U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

PUBLIC ADDRESS SET

1. OBJECTIVE

The objective of this materiel test procedure (~~MTP~~) is to present a series of engineering tests which may be used to determine the technical performance, engineering adequacy and characteristics of public address sets.

2. BACKGROUND

Public address sets provide amplified speech communications for an increasing number of military applications including such diverse fields of endeavor as psychological warfare and helicopter rescue operations. In general, public address sets are employed in military operations to disseminate audio information to large groups of individuals dispersed over a wide area or to overcome high ambient noise conditions.

Engineering tests of prototype public address sets are required to determine the extent to which the equipment meets the technical performance and safety characteristics as prescribed in the Qualitative Materiel Requirement (QMR), Small Development Requirement (SDR), Technical Requirement (TR) or other applicable document and provide data for use in further development and for determination of the suitability of the item for service test.

3. REQUIRED EQUIPMENT

a. Anechoic room or equivalent free-field area
b. Micrometeorological instrumentation
c. Sound level meter (s)
d. Distortion analyzer
e. Oscilloscope
f. Signal generator
g. Frequency meter
h. Qualified listeners
i. Chart Recorder
j. Voltmeter
k. Amplifier

4. REFERENCES

A. TM 11-2586, Public Address Sets, etc., 1955
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F. Neely, K. K., et all A Study of the Speech Transmission Characteristics of Loudspeaker Equipment, Department of National Defense, Canada, 1957
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H. Black, J. W., et Al, Applications of Multiple-Choice Speech Intelligibility Tests in the Evaluation and Use of Voice Communication Equipment, Ohio State University, 1953
I. Egan, J. P., Articulation Testing Methods, Larynyoscope, 1948
J. Egan, J. P., Articulation Testing Methods II, OSRD Report 3802, Psycho-Acoustic Laboratory, Harvard University, 1953
K. MTP 6-2-015, Amplifiers, General

5. SCOPE

5.1 SUMMARY

The major tests and test objectives which constitute this material test procedure are as follows:

a. Microphone Characteristics - The objective of this test is to determine the dynamic range, distortion, bandwidth, and directivity characteristics of the test item's input transducer.

b. Amplifier Characteristics - The objective of this test is to determine the characteristics and performance of the test item's amplifier as promulgated by MTP 6-2-015, Amplifier, General.

c. Loudspeaker Characteristics - The objective of this test is to determine the dynamic range, distortion, bandwidth, and directivity characteristics of the test item's output transducer.

d. Speech Transmission Characteristics - The objective of this test is to obtain a measure of the test item's ability to intelligibly transmit verbal information.

5.2 LIMITATIONS

It is beyond the scope of this materiel test procedure to consider the following factors as variable test parameters or to investigate their statistical properties or interrelationships.

a. Broadcast area geometry
b. Micrometerological conditions
c. Electroacoustic considerations
d. Psychoacoustic considerations

The system test prescribed herein recognizes only a static set of descriptors for these factors with the underlying rationale that factor values are chosen to represent a typical set of conditions in which the test item is designed to be employed.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Select equipment having an accuracy of at least 10 times greater than that of the function to be measured.
b. Record the following information:

1) Nomenclature, serial number(s), and manufacturer's name of the test item(s).
2) Nomenclature, serial number, accuracy tolerances, calibration requirements, and last date calibrated of the test equipment and test items selected for the tests.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item under test such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC).
d. Review all instructional and specifications material issued with the test item by the manufacturer, contractor, or government, as well as reports of previous tests conducted on the same types of equipment, and familiarize all test personnel with the contents of such documents. These documents shall be kept readily available for reference.
e. Prepare record forms for systematic entry of data, chronology of test, and analysis in final evaluation.
f. Assure that qualified safety personnel examines the test item and ascertains that the item qualifies as being safe for further testing (MTP 6-2-507)
g. Consult all pertinent paragraphs, tables and figure references, prior to commencing a test, to prevent risk of equipment damage or test failure through lack of instructions or understanding.

6.1.2 Scheduling Considerations

Acquisition of items which bear consideration in scheduling engineering testing of public address sets shall include but not be limited to the following:

a. Qualified listeners
b. Tactical vehicles as required
c. Anechoic room or equivalent free-field area
d. Test area typical of test item concept of employment

6.1.3 Free Field Considerations

The following procedures shall apply when obtaining free field measurement conditions outdoors.

a. Locate the microphone and loudspeaker at a sufficient distance from reflecting surfaces so that the level of the direct sound striking the microphone is at least 20 decibles above the reflected sound.

b. The microphone and loudspeakers shall be positioned on top of or suspended between suitable masts or towers.

c. Emplace a velocity microphone to discriminate against the reflected sound if there is only one reflecting surface (i.e. the earth).

d. Orient the velocity microphone so that the plane of the ribbon coincides with the direction of the reflected sound. An operational definition of free-field test conditions is where the sound intensity level is reduced 6 decibels for each doubling of the distance from the sound source.

6.1.4 Impedence Matching Considerations

a. Insure that source and load impedence matching is maintained throughout the test (Figure 1)

b. All voltages, current, or power measurements shall be made with respect to the required impedence and shall exclude any bias voltage components present and necessary for the operation of the test item.

