020)

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- British Broadcasting Corporation
- British Radio and Electronic Equipment Manufacturers' Association
- British Telecom
- Home Office
- Institution of Electronic and Radio Engineers
- Radio Electrical and Television Retailers Association

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- British Aerial Standards Council
- Cable Television Association of Great Britain
- Confederation of Aerial Industries
- Consumer Standards Advisory Committee of BSI
- Department of Trade and Industry (Directorate of Radio Technology)
- East Midland Association of Aerial Contractors
- Electronic Components Industry Federation
- National Television Rental Association
- Society of Cable Television Engineers

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Foreword

This British Standard code of practice has been prepared under the direction of the Electronic Equipment Standards Committee and is a revision of CP 1020:1973, which is withdrawn.

This code of practice represents a standard of good practice and takes the form of recommendations. Compliance with it does not confer immunity from relevant legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 54, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This code of practice gives recommendations for ensuring good reception of sound and television broadcasting in buildings and is particularly applicable to installations in new buildings, although many of its recommendations are applicable to installations in existing buildings.

It includes recommendations regarding the provision of aerial systems and cabled distribution systems, the necessary structural accommodation for equipment and cabling, protective measures against danger from electric shock, fire and other hazards.

Recommendations are given on matters concerning the satisfactory completion and handing over of systems.

General guidance is given on the broadcast services available.

This code does not give detailed performance requirements for cabled distribution systems, nor does it make recommendations regarding standards of performance for receivers for use with sound distribution systems.

NOTE 1 Such requirements and recommendations are given in BS 5603-1 and BS 6259 respectively.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this code, the definitions given in BS 4727-3:Group 04 apply. However, this code uses the term “cabled distribution system” which has been internationally agreed, instead of “wired distribution system” as defined in BS 4727-3:Group 04.

3 Principles of broadcast reception

There are two main methods for receiving broadcasts and both require an aerial system at the receiving site. The most common practice is the exclusive use of a receiving aerial for each receiver. The second method uses a common aerial that feeds the received signals into a cabled distribution system to suitable outlets in each dwelling. In this latter method it is sometimes desirable to use a higher-performance aerial that may need to be sited more advantageously than the individual aerials for each receiver.

A transmitting station radiates a carrier wave from an aerial into the surrounding space. The amplitude or frequency of this wave is modulated by an audio, video or other signal. The manner of propagation of the wave is dependent on its frequency and this influences the type of aerial required for reception. The radiated power is determined by the area to be served and the frequency of the wave. The receiving aerial intercepts a small part of this power and passes it to a receiver or into a distribution system.

Service areas of LF and MF transmitting stations normally utilize ground-wave propagation. However, some power is radiated towards the sky and during the hours of darkness some of this power will be returned to earth within the ground-wave range of the same transmitter, producing fading and distortion. When it is dark, the principal cause of interference is sky-wave propagation from distant stations and the consequent reduction in service area is much greater at MF than LF.

VHF and UHF transmissions cannot be reliably propagated far beyond the horizon and so the service areas are limited by the height of the transmitting aerial as well as by the power radiated. Large numbers of stations are therefore required to provide national coverage.

Most transmissions use either vertical or horizontal polarization and it is important to use receiving aerials with the corresponding polarization. Where the transmitter uses any other kind of polarization, the recommendations of the broadcaster should be observed.

There are two forms of modulation in general use for broadcasting, amplitude modulation (AM) which varies the amplitude of the carrier at the modulating frequency and frequency modulation (FM) in which the frequency of the carrier is varied in accordance with the instantaneous value of the modulating signal. AM is used for the long-, medium- and short-wave bands, and for vision signals; FM is used for sound broadcasting in band II and for UHF television sound.

NOTE Further details are provided in Figure 1 and Table 1, Table 2 and Table 3.

4 Choice of receiver

4.1 Sound receivers. It is important to ensure that the selected receiver(s) provides reception on the desired wavebands (see Table 2).

In order to receive the full choice of domestic programmes transmitted, the receiver used will need to have long-wave (LF), medium-wave (MF) and VHF (band II) waveband reception capability. Facilities for stereophonic reception may be an option on VHF.

4.2 Television receivers. Most currently available receivers operate only on the 625-line standard and in the UHF bands IV and V. Models can be obtained for VHF bands I and III also.

VHF bands I and III are at present used for the obsolescent 405-line black-and-white system although some cabled distribution systems use these bands also for the distribution of 625-line programmes.

