



LOU BURROUGHS

MICROPHONE FACTS

for the operating engineer

from *Electro-Voice*[®]

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GEMS FROM THE IVORY TOWER

Over the years, custom - and habit - produces "standard" microphone placement patterns for the solution of "standard" acoustical problems. Usually these patterns are proven by experience to be "best" solutions to these problems. Occasionally, however, it can be demonstrated that another approach may provide a better solution to the problem than the one that is generally accepted as "best".

Wayne A. Beaverson has been associated with Electro-Voice since 1948 and has been personally involved in the design of every Electro-Voice microphone produced since then. As a nationally-recognized authority in the field of electro-acoustics, he is exceptionally well qualified to present the following article. We bring you a gem from the pinnacle of our ivory tower.

FIXED MICROPHONE ROSTRUM INSTALLATIONS

by Wayne A. Beaverson Vice President, Engineering

One of the most difficult microphone applications to cope with concerns adequate sound pickup from a rostrum. The objective of this type of installation is usually sound reinforcement. However, recording and reproduction for a remote audience may also be considerations. One of the simplest solutions to the problem is the lavalier microphone. Although the lavalier microphone sacrifices some sound quality, it nicely solves the problem of maintaining a fixed relationship between the subject and the microphone. However, a fixed microphone installation has proven to be universally more acceptable for the average application. This discussion is presented for the benefit of those who find fixed microphone installations more acceptable.

The rostrum microphone installation can usually be described as a compromise at best and is nearly always complicated by:

- (a) Feedback problems which relate to the acoustic properties of the room and/or the type and placement of the loudspeakers.
- (b) Poor acoustics which seem to be the rule rather than the exception in lecture halls, churches, and school auditoriums.
- (c) Highly mobile speech makers who fail to appreciate an "on-microphone" presentation due to the fervor of their presentation, lack of experience, or preoccupation with use of slides in the presentation.

PAST SOLUTIONS

1. Single Omnidirectional Microphone (Figure 1)

This is the simplest and most economical type of installation. However, it is a feasible approach only in an almost ideal acoustic environment. Considerable improvement in this type of installation can be achieved when there is an operator to adjust the gain control of the amplifier for a relatively constant output. Incidentally, any microphone system can be improved by this technique.

Where conditions permit the use of a single omnidirectional microphone system the resulting sound will be relatively uniform in frequency response range and level if the subject maintains a relatively short distance from the microphone. The uniformity of output results from the omnidirectional pattern of sound pickup.

2. Single Cardioid Microphone (Figure 2)

The use of a single cardioid microphone will improve the quality of sound in the usual environment and may be mandatory in many circumstances where acoustic conditions are less than optimum. A microphone with a cardioid polar pattern has these desirable features:

- (a) Significant reduction of sound pickup from the rear of the microphone which minimizes acoustic feedback problems or permits a higher level of sound reinforcement before feedback conditions occur. This feature can often be demonstrated by rotating the microphone to cause or eliminate feedback.
- (b) Significant reduction of sound pickup in the rear of the microphone which minimizes reverberation effects and extraneous noises that detract from the sound reinforcement quality.
- (c) The two advantages noted above may be exploited by rotating the microphone for optimum performance. Irrespective of this rotation an actual improvement in performance is enjoyed by the cardioid microphone due to its polar pattern which produces a directional efficiency of 33-1/3%. This simply means that, for noises coming from random directions, the cardioid microphone will pick up one-third as much noise as an omnidirectional microphone. The random efficiency of the cardioid microphone is often described as permitting the use of the microphone 1.7 times further from the sound source than a pressure microphone, all other conditions being equal. This statement should be qualified by the additional stipulation that the unwanted sound must be of a random nature. It is rather obvious that an unwanted sound originating directly behind the person speaking into the front of a cardioid microphone will be reproduced just as it would be by an omnidirectional microphone.