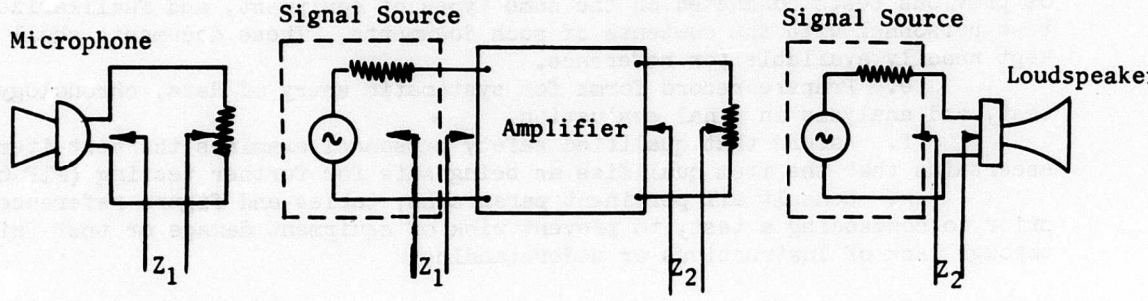

Figure 1. Impedance Matching Requirements

6.2. TEST CONDUCT

6.2.1 Microphone Characteristics

6.2.1.1 Amplitude Response Characteristics

a. Position the microphone and loudspeaker within the confines of the test area or chamber so that a useable audio link is established as shown in Figure 2.

b. Assure that the requirements for free-field test conditions (as expressed in the glossary and paragraph 6.1.3) are met.

c. Adjust the signal generator for a 1000 Hz (or other frequency as dictated by test item specifications or test criteria) undistorted tone of convenient amplitude and orient the transducers for maximum response.

d. Note and record any deviation between the orientation for maximum response and the boresight axis.

e. Decrease the signal generator amplitude such that the impingent sound level is below the system noise level and measure the microphone output.

NOTE: The amplitude response of a microphone may be defined as the ratio of its electric output to its acoustic input at a given frequency. The acoustic input, assumed in this instance* is an undistorted, steady state, free-field sound pressure wave at the microphone location. The corresponding electric output is ideally an exact replica of the sound wave with a certain scaling factor, and is measured at the microphone output terminals with the microphone terminated in its required impedance.

f. Substitute the calibrated sound level meter transducer in place of the microphone and measure the sound level.

g. Increase the signal generator output until the impingent sound level is increased by 3 decibels.

h. Replace the test microphone in its original position and measure the microphone output level and signal-plus-noise to noise ratio.

i. Repeat d and e above until an increase in sound level does not result in an appreciable increase in the corresponding output voltage level or until the specified maximum impingent sound level is reached.

j. The test item scaling factor (electric output per acoustic input) shall also be determined under the specific conditions listed in the test item specifications or test criteria.

6.2.1.2 Frequency Response Characteristics

One of the more important limitations of a microphone's abilities is that the electric output does not faithfully follow the acoustic input if the instantaneous sound pressure varies at a very rapid rate. How well a microphone responds to such sound waves is generally indicated by its response versus frequency characteristic. This characteristic shows the relative response of the microphone for a sine-wave pressure variation as the frequency of the sine wave is changed.

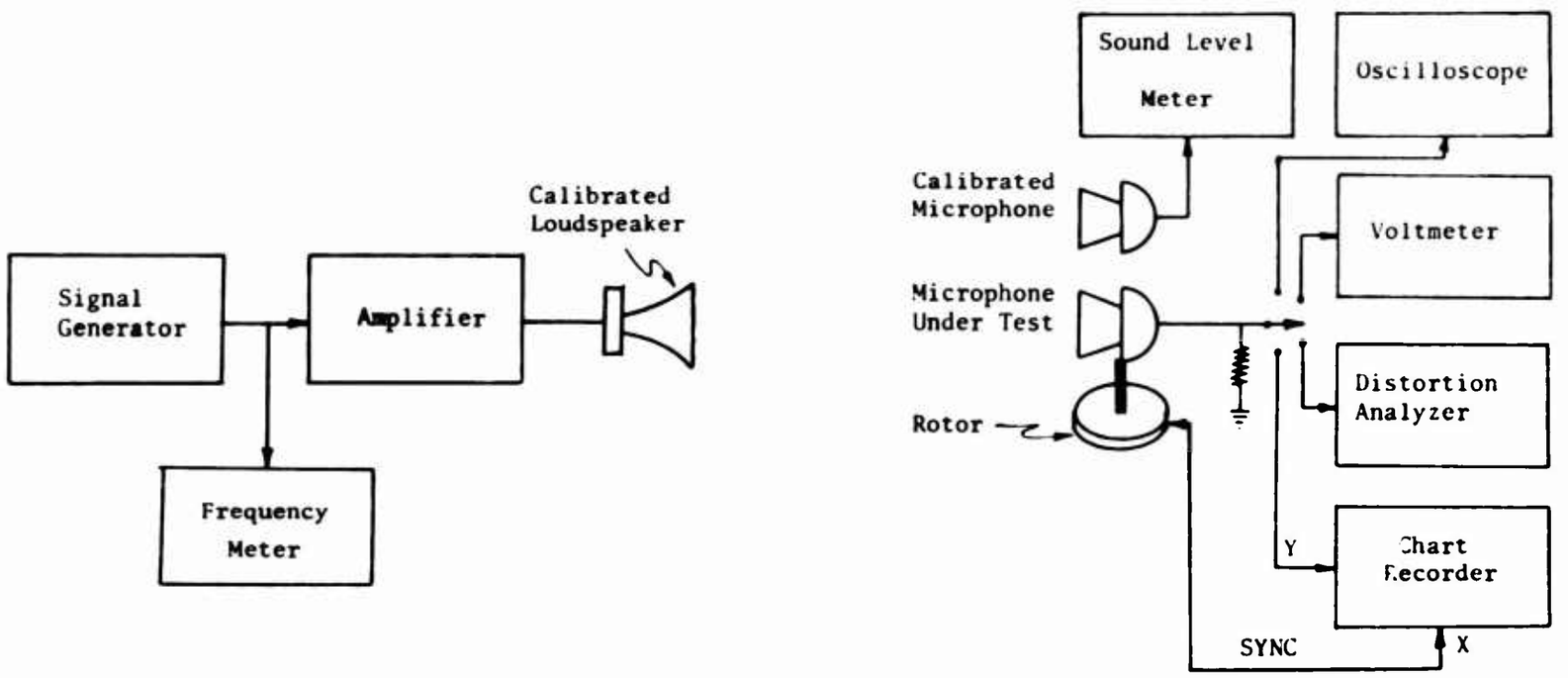

Figure 2. Microphone Characteristics Test Block Diagram

a. Position and orient the transducers as described in paragraph 6.2.1.1.