Table 1 — Classification of frequency bands

Band	Frequency	Wavelength
VLF	Lower than 30 kHz	Longer than 10 000 m
LF	30 kHz to 300 kHz	10 000 m to 1 000 m
MF	300 kHz to 3 000 kHz	1 000 m to 100 m
HF	3 MHz to 30 MHz	100 m to 10 m
VHF	30 MHz to 300 MHz	10 m to 1 m
UHF	300 MHz to 3 000 MHz	1 m to 0.1 m
SHF	3 GHz to 30 GHz	10 cm to 1 cm

Table 2 — Frequency bands allocated in the UK for broadcasting

Band	Broadcast band	Frequency range	Service
LF	Long wave	148.5 kHz to 283.5 kHz	AM sound domestic services
MF	Medium wave	526.5 kHz to 1 605.5 kHz ^a	AM sound domestic and overseas services
HF	Short wave (75 m)	3.95 MHz to 4.0 MHz	AM sound overseas services
HF	Short wave (49 m)	5.95 MHz to 6.2 MHz	AM sound overseas services
HF	Short wave (41 m)	7.1 MHz to 7.3 MHz	AM sound overseas services
HF	Short wave (31 m)	9.5 MHz to 9.9 MHz ^b	AM sound overseas services
HF	Short wave (25 m)	11.65 MHz to 12.05 MHz ^b	AM sound overseas services
HF	Short wave (21 m)	13.6 MHz to 13.8 MHz ^b	AM sound overseas services
HF	Short wave (19 m)	15.1 MHz to 15.6 MHz ^b	AM sound overseas services
HF	Short wave (16 m)	17.55 MHz to 17.9 MHz ^b	AM sound overseas services
HF	Short wave (13 m)	21.45 MHz to 21.85 MHz ^b	AM sound overseas services
HF	Short wave (11 m)	25.67 MHz to 26.1 MHz	AM sound overseas services
VHF	VHF band I	41 MHz to 68 MHz ^c	405-line television (black-and-white only)
VHF	VHF band II	88 MHz to 108 MHz ^d	FM sound domestic services
VHF	VHF band III	174 MHz to 223 MHz ^c	405-line television (black-and-white only)
UHF	UHF band IV	470 MHz to 582 MHz	625-line television (black-and-white and colour, including teletext)
UHF	UHF band V	606 MHz to 854 MHz ^e	625-line television (black-and-white and colour, including teletext)
SHF	SHF band VI	11.7 GHz to 12.5 GHz	Direct satellite broadcasting; not in use at present

^a The extended frequency range 519.5 kHz to 526.5 kHz is, in the UK only, allocated for transmission of Public Utility Information.

^b Not all these frequencies are presently available for broadcasting use.

^c These frequencies will no longer be available for broadcasting in the UK after 1984, following the closedown of the 405-line television service.

^d Only the frequency ranges 88.0 MHz to 97.6 MHz and 102.1 MHz to 104.0 MHz are presently available for broadcasting.

^e The frequency range 606 MHz to 614 MHz is not yet available for broadcasting.

Table 3 — UK television broadcast bands, channels and frequencies

Channel code	Carrier frequencies		Channel code	Carrier frequencies	
	Vision	Sound		Vision	Sound
Broadcast band I (VHF) 405-line channels^a			625-line channels^b		
Transmitter and cabled distribution systems			Cabled distribution systems only		
	MHz	MHz		MHz	MHz
1	45.0	41.5	A	45.75	51.75
2	51.75	48.25	B	53.75	59.75
3	56.75	53.25	RI ^c	55.75	61.75
4	61.75	58.25	C	61.75	67.75
5	66.75	63.25			
Broadcast band III (VHF) 405-line channels^a			625-line channels^b		
Transmitter and cabled distribution systems			Cabled distribution systems only		
	MHz	MHz		MHz	MHz
6	179.75	176.25	D	175.25	181.25
7	184.75	181.25	E	183.25	189.25
8	189.75	186.25	F	191.25	197.25
9	194.75	191.25	G	199.25	205.25
10	199.75	196.25	H	207.25	213.25
11	204.75	201.25	I	215.25	221.25
12	209.75	206.25			
13	214.75	211.25			
Broadcast band IV (UHF) 625-line channels			625-line channels		
Transmitter and cabled distribution systems			Transmitter and cabled distribution systems		
	MHz	MHz		MHz	MHz
21	471.25	477.25	28	527.25	533.25
22	479.25	485.25	29	535.25	541.25
23	487.25	493.25	30	543.25	549.25
24	495.25	501.25	31	551.25	557.25
25	503.25	509.25	32	559.25	565.25
26	511.25	517.25	33	567.25	573.25
27	519.25	525.25	34	575.25	581.25
Broadcast band V (UHF) 625-line channels			625-line channels		
Transmitter and cabled distribution systems			Transmitter and cabled distribution systems		
	MHz	MHz		MHz	MHz
35 ^d	583.25	589.25	52	719.25	725.25
36 ^d	591.25	597.25	53	727.25	733.25
37 ^d	599.25	605.25	54	735.25	741.25
38 ^e	607.25	613.25	55	743.25	749.25
39	615.25	621.25	56	751.25	757.25
40	623.25	629.25	57	759.25	765.25
41	631.25	637.25	58	767.25	773.25
42	639.25	645.25	59	775.25	781.25
43	647.25	653.25	60	783.25	789.25
44	655.25	661.25	61	791.25	797.25
45	663.25	669.25	62	799.25	805.25
46	671.25	677.25	63	807.25	813.25
47	679.25	685.25	64	815.25	821.25
48	687.25	693.25	65	823.25	829.25
49	695.25	701.25	66	831.25	837.25
50	703.25	709.25	67	839.25	845.25
51	711.25	717.25	68	847.25	853.25
^a The 405-line television transmissions in bands I and III will be progressively closed between 1982 and 31 December 1984.					
^b In order to avoid interference, 625-line VHF cabled distribution channels may be offset: they are referred to as, for example, "A – 0.5 MHz".					
^c Channel RI (= B + 2 MHz) was adopted before large offsets became common.					
^d Channels 35, 36 and 37 are not at present allocated for broadcast use in the UK.					
^e In order to protect radio-astronomy interests, channel 38 is not used at present.					

