HOW WE DO IT AND WHY

Over its 30+ year history, Community has repeatedly gone to great lengths to test products in the most revealing and relevant way possible. Community also has a history of constructing large, bizarre-looking pieces of apparatus to accomplish these tests. Not wanting to break with a tradition that has consistently produced really usable information, we have taken a similar path in the design of the test system used to gather the data for our specifications.

Roughly two decades ago, we produced a catalog that contained some fairly extensive test data on our products and on products of some of our competitors. The catalog was well received, and the facts it contained proved to be quite useful to the professional audio community.

In some ways our new data is a repeat of what we did back then. The changes that are evident, both in the products themselves and in the methods and depth of the documentation, are a graphic example of how Community and the professional audio industry have progressed since the mid-1970s.

The test system used to gather the data for that first catalog also bore some similarities to our present test system. Although those measurements were made with pink noise and a third octave real time analyzer photographed with a 35 mm camera, the tests were, as today, conducted outdoors with the speaker located far from any reflective surfaces.

When we devised the new test system, our guiding principles once again were 'free field" and 'far field". The reasons for these choices are simple and practical; they are inherent in the nature of the products being tested and in the applications for which those products are designed. In this case, the products are sound reinforcement speaker systems, and their purpose is to project sound over a distance.

Therefore, far more dependable and relevant data can be obtained by testing the speakers at measurement distances that correspond to the actual listening distances. In our experience, testing in the near field and then trying to extrapolate back out to realistic distances generally produces data with serious flaws when such data is superimposed on actual use conditions, especially with multi-way systems.

Further, testing in the far field has significant benefits in terms of accuracy of data, particularly angular data. Several well known papers have dealt with the matter of the apparent apex of loudspeakers, the point around which the speaker must be rotated to obtain correct coverage information.

Even in a single device, such as a pattern control high frequency horn, apparent apex is not a simple matter, since it can change considerably with horn orientation (horizontal apex can be different from vertical apex). When the test speaker is a multi-way system incorporating several acoustical elements the question of apex becomes absurdly complicated. Not only is the apex of each element changing with frequency and orientation, but each element is clearly at a different location in the system and is operating in a different frequency range.

The effect of the coincidence or lack there-of of the rotational axis of the test and the apparent apex of the speaker being tested is very significant in the near field, but becomes far less significant as the measuring distance increases.

Fortunately, if the distance from the microphone to the speaker is sufficiently large, the effect of any offset between the apparent apex and the rotational axis of the test becomes relatively insignificant, and this complex problem is reduced to a point where it can reasonably be entirely ignored.

This was a major reason for our decision to test in the far field. We could obtain accurate pictures of the dispersion patterns even of fairly large systems, and we would also have the added benefit of being able to rotate them around their centers of gravity. This second benefit made it possible to design and construct a relatively simple and rugged rotator mechanism that could handle not only individual speaker systems but also arrays of speaker systems.

The advantages of far field measurements for accurate dispersion information are fairly easy to see. The advantages for sensitivity and response data are not quite so obvious, but are equally valid. Speaker sensitivity is usually quoted as a 1 watt / 1 meter SPL. The function of this rating for sound reinforcement purposes is to use it as a basis to calculate output at other distances and other power levels. However, if you think about it at all, the output of a speaker at 1 meter does not mean much unless the speaker will actually be listened to at that distance.

Therefore, if you measure speaker sensitivity by applying 1 watt and read the SPL at 1 meter, even though it is an accepted, direct, and technically correct method, it will almost surely lead to substantially erroneous results when the data is used in far field calculations.

We have found that a more useful and realistic sensitivity figure is obtained by making a far field measurement and then calculating back to a 1 watt / 1 meter SPL. We also do this test at a substantial percentage of the loudspeaker's maximum rated input. This not only eliminates errors due to outdoor signal-to-noise problems, but the duration of the test and power level is more realistic in terms of actual use. Because of these things, when the 1 watt / 1 meter SPL calculation is reversed to predict performance in the far field, a correct result is obtained.

The frequency response of a loudspeaker is clearly different in the near field and in the far field. Systems such as studio monitors and domestic hi-fi speakers that are intended for near field applications should certainly have their response measured in the near field. Sound reinforcement speakers should not, and to do so will uniformly give an unrealistic and misleading picture of their performance. The only truly accurate depiction of a speaker will be obtained by measuring it in a manner that is representative of its actual use. We do use a closer microphone distance for lower frequency data that allows us to use the much higher resolutions needed for accurate measurements. Fortunately, lower frequency energy is far less subject to the near/far field differences that affect high frequency performance.

To test in the far field and test over a wide frequency bandwidth, it is necessary to be at a considerable distance from any reflective surfaces. This is the "free field" aspect of our testing program, and it required either testing in a gigantic (60' cube) anechoic chamber or testing outdoors. We chose the second option, and constructed a test system that consists of an automated rotator mechanism that rolls out on a track that projects from the third floor of our manufacturing plant. Above the track a 13.5 meter (44.3ft) long horizontal mast also projects from the side of the building, and on this mast travels the microphone and its boom. This arrangement positions the speaker at a distance of 5 meters from the nearest reflective surface, and positions the microphone at a distance of over 12 meters from the speaker, thus satisfying both the free field and the far field requirements.

Because of the great quantity of data collection necessary to produce spherical coverage information, we elected to automate the rotator mechanism and control it with our TEF20 analyzer. The rotator consists of a horizontal axis section and a vertical axis section, each section being driven by a gear motor and stopped by an air operated brake. Position sensing is done optically on each section.

The test sequence is as follows: The speaker begins at 0 degrees (pointing directly at the microphone) with its horizontal axis horizontal. A response curve is run, and the speaker then rotates 5 degrees clockwise in the horizontal plane. The second response curve is run, followed by another 5 degree rotation, and so on until the speaker reaches 180 degrees (pointing directly away from the mic). After the 180 degree curve is run the speaker returns to 0 degrees. While on its way back to 0 it rotates 5 degrees clockwise in the vertical plane. It then repeats the 5 degree steps from 0 to 180 with the vertical section in the 5 degree position. On its way back to 0 the vertical section rotates to 10 degrees. This process continues until the vertical section has gone through 90 degrees by 5 degree steps and the horizontal axis of the speaker has become vertical.

The result is that a response curve has been recorded at each 5 degree increment on a quarter of a sphere. Even with automation, the angular dispersion portion of a test sequence takes over two hours to complete, and 703 response curves are recorded in the process.

For loudspeakers that are physically asymmetrical in one axis, such as a typical multi-way system, we rotate the vertical section through 180 degrees resulting in response curves recorded at each 5 degree increment on one-half of a sphere. This doubles the amount of time and number of response curves recorded in the process. However, this is the only way to get an accurate picture of the dispersion pattern of these kinds of loudspeakers as shown in the polar graphs, in the EASE data, and as represented by the Q and beamwidth data.

Literally thousands of hours of effort have gone into the testing that produces the data and specifications for our products. We know that properly applied, these results will be truly useful tools.

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