AN INTRODUCTION TO MICROPHONES

Although it is possible to engineer one part of an audio system to compensate to some extent the failings of another, it is obviously better to begin with the best input possible and to make all subsequent reproducing elements such that they pass on a faithful version of what is received. In short, the output of a system cannot be better than the input and to obtain the best results a high quality microphone is essential.

The desirable qualities of a microphone are : small size, robustness, high sensitivity to desired signals with rejection of unwanted sounds (such as background noise, hum pick-up, etc.), uniform response to all frequencies and suitable directional properties. No single instrument can meet all these requirements and the best results depend on the choice of microphone to suit a particular application.

Certain classifications will occur to the user at once, for example ; indoor and outdoor microphones, directional and omnidirectional microphones and microphones for close or distant talking. Detailed consideration of these categories will help to make clear the functional and constructional differences between the various types of high quality microphones manufactured by Standard Telephones and Cables Limited.

The distinction between high quality and low quality microphones must be considered. Where cost must be taken into account, it should be remembered that a good microphone does not usually add much to the overall cost of an installation ; a cheap one is a false economy.

All STC microphones are precision made and utilise the best materials and manufacturing techniques. Each microphone is individually tested over its whole range of performance to a very exacting specification.

Directional Properties

For many purposes a microphone needs to be sensitive to sound sources irrespective of the angle of sound incidence as, for example, when the instrument is located centrally with respect to a group of performers. Such a microphone has been called non-directional since it has no favoured direction of acceptance, but " omnidirectional " is a better and more positive appellation to indicate that the microphone accepts sounds equally from all directions.

It is well known that in air, as in water, the static pressure is the same in all directions ; i.e., air pressure is naturally omnidirectional. In general, therefore, omnidirectional microphones are pressure operated since they respond to changes in air pressure produced by sound waves.

Most early microphones were of the pressure-operated type, but later, microphones were made which responded to changes in pressure gradient rather than changes in pressure. In simple terms,

if pressure is likened to the height of a hill, pressure gradient corresponds to the steepness of the sides of the hill and is thus a vector (i.e. directed) quantity. As air pressure varies with signal rhythm, so does pressure gradient, so that an electrical device sensitive to gradient changes can act as a microphone. Such a microphone is directional since, in its basic form, it is most sensitive to sounds arriving from the front and back and least sensitive to sounds from the sides, top and bottom.

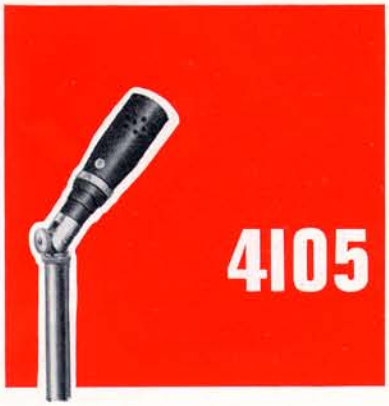
The " figure-of-eight " directional pattern just described has certain advantages as it is sometimes possible to arrange for unwanted sound sources to be on the insensitive axis of the microphone. Furthermore, in a reverberant room this type of microphone is less sensitive by a factor of 3:1 to the reverberant sound (which arrives from all directions) than to the wanted signal coming from the front. This helps considerably with feedback problems in public address work and permits natural reproduction in buildings which have not had adequate acoustic treatment. Also, it allows an artist to stand further from the microphone for a given degree of reverberation, which may be important for the artist's method of presentation and in television production assists in keeping the microphone out of sight.

Conversely, an omnidirectional microphone sometimes helps in a room which is acoustically overtreated. Such a room would sound " dead " if a directional microphone were used.

An even more useful sensitivity pattern is the cardioid (heart-shaped). Cardioid microphones have the same 3 : 1 discrimination between direct and random indirect sound as the bi-directional (figure-of-eight) types but they have the additional advantage of being insensitive to sound arriving from the back. This property is particularly advantageous for use on a stage since the cardioid microphone helps to suppress unwanted noises coming from the orchestra pit or the audience and reduces echo effects from the back of the auditorium.

The growing popularity of stereo reproduction enhances the importance of directional qualities since most systems depend on the use of matched and accurately orientated directional microphones.

Cardioid microphone incorporating moving coil and ribbon elements. Provides front-to-back discrimination of 15–20 *db. Response range* 30–10000 *c/s. See Leaflet PA/*14.

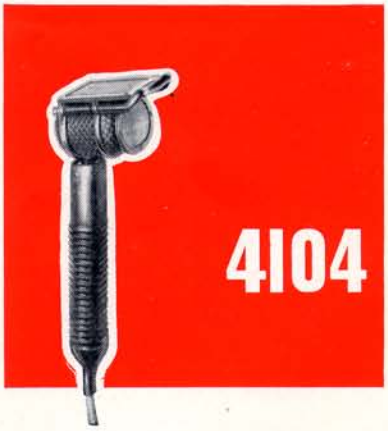


Cardioid moving coil microphone with front-to-back discrimination of 15–20 *db. Response range* 60–10000 *c/s. See Leaflet PA/*27

Close and Distant Talking

In a studio, particularly when music is being reproduced, the sound source is some distance from the microphone, whereas in public address systems, often used in a noisy environment, the talker is much nearer to the instrument. Some vocalists sing within a few inches of the microphone and obtain special effects by so doing. Finally, the commentator who has to provide a commentary during a live programme must put his lips close to the instrument. These different requirements lead to the need for microphones with special characteristics.

