

Introduction

How often have you wondered whether you should dig deep into those hard-earned savings and lash out on the price of a complete new speaker system or combo-amplifier? And to what purpose? Usually in order to improve on what you have already, to obtain a better sound quality - and lots more of it.

To try to achieve this by spending several hundred pounds on completely new equipment is not only (and obviously) a very expensive way of doing it, but is also fraught with pit-falls. To be certain that system 'A' is better than system 'B', assuming that the latter is the one you already own, you need to be able to make an instantaneous detailed comparison of the two systems, under identical working conditions.

At best this is an arduous undertak-

combination systems and separates under the same heading, the foregoing remarks assume that all amplifiers are being driven into their appropriately proper matched speaker load (or correct speaker impedance). Furthermore, the printed specifications of combination sound systems, whatever the type, never make reference to one of the two most significant, if not vital, factors which determine sound output and loudness - that of speaker efficiency. At all times, but particularly when attempting to assess the relative merits of systems with similar nominal power ratings, the conversion efficiency, or sensitivity, of the speakers in question is of prime importance, but is never incorporated into the written specifications. The fundamentals of this very problem were set out in an excellent leading article written by the

ty of your sound is by upgrading your speaker drive units. The Americans call it 're-speakering'. In the USA, the replacement speaker market has become THE major vehicle for speaker sales, well over 50% of all speakers being sold for the express purpose of improving the performance of existing equipment.

Speaker Efficiency Explained

What is sometimes called the sensitivity, conversion efficiency, or just plain efficiency of a speaker, is determined by a whole host of factors concerning the materials used and the technical design of the driver unit. It is not the purpose of this article to provide an in-depth description of speaker design technology, so it will suffice to say that, although there



Improving Your Sound with Replacement Speakers

ing, and for the average person usually impossible. To try to assess sound quality and comparative loudness from printed technical specifications frequently leads to disappointment, particularly if too much importance is placed on that most misleading of criteria, Nominal Power Rating. Amplifier power ratings are almost always given as a maximum at a point beyond which serious distortion occurs, and there is no indication of the 'flat-out' power available (all control knobs fully clockwise).

In other words one brand of 50W amplifier may truly deliver 50 watts maximum output, whereas another model might capably produce 75 watts. This writer has knowledge of one model in particular which produces 97.5 watts! And yet all these come under a nominal 50 watts output classification.

Since we are here considering both

by J.D. Peyton

Technical Editor of 'Music UK', which was published in issue 13 of that magazine. To quote his very words - "...Haven't you ever found yourself confronted with two ostensibly identically rated combo's and noticed one sounding maybe twice as loud as the other? It happens to us all the time ... accordingly a rating in watts can become relatively meaningless when the actual sound pressure levels of a combo are measured ... one thing we've found is that substituting the original speakers with more up-market types can produce a tremendous difference both to the perceived volume of the combo amp's in question, and also the quality of the sound itself."

By far the most cost effective way of improving both the volume and the quali-

are certain specialised models produced in the design of which efficiency plays second fiddle to other considerations, the vast majority of speakers are intended by their designers to produce as much sound, or loudness, as possible within the cost limitations for a particular example. Some manufacturers are much more successful at achieving this high efficiency level than others; if this were not the case this article would scarcely be necessary!

The unit measure used to quantify the loudness of sound is called the Decibel (usually abbreviated to dB). Standing alone the decibel is meaningless for most practical purposes, however, of great significance is the relationship, or difference, between one decibel measurement and another, since the decibel applied to loudspeaker technology is a relative measurement used for comparing the sound output (or Sound