The very feature of the cardioid microphone which enhances the control of feedback, reverberation, and unwanted noise is a detriment from the viewpoint of the subject's freedom of movement. Compared to an omnidirectional microphone a single cardioid microphone installation is restrictive on movement from the principle axis of the microphone by the speech maker. A glance at position #2, as indicated on Figure 2, illustrates the effect of

movement to the edge of the rostrum. It is quite apparent that there will be a drop in output due to the increased distance from the microphone and additional loss of output caused by movement from the principle response axis. This problem is usually assailed by using two cardioid microphones on the rostrum as discussed below.

3. Two Cardioid Microphones (Figure 3)

Use of two cardioid microphones "angled in" to the assumed close position of the subject has become fairly common to overcome the objection discussed in section 2, above. A prime requisite of this system is the use of well-matched cardioid microphones connected "in-phase" electrically.

The objective of this type of system is illustrated by position #2 of Figure 3. It can be seen that the sound originates substantially off-axis from microphone number 2, but the source is very nearly on the principle pickup axis of microphone number 1. At first thought this appears to be desirable. However, a reasonably critical observer will hear radical changes in the quality of the sound output as the subject moves from one position to another. This objectionable result is due to the phase differences between the two microphone outputs caused by the spatial relationship of the two microphones to the sound source. This situation is really intensified by the inward rotation of the two cardioid microphones because the amplitude of the two outputs can be almost equal. It is easily seen that microphone number 1 is responding at a near maximum since the source is nearly on the principle axis. Although the source is considerably off axis for microphone number 2 (and therefore the output tends to be low due to the polar pattern), it is much closer to microphone number 2 and the two outputs are often very nearly equal. However, the phase difference varies widely and major dips in the output can be expected in the range from 800 cycles per second to the highest frequencies reproduced.

A SUGGESTED SOLUTION (Figure 4)

An improved method of installation is illustrated in Figure 4 where two cardioid microphones are rotated slightly "outward". An angle of 15° to 25° is suggested for typical installations. At the same time the microphones should be placed relatively close together. A distance of 6 - 20 inches will usually produce the best results. However, both the angle and distance between microphones should be adjusted for the particular conditions encountered. As a general rule greater angles will allow the subject more mobility, and shorter distance between the microphones will result in more uniform pickup and minimize both feedback and extraneous noise.

When good uniform cardioids are utilized, the output will not be derogated appreciably by the slight off-axis condition which exists for each individual microphone when the subject is on the central line of the installation. As the subject moves to the right side of the installation (point number 2 of Figure 4) the output becomes substantially that of microphone number 2. This is apparent since the subject is now speaking essentially on the major axis of microphone number 2. At the same time, the output of microphone number 1 is decreased appreciably since the sound source is at an angle which is considerably off-axis. An additional factor causing microphone number 2 to have a relatively greater output is the nearness of microphone number 2 to the sound source when compared to microphone number 1. The phase cancellation described in section 3, above, does not become a serious problem in this installation even though the phase difference still exists. The reason, of course, being the great difference in the magnitudes of the two outputs.