b. Adjust the signal generator frequency to the point of maximum response and minimum distortion and record the frequency.

c. Adjust the signal generator output such that the impingent sound level duplicates that achieved in 6.2.1.1 g. Record this level and the resultant output voltage and signal-plus-noise to noise ratio.

d. Increase the impingent sound level to a point three decibels above that achieved in c., and maintaining this sound level, increase the frequency until the original microphone output signal-plus-noise to noise ratio is re-established. Record the sound level and frequency.

e. Decrease the frequency to the point below the reference frequency where the microphone output level again reaches the original conditions and record the desired data as in d above.

f. Repeat the above procedure for increments in sound level of 6, 12, and 20 decibels and in 20 decibel steps thereafter until the maximum specified impingent sound level is reached.

g. Adjust the signal generator in steps of 300 cps each throughout the range of 200 cps to 3000 cps and plot a curve of the frequency response.

6.2.1.3 Directivity

The response of a microphone will also vary with the angle of incidence of an impingent sound wave and the resulting directivity pattern is generally symmetrical about an axis perpendicular to the microphone diaphragm. It is essential that the directivity measurement be accomplished under free-field conditions to avoid diffuse sound fields and random-incidence waves.

a. Position and orient the transducers as described in paragraph 6.2.1.1a.

b. Set the signal generator to 1000 Hz and adjust the sound intensity level until the point of maximum undistorted output voltage is achieved.

c. With the microphone rotor synchronized with the chart recorder drive, rotate the microphone through one revolution and obtain a continuous chart recording of microphone output voltage versus angular position.

d. This test shall be performed with the microphone rotated in both the horizontal and vertical planes.

6.2.2 Amplifier Characteristics Test

The amplifier characteristics test shall be conducted in accordance with MTP 6-2-015, Amplifiers, General.

6.2.3 Loudspeaker Characteristics Test

6.2.3.1 Amplitude Response Characteristics

The amplitude response of a loudspeaker is analogous to the amplitude response of a microphone and may be defined as the ratio of acoustic output to electric input at a given frequency. The electric input, assumed in this instance is an undistorted 1000 Hz sine wave. The resultant acoustic output is a 1000 Hz sound pressure wave plus distortion components as measured in a free-field configuration.

a. The test instrumentation for the amplitude characteristics measurement shall be assembled as shown in Figure 3.

b. Position the loudspeaker/microphone within the confines of the test area or chamber such that a useable audio link is established and the requirements for free-field test conditions are met.

c. Adjust the signal generator for a 1000 Hz tone of convenient amplitude and orient the transducers for maximum response.

d. Decrease the signal generator amplitude level such that the loudspeaker output is below the ambient noise level.

e. Measure and record the sound level and signal distortion.

f. Increase the signal generator output by 3 decibels and record the corresponding changes in sound level and degree of signal distortion.

g. Repeat the above process until an increase in drive voltage does not result in an appreciable increase in sound level; or until the maximum specified drive voltage has been reached.

6.2.3.2 Frequency Response Characteristics

The loudspeaker frequency response characteristics shall be determined in a manner similar to that indicated by paragraph 6.2.1.2. The test instrumentation interconnections for this measurement are given in Figure 3 and the general test procedure is given as follows:

a. Position and orient the transducers as in 6.2.3.1.a.

b. Adjust the signal generator frequency and amplitude until a point of minimum undistorted sound level is indicated.

c. Measure and record the following

1) Frequency
2) Sound level
3) Distortion
4) Drive voltage

NOTE: The sound level and associated degree of distortion shall constitute the reference point.

d. Increase the input drive voltage by three decibels, and maintaining this voltage, increase the frequency until the sound level is re-established at the reference value. Record the frequency and input voltage.

e. Decrease the frequency to the point below the reference frequency where the sound level and degree of distortion again returns to the reference value and record the desired data.

f. Repeat the above procedure for a sufficient number of increments in drive voltage to be able to plot a smooth curve of drive voltage versus frequency.

6.2.3.3 Directivity

The loudspeaker directivity test shall be accomplished with the test instrumentation as described in Figure 3, and with the general test procedure as follows:

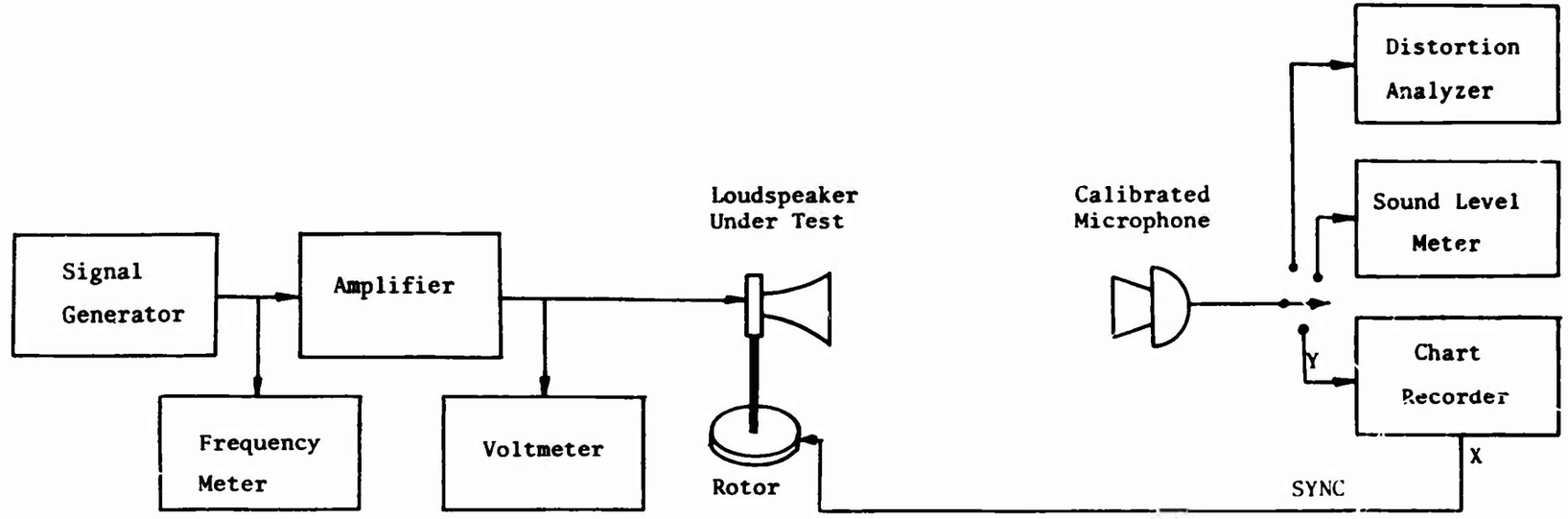

Figure 3. Loudspeaker Characteristics Test Block Diagram

a. Position and orient the transducers as indicated in paragraph 6.2.3.1.a.

b. Set the signal generator to 1000 Hz and adjust the drive voltage until a maximum undistorted sound pressure wave is indicated.

c. With the loudspeaker rotor synchronized to the chart recorder drive, rotate the loudspeaker through one revolution and obtain a continuous chart recording of sound level versus angular position both horizontal and vertical planes.

6.2.4 Speech Transmission Characteristics Test

The speech transmission characteristics of a public address system shall be measured in terms of articulation score (discrimination for speech) which is, in essence, a measure of the listener's response to test stimuli produced through the public address system. The test shall be performed with the test item mounted in the vehicle, cantonment, or structure of intended employment and the listeners deployed in such a manner as to represent a typical audience or sample thereof. Examples of typical test configurations are shown in Figures 4 and 5.

NOTE: The exact number and location of listener posts required will depend largely upon the test item concept of employment and cannot be precisely prescribed other than to establish the following guidelines.

a. Outer perimeter (maximum distance) listener posts shall be sufficiently separated from the test item to establish the location of the 60% articulation score (AS) contour line with respect to the test item. Articulation scores of 60% or less indicate difficult to impossible transmission of information. Special vocabularies and procedures are required for any possibility of information transfer beyond this point. Hence, the probability of information transfer approaches 0.00 beyond this contour line.

b. Inner perimeter (minimum distance) listener posts shall be established sufficiently close to the test item so as to determine the location of the 96% AS contour line within the area of intended coverage. Articulation scores of 96% or greater will provide satisfactory to excellent transmission of information given that normal language is used. Hence, the probability of correct information transfer approaches 1.0 for articulation scores greater than 96%.

c. A sufficient number of intermediate distance listener posts shall be established to investigate the difficult-to-satisfactory information transfer area. The probability of correct information transfer may be assumed to be linearly related to AS between the 60% and 96% contour lines.

d. Alternately, the maximum area of intended coverage may be subdivided into equal area increments and a listener post established at the center of each increment. The articulation score for each listener post shall be inscribed on an area map and the AS contours drawn in by conventional mapping techniques.

e. Listeners shall be subjected to a sweep-check hearing examination to ensure adherence to listener standards promulgated in references D, F, H,

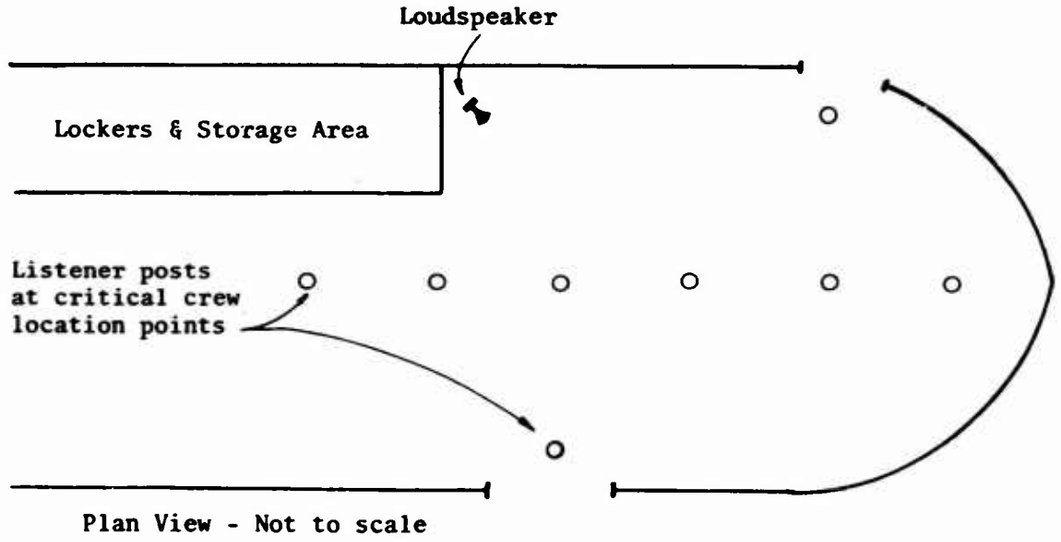

Figure 4. Loudspeaker & Listener Positions for Aircraft Internally Mounted Public Address System Showing Aft Section of Hypothetical Aircraft.