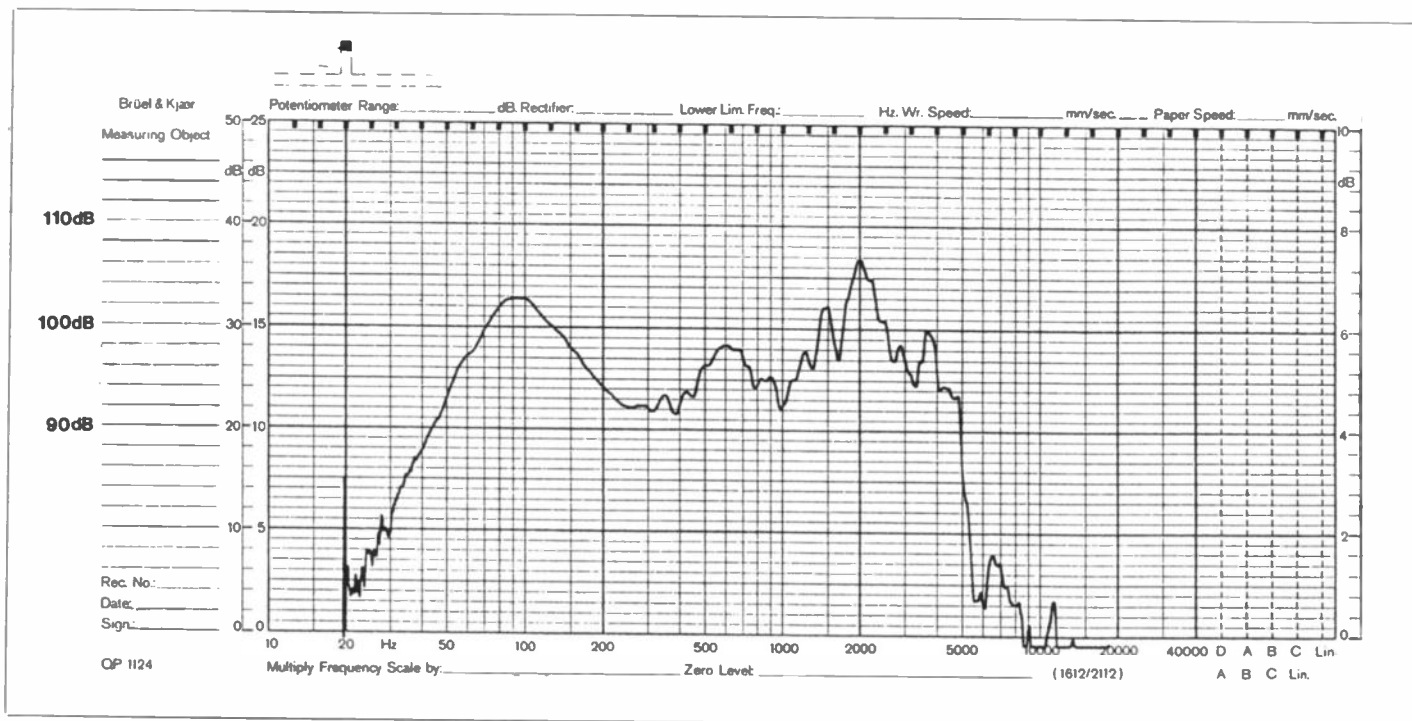


Figure 1. Frequency response curve of a typical 12" disco speaker with suppressed mid-range and emphasised bass and treble. Effective frequency response 50Hz - 5kHz. Average sound pressure level 98dB

Pressure Level - SPL) of one loudspeaker against another, and the crucial point here is that a *difference* of 3dB corresponds to a factor of 2 - times 2 (double) if greater than, or divided by 2 (half) if less, when comparing the sound output of a loudspeaker against a reference. For example, if speaker 'A' produces a sound pressure level of say 95dB, and speaker 'B' produces 98dB, then speaker 'B' is making twice as much sound as speaker 'A'. Similarly, speaker 'C' at 101dB is only half as loud as speaker 'D' which is producing 104dB (Fig.1-3)

Clearly, to enable an accurate comparison to be made between loudspeakers, it is essential that they are all measured and specified under identical

test conditions, and this is almost always the case, certainly in the western world. Standard procedures require the measuring microphone to be positioned along the centre axis of the loudspeaker's cone, at a distance of exactly one metre, while the sound pressure level is measured as the loudspeaker is fed with a constant input of 1 watt, 'swept' over the full audio frequency band.

This produces a response curve, tracing a graph on a continuous paper chart recorder, showing the relative sound output levels at all frequencies. These are then averaged to produce the mean output level or SPL. The graph paper is marked in decibel steps above a zero starting point, making the assess-

ment of a loudspeakers performance both simple and accurate.