FIGURE #1

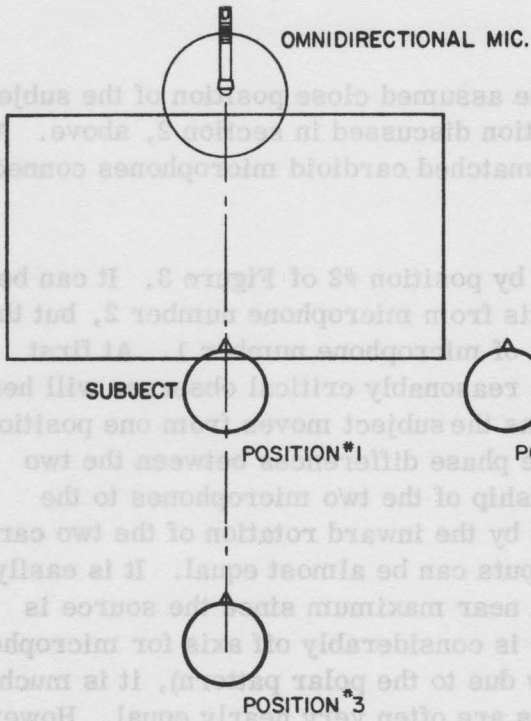


FIGURE #2

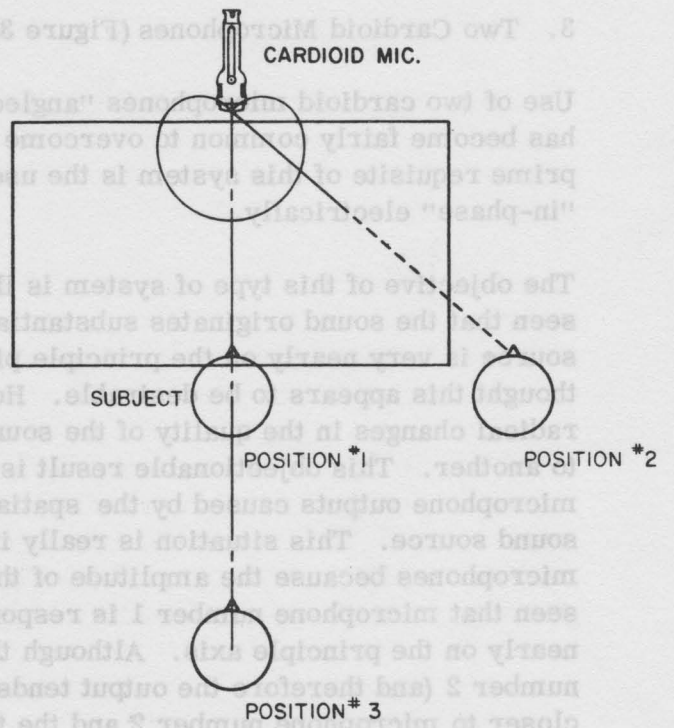


FIGURE #3

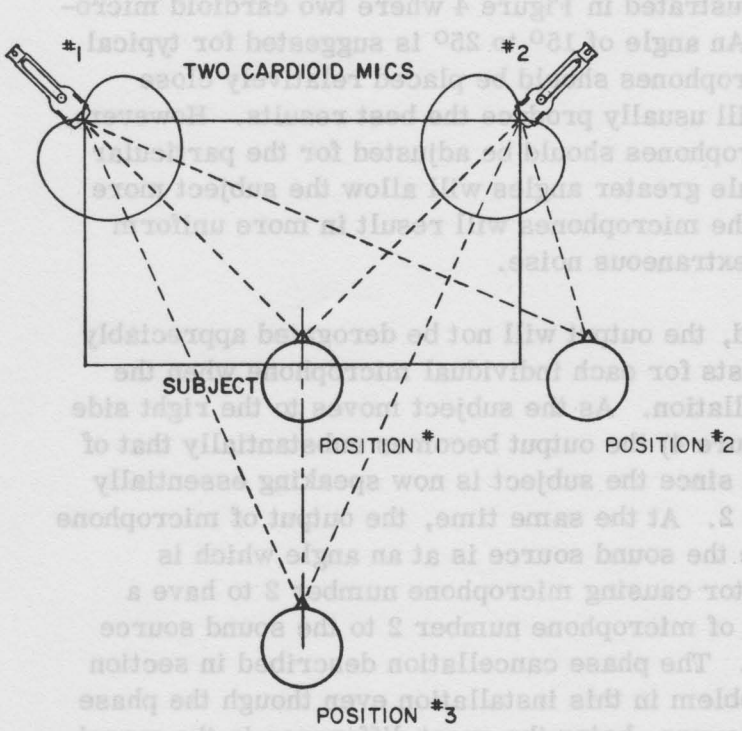
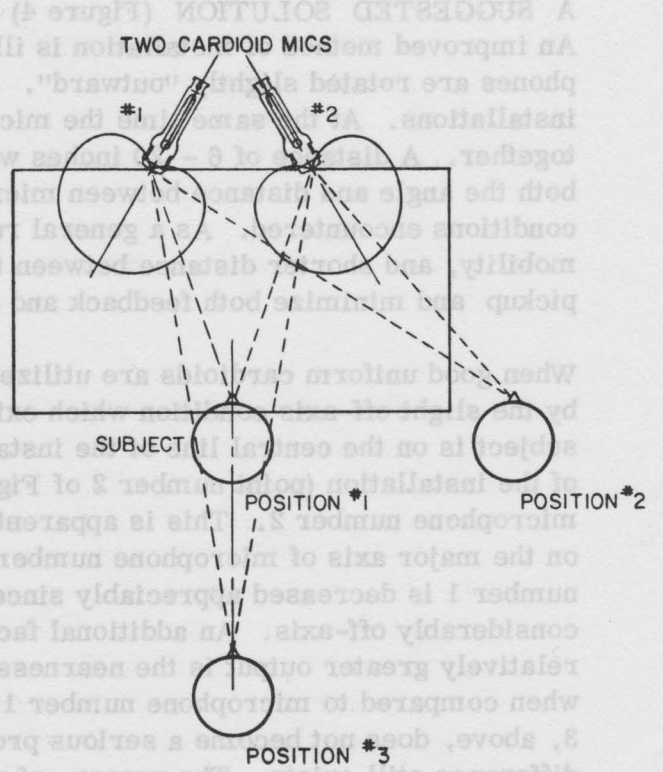