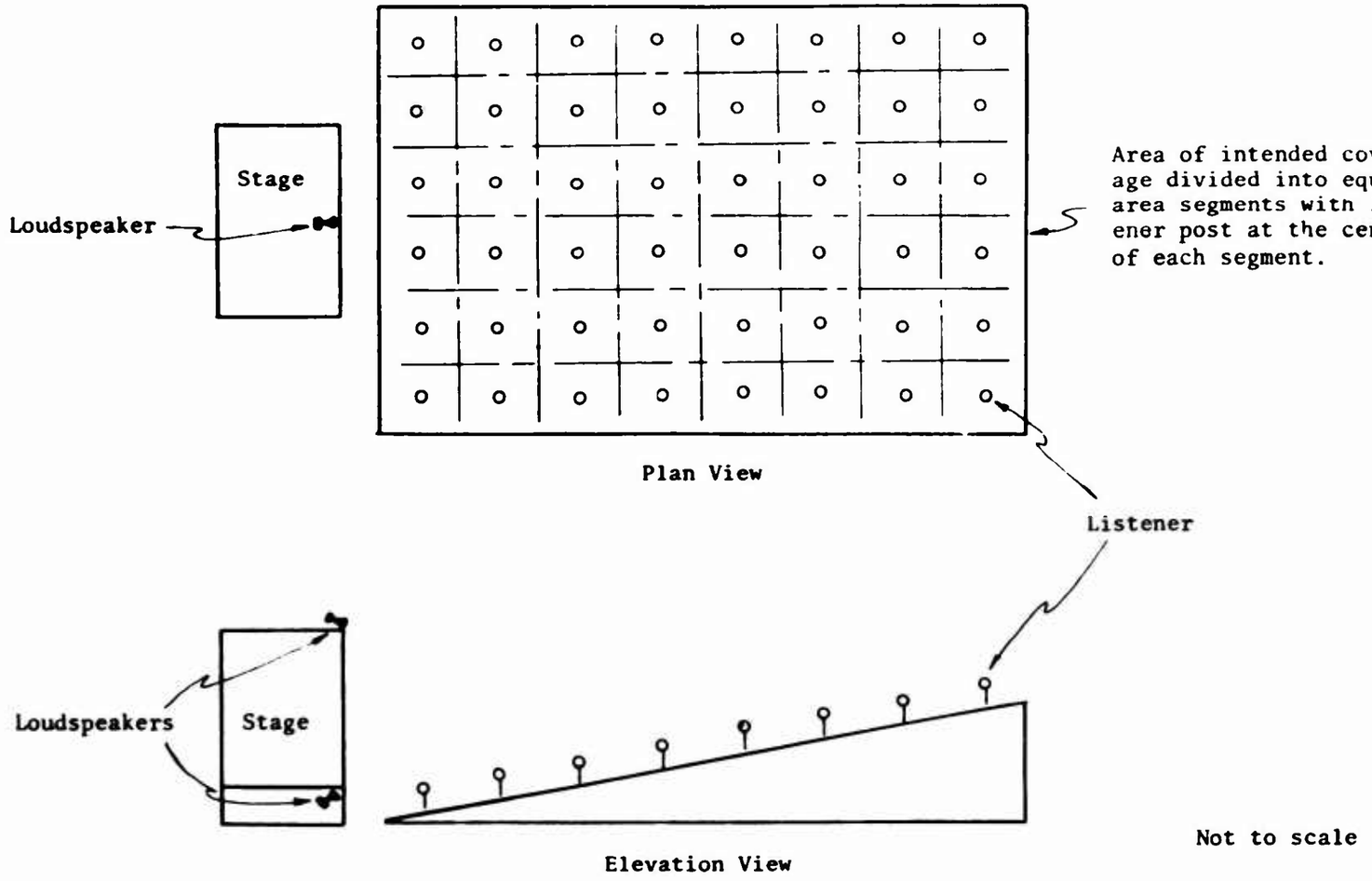

Figure 5. Loudspeaker and Listener Configuration for a Public Address System in an Outdoor Theater