A word of warning at this point - there are a few speaker manufacturers, mainly located in the Far East, who take their measurements with the microphone closer to the speaker under test than 1 metre, often at only 1/2 metre distance. This will produce a falsely high SPL figure, if read as a direct comparison to the western standard. Always check with the manufacturer's specification sheets that SPL figures are given as 1 watt - 1 metre, and beware if this is not so, or not stated.

So far, then, we have seen that a dramatic increase in SPL is possible by 're-speakering', or replacing the drive

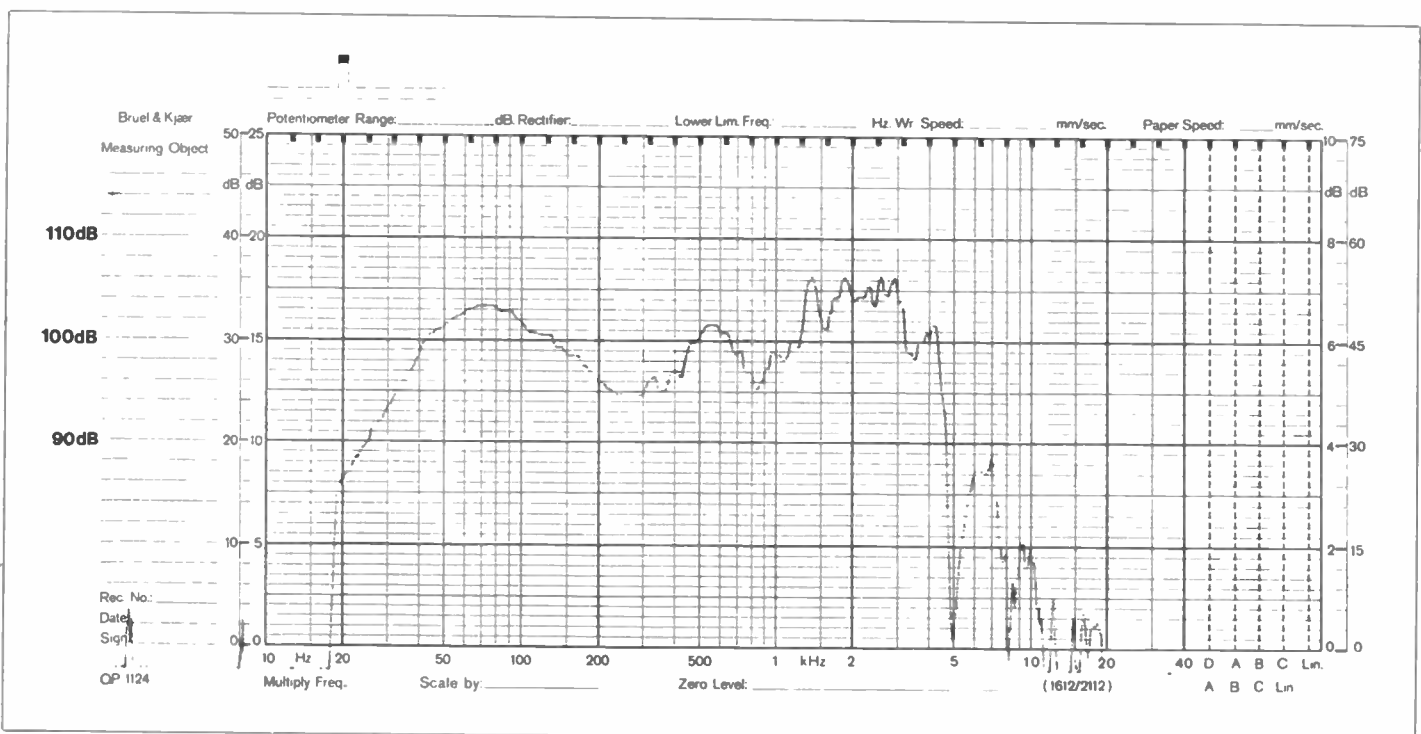


Figure 2. Frequency response curve of higher output 12" disco speaker, showing average sound pressure level of 101dB, thus twice the sound output of speaker in Fig. 1