FIGURE #4



A bonus in this type of installation is a more uniform output as the subject moves back from the installation (position number 3 of Figure 4). Everyone knows that the sound pressure reaching the microphone will decrease as the sound retreats from the installation. However, a glance at Figure 4 indicates that a small compensation occurs due to the fact that, as the source moves to position number 3, each microphone becomes more sensitive due to its polar response. This is in direct contrast to the usual application as illustrated in Figure 3. Here it is seen that the source actually moves off the principle axis of each microphone at position number 3 and a substantial drop in output is detected as well as an increase in working distance as a result of this effect.

It is felt that the installation illustrated by Figure 4 will generally give the most satisfactory results for rostrum use where average acoustical conditions exist. In a few cases there may be a tendency to slightly aggravate feedback and reverberation problems when compared to a single cardioid microphone installation. However, this appears to be the best compromise when the subject is expected to be fairly mobile in his presentation.

CONCLUSION

Conditions vary to such a great degree that it is impossible to define a microphone system which will be universally acceptable. However, if a little generalizing is permitted, the following order of preference is presented:

- (a) The acoustic environment permitting, utilize a single good quality omnidirectional microphone. This system will allow the subject maximum freedom of movement and the highest quality of reproduction will result.
- (b) Under less than ideal acoustic conditions utilize a single good quality cardioid microphone. This system will eliminate the problem of response variations which occur in the normal two microphone system because of phase differences. However, this system should be used only when the subject is expected to maintain a position well within the acceptance angle of the polar pattern. In general, an included angle of 90° is quite acceptable as a working area.
- (c) Under less than ideal acoustic conditions utilize the two cardioid microphone system of Figure 4 for maximum mobility of the subject.

THANKS FOR YOUR HELP

By Paul K. Franklin

In an earlier issue of MICROPHONE FACTS, a microphone survey card was enclosed which requested certain specific statistical information concerning the use of E-V professional microphones. The response to our request was most gratifying, and we wish to take this opportunity to say thanks to all of you for providing this information. As a statistical sampling, the returns were extremely good. The information shown was very interesting and quite helpful to us. Of the cards returned, 83% were from professional broadcasters. The remaining 17% represented motion picture companies, recording companies, and public address and sound installers.

As we expected, more than 50% of all microphones of all types and makes reported used in professional broadcasting, were E-V microphones. There were a substantial number of 100% or near 100% E-V stations, both radio and television.

Large numbers of microphone users, including many whose questionnaire cards indicated a strong concentration of competitive microphones now in use, indicated that future microphone purchases would be E-V. Nearly 80% of the replies to the question "Should the connector be built into the microphone case?" replied "Yes" to this question. The question "What do you think of our repair service?" produced interesting replies. About 52% of the responses indicated that our repair service is good, while 44% either made no response at all to the question, or indicated that the service has not been needed. The remaining 4% indicated that on rare occasions--as will always occur with any organization--our repair service has been slightly less than completely satisfactory.