4.3 Signal levels for satisfactory reception. Typical signal levels required for satisfactory reception by broadcast receivers using an individual aerial are given in Table 4. The signal levels for receivers connected to cabled distribution systems are given in BS 5603-1.

Some television and FM radio receivers may be unable to handle the maximum signal voltages quoted in the table without introducing unacceptable cross-modulation. In these cases the signal voltages may be reduced by a suitable attenuator at the receiver input.

5 Aerial reception

5.1 Aerial systems

5.1.1 LF, MF and HF aerials for AM sound reception

5.1.1.1 General. Many receivers use in-built directional ferrite aerials for LF, MF, and HF reception, but in some cases better results may be obtained with an external aerial, especially at HF where the performance of a ferrite aerial is often poor. However, not all receivers have terminals for connection to an external aerial.

5.1.1.2 LF and MF bands. Transmissions in these bands use vertical polarization. LF and MF reception is prone to co-channel interference which can be minimized by rotation of the ferrite aerial.

An outdoor wire aerial can give a greater input signal to the receiver than a ferrite rod and one form of aerial is shown in Figure 2. An aerial of this description, which should be erected as high as possible, is omnidirectional.

AM reception is very prone to forms of electrical interference that may be generated by industrial and domestic electrical and electronic equipment. A type of aerial installation is available that will minimize the pick-up of such interference (see Figure 3). The vertical aerial element is mounted as high and clear of the interference zone as possible. The lower end of the aerial is connected to a transformer, and a balanced screened cable connects it to another transformer at the receiver input. The cable, being balanced and screened, can pass through the noise field without significant pick-up of noise voltage.

Table 4 — Signal levels for broadcast receivers using individual aerials

Receiver	Signal level		Remarks
	max.	min.	
Sound receivers for long, medium and short-wave bands	mV —	mV 0.1	The r.m.s. voltage when measured across a non-inductive resistor of 300 Ω (see note 1)
Sound receivers for band II, VHF/FM:			The r.m.s. voltage of unmodulated carrier when measured across a non-inductive resistor of 75 Ω or referred to 75 Ω
monophonic	5.0	0.1	
stereophonic	5.0	0.5	
Television receivers:			The r.m.s. voltage of each vision carrier at the peak of the modulation envelope when measured across a non-inductive resistor of 75 Ω or referred to 75 Ω (see note 2)
band I	2.5	0.25	
band III	2.5	0.5	
band IV	5.0	0.75	
band V	5.0	1.0	

NOTE 1 For measurements on the long-, medium- and short-wave bands a “mean level” meter is required.

NOTE 2 When a “mean level” meter is used for vision signals, the readings (average of several picture changes) will usually be about 5 dB lower than the “peak value” specified above.

5.1.1.3 HF bands. Acceptable reception can often be achieved by the use of an aerial of the type shown in Figure 2, but where the wavelengths involved make the use of a dipole practicable, it may provide a more effective aerial.

A dipole consists of a pair of conductors placed end to end, usually with an overall length of approximately half a wavelength. The aerial would be connected to the receiver by means of a coaxial cable joined to the centre of the dipole. A horizontal half-wave dipole is directional, providing maximum signal strength broadside to the dipole axis, and minimum signal strength along the axis. The height above ground should be taken into account when considering directional characteristics.

It can be inferred from Table 2 that a separate dipole will be required for each broadcast band, but any dipole may provide useful signals at other frequencies than its optimum, particularly odd harmonic frequencies. A useful compromise would be a horizontal dipole, about 20 m long.

5.1.2 VHF and UHF aerials

5.1.2.1 Description. The half-wave dipole forms the basis of most types of aerial. In the horizontal plane a horizontal dipole is bidirectional and a vertical dipole is omnidirectional, and thus a simple dipole responds to interfering signals arriving from a number of directions. The dipole is usually incorporated in an array with a number of additional elements. The simplest such array uses a reflector spaced behind the dipole which increases both the aerial voltage delivered to the receiver and the directional discrimination. A horizontally polarized array of this type is shown in Figure 4(a). A reflector may consist of a single element similar to the dipole, or several such elements, or a metal grill or sheet. The performance may be still further increased by adding further elements termed “directors” in, front of the dipole. The complete array is generally designated by the number of elements, counting the reflector as one. Thus, a dipole and reflector is a two-element aerial and a dipole plus reflector with four directors is a six-element aerial. Figure 4(b) shows a three-element array and Figure 5 shows a 10-element horizontal array.