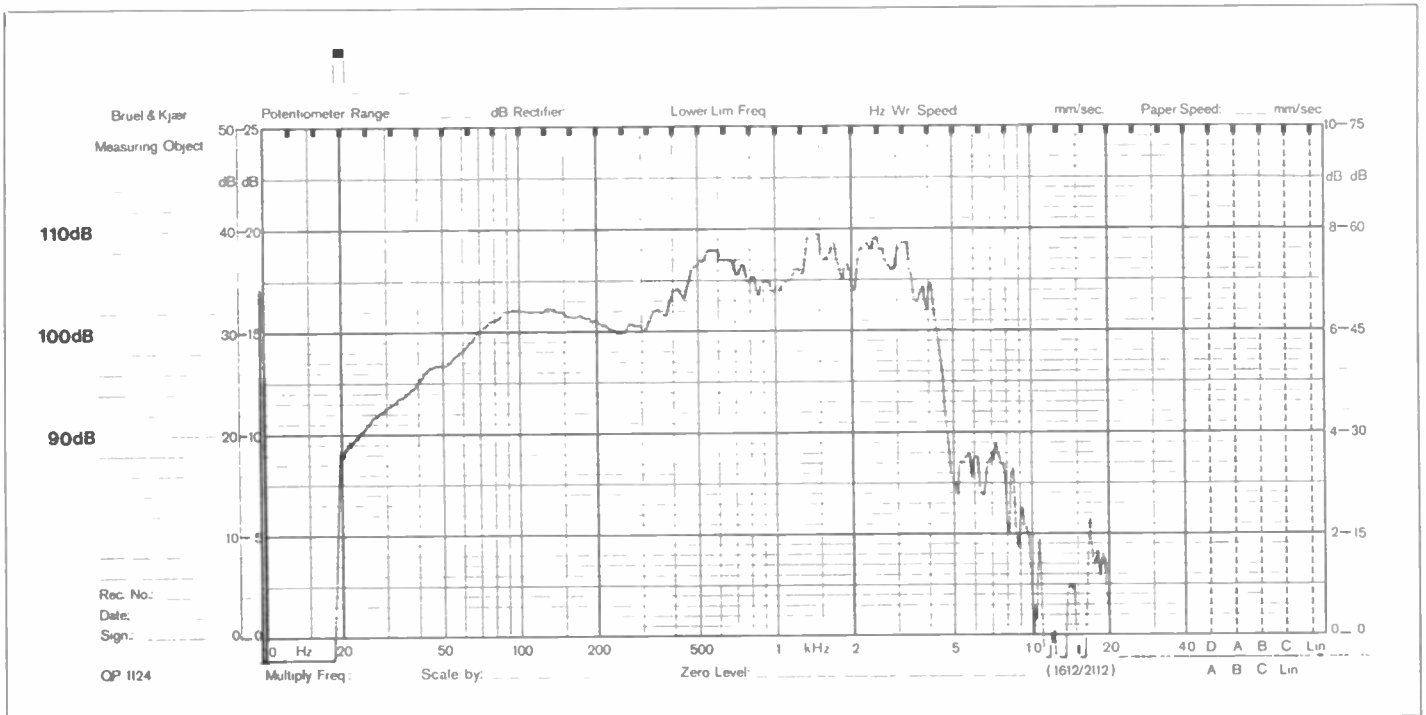


Figure 3. Frequency response curve of extra high output 12" guitar speaker (Fane Studio 12G), showing average sound pressure level of 104 dB, thus twice the sound output of speaker in Fig. 2 and four times the output of speaker in Fig. 1. Note that in the range 500Hz - 3.5kHz, the lead guitar's most effective area, this speaker is putting out an incredible 107 dB, eight times the output of speaker in Fig. 1!

units with higher efficiency ones. But there is another factor to be taken into account, before we discuss the choosing of a suitable replacement speaker - that of how efficient are the existing (original) speakers, and to what extent is it possible for you to determine how many dB's difference you should be looking for, to obtain a suitable improvement.

