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**SPEAKER AND AMPLIFIER
CONSIDERATIONS
FOR MOTION PICTURE THEATRES**

**BY
JOHN F. ALLEN**

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SPEAKER AND AMPLIFIER CONSIDERATIONS FOR MOTION PICTURE THEATRES

by
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In recent months, much has been said and written about the presentation quality in motion picture theatres. Next month, the National Association of Theatre Owners opens its 1981 convention in Las Vegas. On hand will be the usual array of stars, executives, reporters and of course you and I. In my point of view, the trade show is where the action is. This year, more than ever, theatre owners will see displayed before them an impressive selection of brands and product's all designed to help make their theatres an enjoyable place to visit and a profitable place to work.

My specialty is sound. I, like many others, will be there demonstrating my products and services. You, like many others, will be there hearing more answers than you may even have questions for. So it seems fitting to offer some sort of check list of items you should inquire about when considering sound gear, specifically speakers and amplifiers.

Many theatre sound systems are no more than a chain made up of very weak links. Many amplifiers used in theatres today are most inadequate. This is especially true in stereo installations. Dolby Laboratories' loan Allen has suggested a guide for determining the amplifier power required in theatre systems. Divide the number of seats by 4 and add 25. This means a 400 seat house would need at least 125 Watts of power per channel. A 1000 seat house, 275 Watts. As these should be considered minimums (Allen recommends the next higher powered unit available) it is obvious that 50-75 Watt amplifiers are not enough.

In reading over the specifications, the first thing you may notice is that solid state (no tubes) amplifiers have different power ratings depending on the impedance of the speaker connected to them. A typical example is an amplifier that delivers 250 Watts into a 4 ohm speaker system, but only 150 Watts into an 8 ohm system. If you know the impedance of your speakers when you shop for amplifiers, you will be better prepared to compare. Obviously if you have a choice between two speaker systems of equal efficiency (able to produce equal levels from one watt of power) but one has a nominal impedance of 4 ohms and the other 8 ohms, you will get more power from your amplifier if you chose the 4 ohm speaker. This translates into an additional dynamic range of around 2 dB, or just about double. By the way, if your speaker's impedance is 16 ohms, beware. Some solid state

amplifiers do not perform well with 16 ohm speakers.

Amplifiers produce distortion just like everything else. Modern units are very clean. Excellent distortion figures of .05% are not uncommon. Basically when you compare amplifiers you want the lowest distortion, the flattest frequency response and, for theatre use, the highest damping factor.

Damping factor refers to the amplifier's ability to control the speaker's moving diaphragm and to keep its inertia from moving it farther than amplifier wants it to. Long speaker wires have greater resistance than shorter ones. This resistance lowers the effective damping factor. Since theatres have long speaker wires, it's best to start with the highest damping factor possible and also use at least a number 10 gauge copper wire or larger for those long runs.

Other features to look for are: Indicators that tell you when the amplifier is overloading as this can damage speakers; Some way, usually a relay, to protect the speakers from the "thumps" caused when the amplifier is turned on or off; Protection circuitry in case the amplifier malfunctions and tries to deliver a DC voltage to the speakers.

Yes, these things mean something. But in truth there is often very little difference in the way good amplifiers sound. It then comes down to reliability. Some power amplifiers have a high rate of failure. What you want are the ones that NEVER fail, well almost never. So be sure to ask about failure rates and repair services.

While good amplifiers tend to sound the same, speakers definitely do not. And price is not necessarily an indication of quality.

When shopping for theatre speakers, check for the following: Is the speaker a horn system? If so, that's a good start. If not, then in my opinion you should not use it in a theatre. What is the speaker's efficiency? This is very very important. The greater the efficiency, the lower the distortion and the lower the power required from the amplifier. Large systems for stereo installations should be able to produce 1098 dB sound pressure level at one meter, with one watt of power. This means an efficiency of about 20 percent. Smaller systems for use in small theatres can have one watt sensitivities of 106 dB (one half the efficiency of the large systems) as they will not have to deliver as much acoustic power. Speaker distortion factors at those levels should not exceed 1 percent if you want the cleanest sound possible. A little distortion does a lot of damage to clarity. You may have to push a salesman to give you speaker distortion specifications. Some manufacturers won't tell you.

A few three-way systems are available for theatre use. These consist of a woofer, midrange and a tweeter. Two-way systems have only a woofer and a midrange which is extended to the high frequencies. Three way systems offer lower distortion of those higher frequencies than is possible with a two way system.

Some manufacturers are offering fully horn loaded woofers instead of the direct radiating type or the bass-reflex type. Again, the horn system will produce less distortion, as much as 90 percent less.

The frequency range of your new speakers should be from 30 to 15000 or even 20000 Hertz (cycles per second). The frequency response should not vary more than ± 5 dB from 35 to 400 Hertz and $\pm 2 \frac{1}{2}$ dB from 400 to 16000 Hertz. Looking at a graph of a speaker's frequency response, one should see a plot that is essentially flat, not a hump or a valley.

35 MM optical stereo can have a range from about 30 to 12000 Hertz. But it is best to purchase speakers capable of more than they will be asked to produce. This is for both reliability and, future sound system advances. After all, you don't want to buy new speakers every time soundtrack technology improves. It is now possible for you to buy the last set of speakers your theatre is likely to require. So it's best to think along these lines.

Other items to consider are the directivity, or radiating angle, of the midrange horns and the degree this varies within the frequency range of roughly 400 to 6000 Hertz, where most of the dialog exists. You'll find that the directivity of the better systems won't vary more than ± 10 degrees. The radiating angle required depends on the size and shape of your theatre as well as its acoustic properties. It is difficult to recommend any angle except to say that anything over 60 to 90 degrees is probably too much for most theatres. If your theatre is extra wide and not too deep, a wider radiating angle may be permissible.

Only one or two manufacturers make speakers tailored for surround use. Here, efficiency is just as important, not only for low distortion, but also because there are so many speakers in a surround array the amplifier may run out of power very quickly if the speakers need a lot of power to produce a little sound. One watt sensitivity ratings of 95 to 98 dB at one meter seem necessary. Two way and three way surround systems with horn loaded treble sections will sound better and will aim the sound at the audience where it belongs instead of all over the room and the ceiling. As NATO's Bud Rifkin has said so often, "don't scrimp."

If you missed last year's NATO convention, you missed the largest trade show ever and we exhibitors missed the opportunity to meet you. This year's gathering promises to be both

fun and informative. If you haven't yet planned to attend, then on behalf of all exhibitors I invite and urge you to come.

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