The multi-element aerial system improves both the directivity and the receiver signal voltage, compared with the dipole alone. The directivity is expressed in terms of the angle through which the aerial has to be turned to reduce the received signal power to a half. Twice this included angle is often termed the “beam width” or “acceptance angle” so that the smaller the beam width or acceptance angle the better the directional discrimination. The aerial power relative to the power obtained from a single dipole, is termed the “aerial gain” and is usually expressed in decibels (dB).

Gain and directivity can be further increased by mounting two or more aerial arrays in a suitable configuration which may be designed to provide high discrimination against one or more unwanted signals. These configurations require precise interconnections.

The aerial terminal impedance is nominally 75 Ω and the coaxial cable of this impedance should be used to connect the aerial to the receiver.

Aerials are available for use in the same room as the receiver but they are usually much less effective than outdoor aerials. Where outside aerials cannot be used for any reason, then an aerial installed in the loft may provide an adequate signal.

The performance of the aerial with respect to directivity, gain and impedance should be maintained over the bandwidth necessary for the required channel or channels.

5.1.2.2 VHF/FM sound reception. FM broadcasting reception is characterized by:

- a) relative freedom from noise and interference effects, making possible a near-silent background;
- b) possibilities for high-quality sound reproduction;
- c) opportunities for stereophonic reception.

The FM receiver, without any signal input, generates a high level of noise (some receivers incorporate muting circuits to suppress this noise). This noise is reduced as the signal input increases; thus, in order to obtain a quiet background, an adequate signal input is required from the aerial. The minimum signal strength required for satisfactory stereophonic reception is substantially higher than that required for satisfactory monophonic reception. The receiver also has a property known as “capture effect” whereby a receiver picking up two signals on the same channel will reject the weaker. Most portable receivers use an extended telescopic rod for band II reception.

Many VHF sound transmissions are horizontally polarized while some have slant or circular polarization. It is recommended that a receiving aerial with its elements horizontal should be used.

The domestic band II aerial is normally designed for operation over the entire band, and a typical example is shown in Figure 4(b). Its gain would be about 6 dB, but an equally important property would be its directional discrimination. Service planning requires that extensive co-channel operation of transmitters is necessary for a national service and, although the receiver exhibits a capture effect, the aerial should be orientated to provide a suitable compromise between the rejection of an unwanted signal and the acceptance of wanted signals.

5.1.2.3 VHF and UHF television and teletext reception. Table 3 shows the television bands and channel numbers of the television services. The 405-line black-and-white television service on bands I and III will eventually be discontinued and most television reception is now on the UHF band.

The planning of the UHF transmitter network provides for four television services. This means that, in general, four channels have to be allocated to each transmitter site. Each channel is capable of carrying teletext in addition to the television service.

The UHF aerial should function on all four channels. Manufacturers supply aerials for the channel groups shown in Table 5.

Table 5 — UHF receiving aerial groups and coding

Channels covered	Group code	Colour code
21 to 34	A	Red
39 to 53	B	Yellow
48 to 68	C/D	Green
39 to 68	E	Brown
21 to 68	W	Black

A typical aerial for use within the service area is shown in Figure 5. It has 10 elements and a gain of about 10 dB.

Within the service area there may be low-lying or heavily screened areas in which a more elaborate aerial with more elements may be necessary. The broadcasting authorities are continuing to install low-power stations in places that are badly served by the main stations. The main transmitting stations use horizontal polarization; low-power stations generally use vertical polarization and require receiving aerials of a different aerial group to the associated main station.

5.2 Installation of aerials

NOTE To minimize risk during installation the precautions described in clause 7 should be observed.

5.2.1 Mechanical considerations for aerials and accessories

5.2.1.1 General. An outdoor aerial system erected in a situation where it is fully exposed to the rigours of climatic variation is very vulnerable. It will experience wide ranges of temperature (from well below freezing to over 55 °C), rain, snow, ice formation and high-velocity winds and will be subject to metal fatigue, as are all stressed metal structures. Due regard should be paid to this to ensure satisfactory performance and durability.

The materials selected for the aerial installation should be chosen so as to resist corrosion. Where aluminium or aluminium alloys are used, they should comply with BS 2898.

Parts of the aerial structure, such as mounting brackets, fixing bolts and mast-head clamps, are made of steel. This metal does not enjoy the natural protection of aluminium and a separate protective finish is required.

Steel parts should be protected by hot-dip galvanizing complying with BS 729 after fabrication, or by zinc or cadmium plating complying with BS 1706.

If dissimilar metals are brought into contact they and/or their finishes should be selected so as to minimize galvanic corrosion.

When an aerial is added to an existing installation, the latter should be checked to ensure that it is suitable to accept the additional stress and that the spacing between aerials is sufficient to avoid degradation of the performance of any of the aerials.

After assembly, when all performance checks have been made, a final check on mechanical security should be carried out.

Information about the electrical and mechanical characteristics and the method of measurement of the performance of aerials for VHF and UHF sound and television broadcasting are contained in BS 5640.

5.2.1.2 Aerials. The aerial elements should be constructed of non-ferrous metal tube, rod or strip.

Terminals should be of non-ferrous material, plated to inhibit oxidation and suitable for the selected feeder cables. They should be enclosed in a weatherproof housing designed to prevent deterioration of performance.