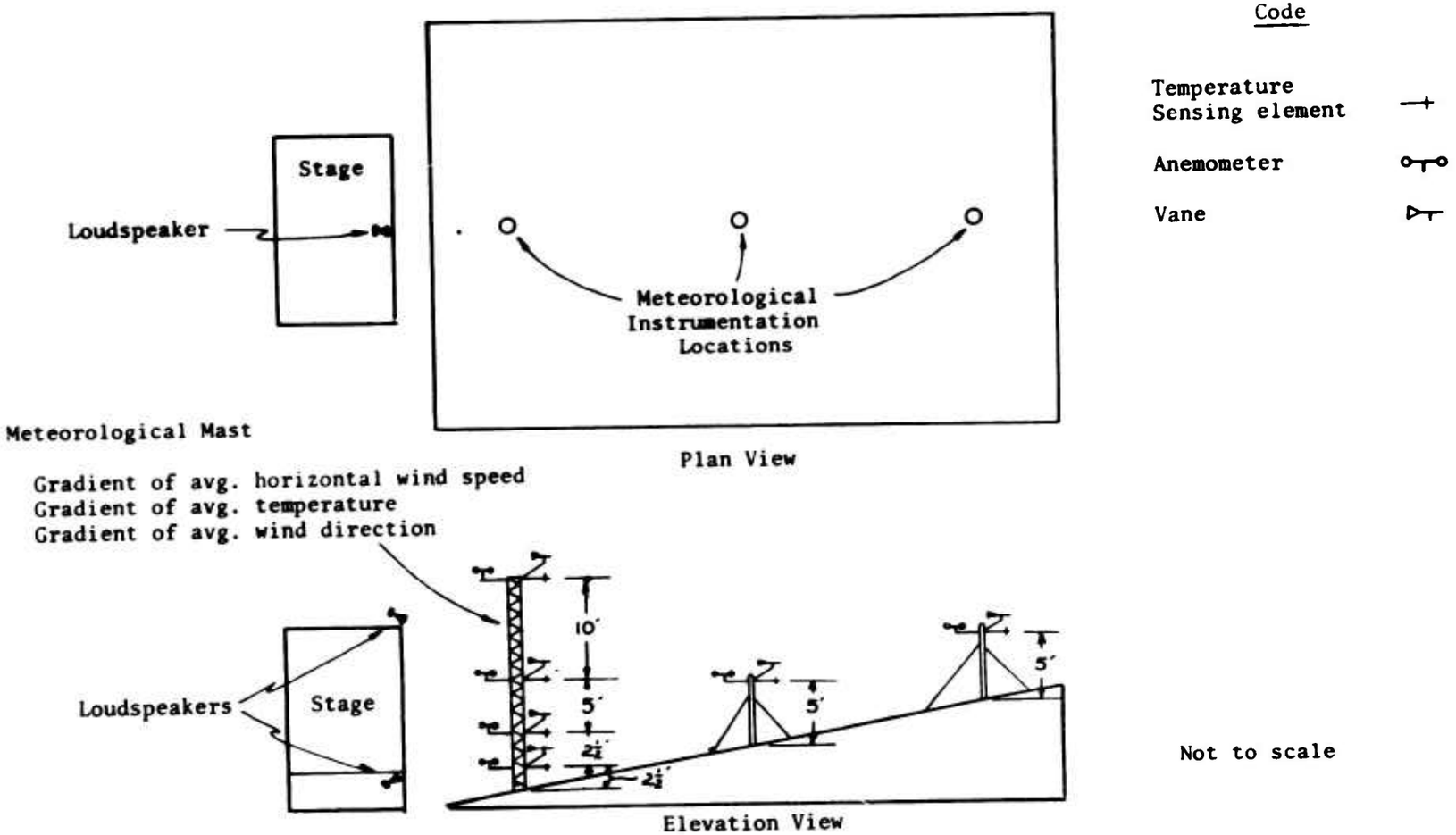

Figure 6. Typical Meteorological Instrumentation Configuration for a Public Address System in an Outdoor Theater

I and J, and given in minimum of one hour of practice in responding to a multiple choice intelligibility test stimuli in noise.

f. Test stimuli shall consist of a phonetically balanced (PB) word list. See Appendix A. A phonetically balanced word list is a list of words in which speech sounds (phonemes) appear with their normal converstaional frequency.

g. The test area noise level shall either by simulation achieved by the injection of a shaped-white noise spectrum into the public address amplifier, or by actual inclusion of noise sources in the test area, correspond to the anticipated or known noise environment in which the test item will be employed.

h. The following quantities relating to the gross state of the atmosphere in order to predict the atmospheric propagation of sound shall be determined and recorded.

1) Average vertical temperature differences
2) Average vertical differences in horizontal wind speed
3) Average horizontal wind speed and wind direction from 5 to 10 feet above the ground
4) Relative humidity at that height
5) Air Temperature at that height
6) Barometric pressure at that height
7) Fluctuations is wind directions and wind speed at that height

i. Micrometeorological instruments shall be placed so as to adequately determine the presence of any vertical or horizontal gradients of the above mentioned parameters.

j. Vertical gradients shall be made at one location (preferably near the loudspeaker) with the sensors spaced logarithmically. A simplified diagram of a typical micrometeorological instrumentation setup is shown in Figure 6.

k. The required instrumentation shall be held to a minimum by testing only on those days where static or minimal gradient conditions are known to exist.

l. Deploy the trained listeners in accordance with the established guidelines and test item concept of employment.

m. Set up the micrometeorological instrumentation in accordance with established guidelines, considering meterological conditions, etc.

n. Broadcast the phonetically balanced word list (and noise spectrum as necessary) allowing sufficient time between words for the listeners to indicate what he heard and to ready himself to listed to the next item.

NOTE: Should the test item concept of employment dictate communication between an airborne announcer and ground troops (or other similar tactical situation) a test scenario delineating occupied airspace or aircraft holding pattern with respect to listener deployment shall be prepared and a dynamic test conducted accordingly.

6.3 TEST DATA

6.3.1 General

Data to be recorded prior to testing shall include but not be limited to:

a. Nomenclature and serial number of test item
b. Nomenclature, serial number, calibration date, and stated accuracy or tolerance of test instrumentation.

Data to be recorded in addition to specific instructions listed for each individual subtest shall include an engineering log book containing in chronological order pertinent remarks and observations which would aid in a subsequent analysis of the test data.

6.3.2 Microphone Characteristics Test Data

6.3.2.1 Amplitude Response Characteristics

Amplitude response characteristics test data to be recorded for analysis shall consist of:

a. Deviation (azimuth and elevation angles) between the orientation for maximum response and the transducer boresight axis.
b. Impingent sound level values versus corresponding microphone output voltage and distortion.