We sincerely appreciate your interest and your assistance.

The following article provides an opportunity to introduce an Electro-Voice personality who is a very important person to our customers. As Service Manager, Bill Rutz is directly responsible for our customers' long-term satisfaction with their E-V products.

Bill is a man with a wide variety of interests. Some of you know him as W8SCS. As a professional musician for over 30 years, five of them full-time with name bands, he has won several national awards as an outstanding jazz bass man.

In his eight years with Electro-Voice he has had several job assignments, each with increased responsibility, and each contributing to his qualifications for his present assignment. Because Bill, and his department, are so directly concerned with the problems of our customers, we felt you would like to know him, and the way his department operates.



BILL RUTZ

THE E-V SERVICE DEPARTMENT AND YOU

By Bill Rutz, Service Manager

GETTING ACQUAINTED

It may be worthwhile for you--the professional microphone user--and for us in the E-V Service Department to get acquainted. When microphone troubles do occur, you naturally want fast and economical repair service. It is not only our job, but our pleasure, to give you the best possible service at the lowest cost. Your help will, in turn, help us to improve this service.

Among our people who are most concerned with microphone repair, is a continuous accumulated experience in repairing microphones of many years. We have testing facilities for service alone representing an investment of more than \$50,000. We have the pride in our product and in our record of service that assures you of great interest and effort in giving you the maintenance to which you are entitled as an E-V customer.

OUR REPAIR PROCEDURE

When a microphone arrives for repair, we must--to assure fast service--follow a well-organized sequence of procedures. This sequence is pretty much as follows:

1. Check package--get necessary paperwork established, check for customer instructions, description of trouble, etc.

2. Careful inspection of unit. If it is in warranty, a rebuilt unit is immediately shipped. This unit will carry the unused portion of your 2-year warranty.
3. If customer has indicated that extra rush is desired, a replacement unit is immediately shipped from our rotating stock and the returned microphone repaired later. His billing on the replacement is the exact amount that would have been charged for repair of his microphone. Incidentally, these replacement units from rotating stock will, in all ways, meet specifications for new microphones.
4. If a customer's microphone is to be repaired and returned to him the following steps are taken:
 - a. Microphone is disassembled and defective parts are replaced.
 - b. Unless customer has specified otherwise, microphone will be refinished if case is marred. Actually, a new case is installed for the small refinish charge.
 - c. Any design modifications, in effect since this unit was built, are incorporated. Unit is then re-assembled.
 - d. Unit is thoroughly tested in our anechoic chamber--and must meet all requirements for a new microphone.
 - e. When unit has passed final inspection, it is packaged for shipment--and billing is rendered for only actual parts and labor.
 - f. Unless the customer specifies otherwise, a microphone is usually refinished automatically. Many users have found that the small charge is well justified by the fact that their employees are inclined to treat with extra care a microphone that looks new.

As you can see, our procedure requires great care and precision. Because of this and for several other pertinent reasons, we do not sell replacement parts of the critical portions of the microphone for installation in the field.

These reasons are as follows:

1. It is impossible to adjust and verify the performance of the unit after repair without our extensive test facilities.
2. Our repairs always include any design modifications. The customer cannot normally effect these changes.
3. A reconditioned microphone from our Repair Department will match in performance and appearance a brand-new microphone from your dealer's shelf. A microphone repaired in the field usually will not meet this test.

SOME TYPICAL TROUBLES AND THEIR CAUSES

Basically, microphone trouble can be separated into two groups--those which arise from component defects--and those which arise from normal usage and from accidents.