5.2.1.3 Tubular masts. It is preferred that masts should be of non-ferrous metal. If steel masts are used, it is necessary that they should have a hot-dip galvanized finish to ensure that the inside is adequately protected.

With all installations, care should be taken that no water can be trapped inside the mast. This is particularly important where steel masts are used.

Mast diameter alone is no indication of mast strength. The wall thickness should be adequate; the recommended thickness is shown in Table 6.

Table 6 — Tubular masts; tube diameter and wall thickness

Tube diameter (nominal)	Wall thickness	
	Non-ferrous alloy tube	Steel tube
25 mm	1.2 mm	1.2 mm
32 mm	1.6 mm	1.2 mm
38 mm	1.6 mm	1.2 mm
50 mm	2.0 mm	1.6 mm

The mast length and diameter will be determined by the size and type of aerial which is to be supported. A 25 mm mast should not exceed 18 m in length, and a 38 mm mast should be no longer than 3 m. All masts with a length exceeding 3 m should have a minimum diameter of 50 mm.

In selecting the size of mast, particularly for cabled distribution system aerals, consideration should be given to the required height and the loading due to the aerals, ice and wind. The aerial array should be capable of withstanding winds of 100 km/h and gusting of 160 km/h without excessive movement or permanent deformation. For cabled distribution systems, masts of 50 mm or greater diameter and wall thickness of 2.0 mm or greater for non-ferrous alloy or 1.6 mm or greater for steel are recommended, in order to improve the reliability.

Masts longer than 3 m may require guys to provide additional support in high winds. The degree of exposure of the site should be borne in mind; in general, coastal sites, sites on hills or on very tall buildings will require particular care. Further information relative to icing and wind loading may be found in CP 3:Chapter V-2.

5.2.1.4 Brackets and lashings

5.2.1.4.1 Installation. Masts are generally secured to buildings by either of the following methods:

- using a chimney stack for attachment of a bracket by means of a lashing wire or wires;
- using a wall-mounting bracket attached at the side of a building.

Where installation and reception conditions allow the aerial to be either chimney or wall mounted, the latter method is preferred as it eliminates the necessity for lashing wires.

For brackets of a welded construction, it is essential that the welds are of a good quality, and preferably the welding process should be such that it produces a clean surface for finishing.

Guy and lashing wires where used should be properly terminated with provision for adjustment of the tension.

When fitting the mast to the bracket, all nuts should be spanner tightened. When the mast is secured by U or V bolts, care should be taken to avoid undue distortion of the mast. Severe distortion can result in metal fatigue and fracture after a lapse of time.

5.2.1.4.2 Chimney-mounting brackets. Chimney-mounting brackets are available in several types and those required for a particular installation will depend on the types of aerial and mast to be provided. Some typical examples are shown in Table 7.

In all cases, the lashing wire should be of stranded steel with an electro-plated or galvanized finish. A seven-stranded lashing wire should be used with each strand being not less than 1.2 mm diameter.

The lashing wire should be correctly terminated and steel corner plates provided. The steel plates are necessary at each corner to protect the brickwork structure of the stack. Figure 6 shows a method for terminating the lashing wire.

The top of the lashing bracket should be at least three courses of brickwork or 250 mm from the top of the stack. The lashing bracket should have a minimum bearing depth as follows:

- masts up to 1.8 m, 150 mm depth;
- masts from 1.8 m to 3 m, 300 mm depth;
- masts from 3 m to 5 m should be fitted with double lashings with a vertical spacing of not less than 450 mm.

5.2.1.4.3 Wall-mounting brackets. Several types of wall-mounting brackets are available. Some typical examples are shown in Table 8.

Care should be taken to ensure that the surface, e.g. the wall, onto which the aerials are to be mounted is sufficiently strong and durable to withstand the expected loadings. When attached to brickwork, concrete or masonry, brackets should either be fitted by at least four expansion type bolts or through bolted. When brackets are secured to brickwork, the bolts should enter the brick and *not* the mortar joint. Where there is doubt about the security of fixings, advice should be sought from the builder or architect. In exceptionally thin or weak walls, additional support and measures to spread the loading over a large area should be provided.

Where double brackets are used for wall mounting, one should be a tripod in order to provide proper support against the vertical thrust. The brackets should be spaced at least 450 mm apart.

5.2.2 Siting of aerials

5.2.2.1 General. The position of the aerial is of considerable importance. All local obstructions between the aerial and the transmitter should be avoided as far as possible, and where reception conditions are difficult, it will be advantageous to find the best position by experiment.

An aerial erected on the top of a tall building will generally give the strongest signal, but better reception may sometimes be obtained by placing the aerial in a lower position so that the building acts as a screen between the aerial and a source of interference, such as a busy street. Multiple images may often be eliminated by a careful choice of position for the aerial and by proper use of its directional properties. This is particularly important for the reception of digital data signals (teletext, etc.) which can be seriously impaired by the presence of echoes that may not visibly affect the picture.