6.3.2.2 Frequency Response Characteristics

Frequency response characteristics test data to be recorded for analysis shall consist of:

a. Reference point values of impingent sound level and frequency, and distortion.
b. Sound frequency and level at the 6, 12, and 20 decibel points relative to the reference point.

6.3.2.3 Directivity

Directivity test data to be recorded for analysis shall consist of:

a. Impingent sound level
b. Microphone output voltage versus angular position (both horizontal and vertical).

6.3.3 Amplifier Characteristics Test Data

Amplifier characteristics test data shall be recorded in accordance with MTP 6-2-015, Amplifiers, General.

6.3.4 Loudspeaker Characteristics Test Data

6.3.4.1 Amplitude Respons Characteristics

Amplitude response characteristics test data to be recorded for analysis shall consist of:

a. Deviation (azimuth and elevation angle) between the orientation for maximum response and the transducer boresight axis.

b. Drive voltage values versus corresponding sound level and distortion readings.

6.3.4.2 Frequency Response Characteristics

Frequency response characteristics test data to be recorded for analysis shall consist of:

a. Reference point values of drive voltage, frequency, and sound level.

b. Sound frequency and drive voltage at the 6, 12, and 20 decibel points relative to the reference point.

6.3.4.3 Directivity

Directivity test data to be preserved for analysis shall consist of:

a. Microphone drive voltage
b. Sound level versus angular position (azimuth and elevation)

6.3.5 Speech Transmission Characteristics

Speech transmission characteristics test data to be preserved for analysis shall consist of:

a. Meteorological data including:

1) Average vertical temperature
2) Average vertical differences in horizontal wind speed
3) Average horizontal wind speed and wind direction from 5 to 10 feet above ground.
4) Relative humidity from 5 to 10 feet above ground
5) Air temperature from 5 to 10 feet above ground
6) Barometric pressure from 5 to 10 feet above ground
7) Fluctuations in wind direction and/or wind speed from 5 to 10 feet above ground

b. Scaled plan view of test area showing:

1) Listener location and articulation score
2) Loudspeaker location or carrier vehicle path during test
3) Location and description of physical objects in the test area which would influence sound propagation
4) Location of micrometeorological instrumentation.

c. Scaled elevation view of test area as above.

6.4 DATA REDUCTION AND PRESENTATION

6.4. General

All test data shall be properly marked for identification and

correlation and grouped according to subtest title. Test criteria or test item specifications shall be noted on the test data presentation to facilitate analysis and comparison.

Test data measurement units shall be converted as necessary to be compatible with units given by test criteria or specifications. Electrical units are commonly given in millivolts or decibels re 1 millivolt across the requisite impedance and acoustic units are commonly given in terms of sound pressure at the microphone converted to a reference of 1 microbar (74 db re 0.0002 microbar) or 10 microbars (94 db).

Specific instruction for the reduction and presentation of individual subtest data are outlined in the succeeding paragraphs.

6.4.2 Microphone Characteristics Test

6.4.2.1 Amplitude Response Characteristics

The amplitude response characteristics test data shall be reduced to tabular and graphical presentations as indicated.

a. Tabular data shall be presented under the following general headings:

Impingent Sound Level (db)	Voltage Output (volts)	Distortion (per cent)

b. Graphical presentations of the above data shall be constructed displaying values of output voltage and per cent distortion as functions of impingent sound level.

6.4.2.2 Frequency Response Characteristics

The frequency response characteristics test data shall be presented as both tabular and graphical displays of impingent sound level values versus sound frequency.

6.4.2.3. Directivity

The directivity test data presentation shall consist of the chart recording of microphone output voltage versus microphone angular positions.

6.4.3 Amplifier Characteristics Test

The amplifier characteristics test data shall be reduced and presented in accordance with MTP 6-2-015, Amplifiers, General.

6.4.4 Loudspeaker Characteristics Test

6.4.4.1 Amplitude Response Characteristics

The amplitude response characteristics test data shall be reduced

to tabular and graphical presentations as indicated.

a. Tabular data shall be presented under the following general headings:

Drive Voltage Volts	Sound Level (db)	Distortion (per cent)

b. Graphical presentations of the above data shall be constructed displaying values of sound level and distortion as functions of drive voltage.

6.4.4.2 Frequency Response Characteristics

The frequency response characteristics test data shall be presented as both tabular and graphical displays of drive voltage versus frequency.

6.4.4.3 Directivity

The directivity test data presentation shall consist of the chart recording of sound level versus loudspeaker angular position.

6.4.5 Speech Transmission Characteristics Test

6.4.5.1 The speech transmission characteristics test data presentation shall consist of those data described in paragraph 6.3.4 as suitably arranged for correlation and analysis. The test area plan view shall indicate listener location and articulation score and where applicable, the location of the 96% and 60% AS contour lines as constructed by conventional mapping techniques.

Micrometeorological data shall also be inscribed on the plan and elevation views of the test area and the effects of any adverse conditions on the test results noted.

A narrative description of the test shall accompany the test data and shall include but not be limited to:

a. Test scenerio (where applicable)
b. Ambient noise conditions
c. Pertinent remarks or observations concerning those parameters given in paragraph 5.2 which influenced test results.

APPENDIX A

ARTICULATION TESTING

As indicated in paragraph 6.2.4, the objective of the speech transmission characteristics test is to obtain articulation scores in the field as a function of distance from the loudspeaker and other parameters. This type of experiment is essential to interrelate the properties of the public address system (including the transmission properties of the atmosphere) with intelligibility of received speech.