Among those troubles from normal usage, perhaps some examples of the more frequent--but very typical--situations would be of interest. Most common is what we call a rub. This occurs when, for a variety of reasons, the alignment of the voice coil and diaphragm is disturbed, causing the voice coil to rub against the pole piece. When this happens, distortion will be heard at some frequencies, and a very noticeable dip or peak in the frequency response of the microphone will occur. It may sound "tinny" or too "bassy". Most common cause of this condition is that of foreign material--dust, iron filings, etc.--accumulated on the diaphragm, destroying the alignment of the diaphragm voice coil assembly. E-V microphones are provided with magnetic screens and filters in front of the diaphragm to prevent this--but, over a long period of time, enough microscopic magnetic material always present in the air will penetrate any filter so that performance will be degraded. (The only certain remedy--in the long run--is periodic service in our Repair Department). Other frequent failures occur from physical abuse to the microphone itself, such as damage from dropping on hard surfaces and damage to the connector from improper handling. E-V dynamic microphones will take fantastic abuse--yet anything that causes actual distortion of the case near the transducer element will almost certainly change the performance of the instrument, since the magnetic structure and the diaphragm will be displaced.

OUR WARRANTY

Reports from the field indicate that many people are aware of our generous warranty policy on professional microphones but do not believe that we really mean it. For this reason we want to emphasize the guarantee and its full meaning to you. For two full years from the date of purchase, all E-V professional microphones are fully guaranteed against any kind of malfunction regardless of the nature of the malfunction or whose fault it is. We mean it. No matter what happens to your microphone in that two-year period, we will repair it free of charge. The only exception to this is the microphone finish--since we cannot guarantee that paint will not scratch. As you will notice in the table of charges at the end of this article, however, the most you would ever pay for refinish is \$15.00 on the 642--others are much less. Incidentally, within that two-year period, there is no limit to the number of times we will repair the microphone--it will cost you nothing for maintenance for two years, except for transportation.

After the two years, our regular warranty applies. Your microphone is guaranteed against defects in material or workmanship for life. Where a question may exist as to whether or not the unit is in warranty the customer always gets the benefit of the doubt.

HOW YOU CAN HELP SPEED SERVICE AND REDUCE COSTS

It is never necessary to have prior authorization to return an E-V microphone for repair. Just package the microphone securely and ship it direct to Electro-Voice, Attention: Repair Department. You may return it through your dealer if you wish, but this is not required. Some customers return microphones through Lou Burroughs or Paul Franklin. While these gentlemen are always happy to be of service, they may be out of town when your microphone comes in and some delay may result. It is better to send it to my attention and direct a separate note to them if you wish their follow-up.

Certain specific information enclosed with your microphone will help us greatly in giving you speedy service.

1. We need detailed information on the trouble you are having, including all you can tell us about how and where the microphone was being used when trouble was first noted. This will tell us a lot about where to look for the trouble and in turn will speed the service.
2. Give us specific authority to repair the microphone, unless you definitely need to have an exact estimate first. A list of typical charges are included at the end of this article-- you are charged on the basis of cost of materials and labor--and our charges will always fall within the indicated limits. We are happy to render estimates, but they do involve time. If it is necessary to establish a maximum cost for the service, we suggest you send a repair P.O. which says "Not to exceed_____". This way, we can usually proceed with the repair without delay. In any event, you are charged only for actual parts and material required.

The following table of typical charges should be of considerable help to you in determining your list of repairs.

Professional Microphones		Repair Charges	
Model	Maximum Repair Charges		Refinish Charge
642	47.00		15.00
666 and 666R	38.00		8.75
666 Previous style- convert to present 666	45.00		
666 convert to 666R	10.00		
666R convert to 666	10.00		
665	23.00		7.50
655C	24.00		7.50
655 convert to 655C	30.00		
654	17.50		7.50
654A	17.50		8.50
635	17.50		8.00
649B	19.75		6.50
649A	17.75		6.50
643	Time plus material (estimate)		
646	22.75		7.00
652 - 652A	23.75		12.00

Service in Canada will include above charges plus Canadian exchange, Canadian import duty, taxes, and special handling. For details contact E. V. of Canada, Ltd., 359 Enford Road, Richmond Hill, Ontario, Canada.

Where conversion is indicated, this means microphone will meet all requirements for appearance and performance that must be met by new microphones.