Where practicable, aerials should be mounted well clear of other conductors, including structural metalwork, and other aerials. Every effort should be made to install aerials as far as possible from power lines to avoid interference pick-up (see also 8.9).

Roof space mounting is not as effective as an external aerial and should not be used where metal foil roof linings are present. When siting aerials in the roof space, care should be taken to position them as far as possible from the pipes, cisterns and other metalwork.

5.2.2.2 UHF aerials. The siting of UHF aerials, in particular, calls for great care. It may be necessary to experiment with the position of the aerial over considerable areas of the roof and it should be remembered that the high degree of directivity of multi-element UHF aerials necessitates accurate orientation of the aerial. Use of a signal strength meter is recommended to find the optimum position but the quality of the pictures (and where appropriate teletext) obtained on all required channels should always be checked before deciding upon the final position. Should any further programmes be transmitted, it may be necessary to repeat this procedure. Where reception is particularly difficult, more than one aerial may be necessary for satisfactory reception on all UHF channels, in case specialized combining equipment will be required where connection is to be made to a wide-band amplifier or domestic television receiver. Where more than one aerial is used, a minimum clearance of not less than a half-wavelength at the lowest frequency should be provided. This clearance should also be provided between the aerials and adjacent objects.

5.2.2.3 Avoidance of contamination and damage. In order to avoid contamination by smoke and flue gases or damage by chimney sweeps, an aerial should not be erected over the top of a chimney. Use of a cranked mast might assist and would also facilitate alignment of the aerial for optimum results. When mounting above a chimney is unavoidable, a minimum clearance of 1.25 m between the lowest part of the aerial and the top of the chimney should be maintained. The aerial should be kept as clear of local obstruction as possible.

5.2.3 Precautions against damage and interference from atmospheric electricity

WARNING. For protection against lightning, reference should be made to CP 326. The following recommendations in this subclause provide only for the means to minimize the build-up on aerial installations of static charges that cause damage, danger and interference.

Metal masts, supporting structures and the booms of television and VHF/FM aerials should be connected to earth. In most cases, it is sufficient to ensure that the mast is earthed, relying on the clamp that secures the aerial to the mast for electrical contact between the aerial and the mast.

The aerial system should be connected to any earthed metalwork situated near the top of the structure, e.g. water tanks or pipes, using an earthing clamp complying with BS 951. If no earthed metalwork is available, the earth connection should be made by the most direct route to the nearest earthing point. A copper conductor should be used for this connection with a minimum cross-sectional area of 1.5 mm².

In some aerial designs the elements are not in electrical contact with the boom to which they are secured and no such connection should be made.

With some aerials the outer conductor of the aerial feeder is not connected to the supporting metalwork of the aerial. In this case, the outer conductor should be separately earthed at the receiver end of the downlead.

5.2.4 Earth connections

NOTE Safety is not dealt with in this subclause and reference should be made to 8.13 and to BS 415, CP 326 and CP 1013. In addition, attention is drawn to the IEE Regulations for Electrical Installations. Any colour coding and connections to mains plugs should comply with the appropriate British Standard.

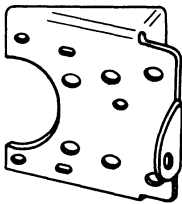
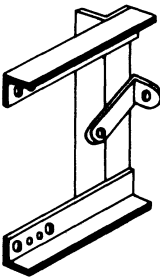
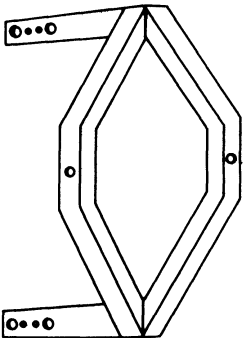
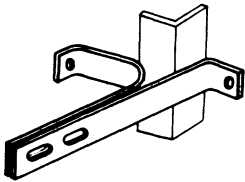
Some sound receivers and most television receivers have their chassis directly connected to the mains supply and such chassis should in no circumstances be earthed.

Sound receivers for long-, medium- and short-wave bands sometimes have an earth terminal provided for the improvement of reception. When an aerial external to the receiver is used, an earth connection is desirable. In most cases the earth connection for a mains-operated receiver may satisfactorily be made by means of the earthing pin of the three-pin mains plug.

If use of the earth-continuity conductor does not reduce interference, a separate “quiet” earth should be provided. Where practicable, this earth connection should be distinct from other earth connections and should be connected by the shortest available route, either to a rising metal water pipe near its point of emergence from the ground or to a buried electrode (see CP 1013) which provides a low-resistance connection with the general mass of earth. To obtain worthwhile improvements to reception it may be necessary to use an earth conductor of very low resistance together with substantial metal clamps for connection to the earth electrode or water pipe. Water pipes may not provide a continuous electrical connection due to the use of sections of plastics piping or the use of plastics couplers on metal piping. Connections to a metal water pipe above its first joint, to structural steelwork of a building, or to water pipes using plastics couplers or sections are unlikely to effect any improvement.