Various organizations and individuals have evolved a methododology for determining the "intelligibility" of a voice communication system which has come to be known as articulation testing. Intelligibility in this context is operationally defined as being the number of words correctly identified by a qualified listener from a list of 50 words (normalized to a base of 100) whose phonetic characteristics are representative of the distribution of phonemes in the English language. This is also known as an articulation score (AS).

A representative phonetically balanced (PB) word list commonly employed in articulation testing is given of the following page. One word per block of six words is selected for transmission on a random basis and the listener indicates on a corresponding sheet the word which most closely resembles that which he thought he heard. In transmitting the word list the talker speaks into the test item microphone connected directly to a VU meter which he watches in attempting to keep his voice level constant. When spoken, each of the PB words is normally contained in a carrier sentence, such as, "You will circle the word . . . . . ".

References D, I, and J may be consulted for additional PB word lists and a more exhaustive treatise on the principles of articulation testing.

REPRESENATIVE PHONETICALLY BALANCED (PB) WORD LIST

lick pick tick wick sick kick	sad sass sag sat sap sack	sung sup sun sud sum sub	cave cane came cape cake case
seat meat beat heat neat feat	sip sing sick sin sill sit	red wed shed bed led fed	game tame name fame same came
pus pup pun puff puck pub	sold told hold cold gold fold	hot got not tot lot pot	oil foil toil boil soil coil
look hook cook book took shook	buck but bun bus buff bug	dud dub dun dug dung duck	fin fit fig fizz fill fib
tip lip rip dip sip hip	lake lace lame lane lay late	pip pit pick pig pill pin	cut cub cuff cuss cud cup
rate rave raze race ray rake	gun run nun fun sun bun	seem seethe seep seen seed seek	feel eel reel heel peel keel
bang rang sang gang hang fang	rust dust just must bust gust	day say way may gay pay	dark lark bark park mark hark
hill till bill fill kill will	pan path pad pass pat pack	rest best test nest vest west	heap heat heave hear heath heal
mat man mad mass math map	dim dig dill did din dip	pane pay pave pale pace page	men then hen ten pen den
tale pale male bale gale sale	wit fit kit bit sit hit	bat bad back bath ban bass	raw paw law saw thaw jaw
sake sale save same safe sane	din tin pin sin win fin	cop top mop pop shop hop	bead beat bean beach beam beak
peat peak peace peas peal peach	teal teach team tease teak tear	fig pig rig dig wig big	
king kit kill kin kid kick	tent bent went sent rent dent	tap tack tang tab tan tam	

GLOSSARY

Acoustic, Acoustical: The qualifying adjectives acoustic and acoustical mean containing, producing, arising from, actuated by, related to, or associated with sound. Acoustic is used when the term being qualified designates something that has the properties, dimensions, or physical characteristics associated with sound waves; acoustical is used when the term being qualified does not designate explicitly something which has such properties, dimensions, or physical characteristics.

Acoustics: Acoustics is the science of sound, including (a) its production transmission, and effects, or (b) the qualities that determine the value of a room or other enclosed space with respect to distinct hearing.

Articulation (Per Cent Articulation) and Intelligibility (Per Cent Intelligibility): Per cent articulation or per cent intelligibility of a communication system is the percentage of speech units spoken by a talker or talkers that is understood correctly by a listener or listeners. The word "articulation" is customarily used when the contextual relations among the units of the special material are thought to play an unimportant role; the word "intelligibility" is customarily used when the context is thought to play an important role in determining the listener's perception. The kind of speech material used is identified by an appropriate adjective in phrases such as "syllable articulation", "individual sound articulation", vowel (or consonant) articulation", "word articulation", "discrete word intelligibility", "discrete sentence intelligibility".

Articulation Score: The articulation score of an ear is the percentage of items in an appropriate form of test, usually monosyllabic words, that is correctly repeated, written down, or checked by the listener. This form of test is usually administered at an acoustic level well above the threshold for speech. The normal value of discrimination (or articulation score) for each test must be determined empirically.

Free Field: A free sound field is a field in a homogeneous, isotropic medium free from boundaries. In practice it is a field in which the effects of the boundaries are negligible over the region of interest. The actual pressure impinging on an object (e.g. a microphone) placed in an otherwise free sound field will differ from the pressure which would exist at the point with the object removed, unless the acoustic impedance of the object matches the acoustic impedance of the medium.

Free-Field (Anechoic Room): A free-field room is a room in which essentially free-field conditions exist.

Sound Intensity (Sound Energy Flux Density): The sound intensity in a specified direction at a point is the average rate of sound energy transmitted in the specified direction through a unit area normal to this direction at the point considered.

Sound Level: Sound level, in decibels, is the weighted sound pressure level obtained by use of a sound-level meter whose weighting characteristics are specified in the latest revision of the American Standards Association stand-

ard on sound-level meters. The reference pressure is 0.0002 microbar, unless otherwise specified.

Sound Power of a Source: The sound power of a source is the total sound energy radiated by the source per unit of time.

Sound Power Level: The sound power level of a sound source, in decibels, is 10 times the logarithm to the base 10 of the ratio of the sound power radiated by the source to a reference power. The reference power is normally 1 picowatt (1 $\mu\mu$watt). To indicate the 1-picowatt-reference power, the letter p is affixed to the abbreviation for decibel, that is, dbp.

Sound Pressure Level: The sound pressure level, in decibels, of a sound is 20 times the logarithm to the base 10 of the ratio of the pressure of this sound to the reference pressure. The reference pressure employed throughout this test is 0.0002 microbar. In many sound fields the sound-pressure ratios are not proportional to the square root of corresponding power ratios and hence cannot be expressed in decibels in the strict sense; however, it is common practice to extend the use of the decibel to these cases.