Microphones are sometimes said to respond to talkers from a great distance. This is often legend or exaggeration, but it has a basis



Close talking commentator's lip microphone with high degree of extraneous noise discrimination. Response range 30–10000 *c/s. See Leaflet PA/*30.

Studio ribbon microphone with figure-of-eight directional response. Response range 30–15000 *c/s. See Leaflet PA/22.*

Omnidirectional moving coil studio microphone. Response range 30–15000 *c/s. See Leaflet PA/17.*

Omnidirectional moving coil microphone of unobtrusive appearance especially suitable for television interviewing. Response range 30–15000 *c/s. See Leaflet PA/20.*

in fact and usually implies a microphone with very pronounced directional quality. Such an instrument will reject signals from other directions and so permit the amplifier gain to be increased until the distant talker is audible without a corresponding increase in other noise or in over-reverberant sound. This fact emphasises one of the important uses of a microphone with directional properties, that of noise exclusion. Microphones, or more usually, an array of microphones, in which this effect is pronounced can to some degree be "focused" on the talker. The single cardioid or bi-directional microphone often gives a useful degree of exclusion of unwanted sound without the disadvantages of considerable size or complication. Microphones which operate on the pressure gradient principle have a special property not found with pressure-operated types. With the former, the response to low frequency sounds rises more rapidly as one approaches the instrument than do the middle or high frequency sounds. Ribbon microphones, which generally work on the gradient principle, are therefore well suited to studio use, but would give frequency distortion if used by a commentator. This property can, however, be put to good use by introducing elements into the construction of the instrument which attenuate the lower frequencies so as to give an overall flat response when used for close talking at a prescribed distance.

Microphones with these characteristics can be designed so as to be eminently suitable for a commentator's use. Room noises, or the programme through which the commentator has to talk, besides being relatively distant are robbed of most of their low frequency content. The result is an effective suppression of everything but the commentator's voice. A microphone of this type is fitted with a mouth guard so that the distance from the speaker's mouth is accurately fixed.

Microphones operate on the alternating components of air pressure which comprise the sound waves, thus puffs of air from mouth or nose, and bursts of pressure which accompany certain labial consonants (such as p or b), can produce disastrous results when amplified from a microphone. One of the difficult problems of close-talking microphone design is to neutralise this "blasting" without causing deterioration of the response. The STC commentator's microphone as used by the national broadcasting and television organisations, is so constructed that this unwanted characteristic is largely avoided and distortion-free speech of broadcasting quality is obtained. Very few, if any, close-talking microphones with noise reducing properties have previously attained this standard.

Outdoor Microphones

Some microphones, such as ribbon microphones, perform excellently in the calm atmosphere of a studio but are unsuitable for outdoor use. In general a microphone to be used outdoors should have smooth contours with no sharp edges to encourage air turbulence, and a robust moving

element. Pressure types are more suitable than gradient types since any low frequency turbulence produced by the action of wind on a gradient microphone is likely to be emphasised by the L.F. boost effect dealt with under " Close and Distant Talking."

Moving coil hand microphone for use outdoors. Response range 30–10000 *c/s. Windshield available. See Leaflet PA/16.*

Windshields

It is nearly always necessary to provide a microphone that is to be used out of doors with a windshield. At its simplest, this may take the form of a glove of foam material, silicone treated to repel water. For use in high winds, however, the microphone must be enclosed in a cage of wire mesh lined with a suitable material.

Windshields act by attenuating the " D.C." Velocity of the air stream so as to prevent its setting up serious turbulence round the body of the microphone, while, if carefully designed, giving little attenuation of the much slower waves of sound. Because the shield itself generates turbulence, it must always be rather large to be efficient in very windy conditions, so that this turbulence is kept as far away as possible from the operating elements. This is specially important for gradient microphones which, as pointed out earlier, have an increased response for low frequency sounds generated near the sensitive element.

The simpler and smaller foam shields are still effective at low wind speeds and are also very useful to suppress noises due to a speaker's breathing and to the effects of explosive consonants.

As an example of the care and thought given to protection problems, it may be noted that STC microphones were used in the Trans-Antarctic expedition and gave unfailingly satisfactory service in some of the worst climatic conditions in the world.

Similar to Type 4032 *but for stand mounting. See Leaflet PA/19.*

Standard Telephones and Cables Limited have had wide experience in the manufacture and installation of microphones, amplifiers, loudspeakers, and all forms of sound reproduction systems and will be pleased to discuss problems which may arise from any installation project.

Descriptive leaflets for the wide range of STC microphones, accessories and associated sound reinforcement equipment are available on request.

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