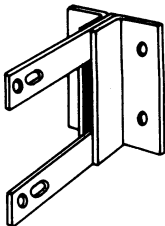
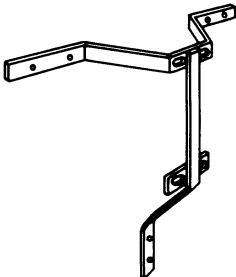
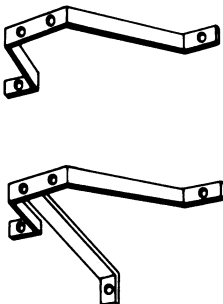
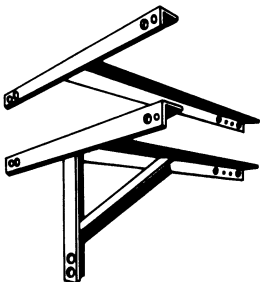
Gas pipes should not be used for electrical earth connections.

Table 7 — Chimney-mounting brackets

Type of bracket	Bracket dimensions	Bearing depth or spacing distance for mast fixings	Mast size		Typical aerial loading
			Max. length	Min. overall diameter	
Pressed steel chimney 	mm Depth 150 or 190 Bearing width 40 Thickness 2.5 Flanges and ribs incorporated for strengthening	mm 150 or 190 (depth)	m 1.8	mm 25	One 18-element UHF or one 3-element FM
Welded chimney 	Mast support arm 25 × 6 Arm length 150	150 (depth)	1.8	25	One 18-element UHF
	Body 40 × 40 × 3 angle Tensioning lugs 25 × 6	230 (depth)	1.8	32	One 18-element UHF and one 3-element FM
	Mast support arm 40 × 40 × 3 angle Arm length 150 Assembly 40 × 40 × 3 angle Tensioning lugs 25 × 6	300 (depth)	Up to 3.0	38	One high-gain UHF or one 18-element UHF and one 3-element FM
Mitre chimney 	Vertical depth 340 Assembly 30 × 30 × 3 angle Arm length 180 Mitres tack welded	340 (depth)	3.0	38	One 18-element UHF and one 3-element FM
	Vertical depth 450 Assembly 40 × 40 × 3 angle Arm length 180 Mitres tack welded	450 (depth)	3.0	50	One UHF multi-director array or one 6-element FM
Double chimney lashing (in pairs) 	Mast support arm 30 × 6 Arm length 190 Body 40 × 40 × 3 angle Tack welds	450 min. (spacing)	Up to 5.0	50	One UHF multi-director array and one 6-element FM

NOTE Other types of bracket may be equally suitable.

Table 8 — Wall-mounting brackets

Type of bracket	Bracket dimensions	Bearing depth or spacing distance for mast fixings	Mast size		Typical aerial loading
			Max. length	Min. overall diameter	
Welded wall 	mm Depth of base 150 or 230 Base $30 \times 30 \times 3$ angle (2 angle sections) Mast support arms 25×6 Arm length 150 (four-hole fixing)	mm 150 or 230 (depth)	m 1.8	mm 32	One 18-element UHF or one 3-element FM
One-piece welded wall 	Up to 450 stand-off Assembly 30×6 (three- or six-hole fixing)	900 (depth)	3.0	38	One 18-element UHF and one 3-element FM
Two-piece welded wall 	Up to 450 stand-off Assembly 30×6	450 min. (spacing)	5.0	50	One UHF multi-director array and one 6-element FM
	Over 450 stand-off Assembly 40×6 (five-hole fixing)	600 min. (spacing)	5.0	50	One UHF multi-director array and one 6-element FM in exposed locations
T and K welded wall 	Up to 300 stand-off Assembly $40 \times 40 \times 3$ angle Min. bearing width 230	450 min. (spacing)	5.0	50	One UHF multi-director array and one 6-element FM
	Over 300 stand-off Assembly $40 \times 40 \times 3$ angle Min. bearing width 300 (five- or ten-hole fixing)	600 min. (spacing)	5.0	50	One UHF multi-director array and one 6-element FM in exposed locations
NOTE Other types of bracket may be equally suitable.					

5.3 Cabling between aerials and receiving equipment

5.3.1 Types of cable

5.3.1.1 VHF and UHF bands. Cables used for the reception of broadcast transmissions in these bands should be of the coaxial type with a nominal impedance of $75\ \Omega$ and should comply with BS 2316 and BS 5425-1 where relevant.

For cabled distribution systems, high-quality distribution cables should be used, e.g. well screened types having correct and uniform impedance characteristics and robust construction. Connections should be properly designed and constructed in order to provide a high standard of impedance matching between cables and equipment. This minimizes the generation of signal reflections within cables and at the interface between cables and equipment.

This is particularly important for the satisfactory handling of digital data signals (teletext, etc.) which can be seriously impaired by the presence of echoes that may not degrade the picture.

5.3.1.2 HF, MF and LF bands. For HF bands see 5.1.1.3 and for MF and LF bands see 5.1.1.2.

5.3.2 Cabling

NOTE Attention is drawn to the IEE Regulations for Electrical Installations.

5.3.2.1 General. It is important to segregate r.f. cables from cables carrying mains electricity and fire alarm circuits.

