

Recommended Practices on Audio and Electroacoustics: Loudspeaker Measurements, 1961

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1. SCOPE

These Recommended Practices define terms associated with loudspeakers and their testing, recommend various methods of testing, and indicate preferred methods of presenting information regarding their characteristics. Specific information is presented in Sections 2–7. Discussions of a more qualitative nature are given in Sections 8 and 9.

In these Practices, the tests recommended involve physical, steady-state measurements only. Work has been and is now being done on transient measurements of loudspeaker performance, but experience with these methods is still not sufficiently widespread to warrant their inclusion.

While the physical data which can be obtained as detailed in Sections 4–9, inclusive, are a helpful guide in designing and in selecting a loudspeaker for a certain purpose, they are not a complete guarantee that the subjective performance will be satisfactory. Wherever it is possible, the quality of reproduction should be checked by means of listening tests such as those described in the literature.¹

2. INTRODUCTION

2.1 Definition

A loudspeaker is an electroacoustic transducer intended to radiate acoustic power into the air.

2.2 Types

There are two general types of loudspeakers, namely, direct-radiator and horn. The direct-radiator type of loudspeaker is arranged so that it radiates acoustic power into the air directly from one or both sides of its acoustic radiating element, or diaphragm. One side of the diaphragm may be totally isolated by means of an airtight enclosure, or, effectively, by a baffle of adequate size. In order to control the response over part of the useful frequency range, the energy radiated from the back surface of the diaphragm may be acoustically coupled to the energy radiated from the front.

The horn type of loudspeaker radiates the major portion of its acoustic power through a horn. This is a tube whose shape and cross section are chosen by design so as to increase the radiation resistance loading on the diaphragm of the loudspeaker for a substantial portion of the useful frequency range, and increase its radiated output and electroacoustic conversion-efficiency over that obtainable when it radiates directly.

Both direct-radiator and horn loudspeakers have been designed for a wide variety of applications which influence their range, directional characteristics, permissible distortion, and power handling capacity. Also, either type may be designed to operate as a single or multiunit device. One loudspeaker may be used to

cover the desired frequency range. Alternatively, two or more loudspeakers, usually interconnected by means of frequency-selective electric networks, may be operated together so that each covers a portion of the desired frequency range, while the combination of loudspeakers covers the entire range.

3. MEASUREMENT CONDITIONS

3.1 Loudspeaker Mounting

The direct-radiator loudspeaker unit should be mounted in or on the enclosure or baffle called for by the manufacturer, or it should be mounted in or on a baffle or enclosure which is completely described. The horn loudspeaker unit should be equipped with a horn specified by the manufacturer, or with a horn which is completely described.

3.2 Electrical Connections

The loudspeaker should be connected as specified by the manufacturer, with the proper networks and controls, if any, and these networks and controls should be adjusted as recommended. If not specified, the connections and adjustments used must be completely described.

If the loudspeaker is of the excited-field type, the field should be energized with the rated current.

3.3 Acoustic Environment

The acoustic environment should simulate free-field conditions to the extent that the inverse-pressure vs distance law should hold within plus or minus 1 db at all frequencies at which measurements are made.² Ambient noise should not affect the measurements to an extent greater than plus or minus 1 db. Departures from these conditions should be measured and described.

3.4 Test Signals

Fixed frequency, swept frequency and warbled sinusoidal signals, as well as bands of noise, may be used for loudspeaker testing as dictated by the test and the type of instrumentation being utilized. Sweep and warble rates should be sufficiently slow that response-frequency measurement results do not differ significantly from the steady-state readings. When bands of noise or warble signals are used their characteristics should be specified.

Each performance parameter of a loudspeaker must be expressed as a function of frequency if it is to be expressed completely. However, for many purposes it is desirable to condense the information to a single number which represents a weighted average over a prescribed portion of the spectrum. Such an average may be obtained by means of a signal which sweeps re-

¹ H. F. Olson, "Subjective loudspeaker testing," IRE TRANS. ON AUDIO, vol. AU-1, pp. 7–9; September–October, 1953.

² H. F. Olson, "Acoustical Engineering," D. Van Nostrand Co., Inc., New York, N. Y., 3rd ed., ch. 10, pp. 445–450; 1957.