5.3.2.2 Installation. The installation of cables should be carried out in a neat and workmanlike manner. All cable runs should be continuous between operational equipment, and free from joints.

Where cables are to be concealed within the fabric of a building, routed underground or involve overhead spans, reference should be made to 6.4.2.

Bending or setting radii should be as large as possible and in no circumstances less than the manufacturer's recommendations. Where the latter cannot be determined, the radius should be not less than six times the outside diameter of the cable.

The route from the aerial to the receiving equipment should minimize the length of cable used and satisfy the following.

- a) The cable should be provided with a loop between its point of attachment to the mast and the building or chimney, to permit servicing of the mast without straining the cable and to provide a water drip, see Figure 4(a).
- b) The cable should not be secured under "flashing", e.g. round chimneys.
- c) The cable should be laid directly down a roof taking the shortest route to the gutter and secured by tile or slate clips. It should not be laid obliquely on a roof.
- d) The cable should be protected where it crosses a gutter, taken behind it where possible, and then routed in horizontal and vertical runs.
- e) The cable should be attached to support surfaces and masts with the following spacings between fixings:
 - 1) on masts, an interval of fixing no greater than 230 mm;
 - 2) on other vertical runs, an interval of fixing no greater than 750 mm;
 - 3) on horizontal runs, an interval of fixing no greater than 230 mm.

Fixings should be such that deformation of the cable does not occur. Staples should not be used.

f) Cable entry holes in an external wall or window frame should slope downwards to the outside and be a close fit for the cable. At the point of entry the cable should be formed into a drip loop that satisfies the recommendations for minimum bending radius. Woodwork should be painted and the gaps finally sealed with a suitable sealant.

g) Cable connections on to equipment should be made in such a manner as to prevent any ingress of moisture. External cables should always enter terminal or junction boxes in an upward slope so that any water drains away from the point of entry.

h) Internal cabling should be properly secured and, for domestic installations, routed as inconspicuously as possible where it cannot be damaged. It should be terminated with the lead reaching the receiver in a coaxial plug, or in a coaxial socket complying with BS 3041-2.

For the head-end equipment of a cabled distribution system, the termination will be that provided in the equipment; for clamps and terminals, reference should be made to **6.4.2.1**.

j) Coaxial plugs should be assembled in accordance with the manufacturer's instructions and the inner conductors soldered where applicable. A type employing a crimped connection should only be used in conjunction with a proper crimping tool.

5.4 Ancillary equipment

5.4.1 Aerial amplifier. In low-signal areas or where long coaxial down leads are used, a mast-head pre-amplifier in conjunction with a higher-gain aerial may improve signal reception. Pre-amplifiers should be sited as close to aerial terminals as possible.

5.4.2 Multiple outlets. Where the down lead is to be taken to more than one outlet, impedance-matching splitters should be used. If several outlets are needed a suitable amplifier can be installed (see Appendix A).

5.5 Testing and acceptance of aerial installation

On completion of an installation or extensions or alterations to an installation, signal levels and mechanical security should be checked. Viewing and listening tests should also be carried out.

Where aerials have been added to an existing installation, the performance of the original aerials should also be checked.

For the acceptance of cabled distribution systems, reference should be made to **9.3.4**.

6 Cabled distribution systems

6.1 Types of system

6.1.1 General. Cabled distribution systems provide a means of distributing sound and television programmes over a network to receivers that may be, for example, within a group of individual dwellings, within a block of flats, in rooms in a hotel, or spread throughout a town. The cabled systems will comprise any necessary equipment to process, amplify and distribute the incoming signals. The types of system that may be used fall into the categories given in **6.1.2** to **6.1.4**.

NOTE For the distribution of sound programmes at audio frequencies see BS 6259.

The distribution of sound programmes at low and medium frequencies are not dealt with in this code because of limited demand.

6.1.2 Distribution of sound and television programmes at high frequencies (3 MHz to 30 MHz). A typical system (see Figure 7) will include most but not necessarily all of the following:

- a) the aerial system;
- b) low-noise aerial amplifiers;
- c) UHF and/or VHF to HF converters, modulators and amplifiers;
- d) trunk, branch, spur and subscriber feeders;
- e) splitters and subscriber tap-off units;
- f) programme selector units;
- g) system outlet units;
- h) signal adaptors.

High-frequency systems use the band 3 MHz to 30 MHz for distribution, the aerial signals being translated to appropriate television and sound carrier frequencies. On some systems the sound is distributed at audio frequency. The feeder cables usually contain a separate balanced pair of conductors for each television signal and its associated sound channel. On some systems an additional sound radio programme is distributed on the same pair.

Cabled system receivers of appropriate design are available; alternatively, aerial receivers may be used by introducing an adaptor (sometimes known as an inverter) between the system outlet and the receiver.

At the receiver the required programme is selected by a programme selector unit containing a switch that connects the appropriate pair of conductors to the receiver input. The programme selector may be mounted remotely from the receiver and embody mains switching and a volume control. The system layout is broadly similar to that for VHF and UHF systems except that the number of amplifier locations are fewer and a subscriber's tap-off box contains a tap-off unit for each channel.