If you are in the habit of putting your sound equipment together yourself, you will obviously know which make and model of speaker you have originally used, and it is a simple matter to refer to the relevant manufacturer's literature (assuming you remembered to keep it). Alternatively you can make a direct enquiry with the manufacturer to determine the conversion efficiency of the model in question. Suppose it were, say, 95dB, you then know that you should seek a unit giving at least 98dB to obtain a significant increase in sound output.

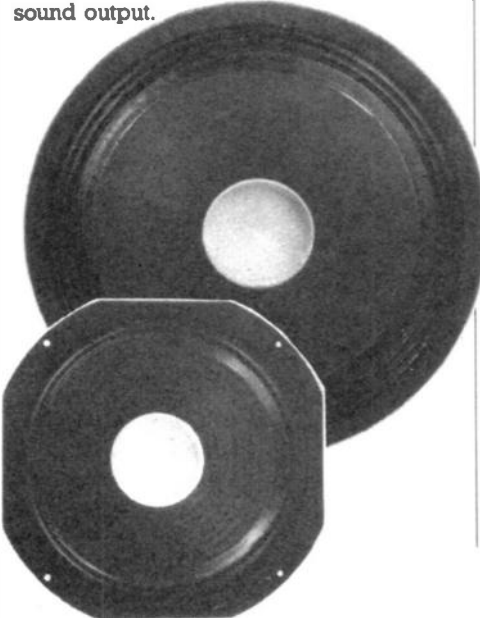
Much more commonly, though, it will be a standard, commercially fitted product which is the subject of 're-speakering', and so determining the efficiency of this originally fitted item is not always so straightforward.

Speakers fitted by equipment manufacturers can be broadly divided into two categories - standard, off-the-shelf models, or specially-customised (or OEM) models. A standard model will have been selected for ease of availability, cheapness, or because, quite by chance, it happens to be the most suitable for the application. Unless it is one of the few very expensive and exotic types, it will almost certainly be a suitable candidate for up-grading.

On the other hand, an OEM model will have been carefully 'tailored' and customised by the manufacturer to match the characteristics of the amplifier it relates to or to provide a specific quality

and level of sound output. Many of these are already high output types and special care is needed when trying to upgrade one of these. Even so, nearly all equipment manufacturers have to balance cost and competitiveness against the ultimate in performance, and so it should be possible in many cases to achieve some degree of improvement by careful 're-speakering'.

OEM speakers usually carry a specification number, but never a model type identifier. Often they are labelled with the equipment name rather than the actual speaker manufacturer, implying that they are rather special and exclusive to that product. Enquiries to determine SPL must of necessity be directed through the equipment manufacturer. If all else fails it is a useful 'yardstick' to assume that a replacement speaker with an efficiency of 100dB is likely to provide some sort of improvement, and that the higher one can achieve over 100dB, then the more dramatic will be the final difference in sound output.



Choosing a Replacement Speaker

So far, we have considered the increase in sound output and quality which can be obtained at relatively modest cost, by following the popular American custom of re-speakering. But there are a number of other factors which must be considered when choosing a replacement speaker. Will it fit where the old one fitted? Is it well made and durable? Is the speaker impedance a correct match to your amplifier? Is it designed to do the job for which you are intending to use it, and does it have a sufficient power rating? Is it covered by a suitable guarantee? Let us consider these remaining important factors one by one.

Fitting

There are two commonly-used methods of fitting speakers: front-mounting or rear-mounting. Front-mounted speakers are often accompanied by a protective steel grille, which is either separate from the speaker or permanently attached to it, as is the case with some models from Fane and McKenzie. In either case, the speaker is normally secured either by means of special front-mounting clamps, or with bolts directly through the speaker fixing holes and into T-nuts secured to the inner surface of the cabinet. If the former is the case, the only fitting consideration is the diameter of the speaker cut-out in the cabinet. This should be measured and checked with speaker manufacturers literature in respect of baffle hole requirements since there can be a variation in this requirement between different models.

With the latter fixing method, and also in the case of rear-mounting speakers, the location of the fixing holes in the speaker chassis is of crucial importance.

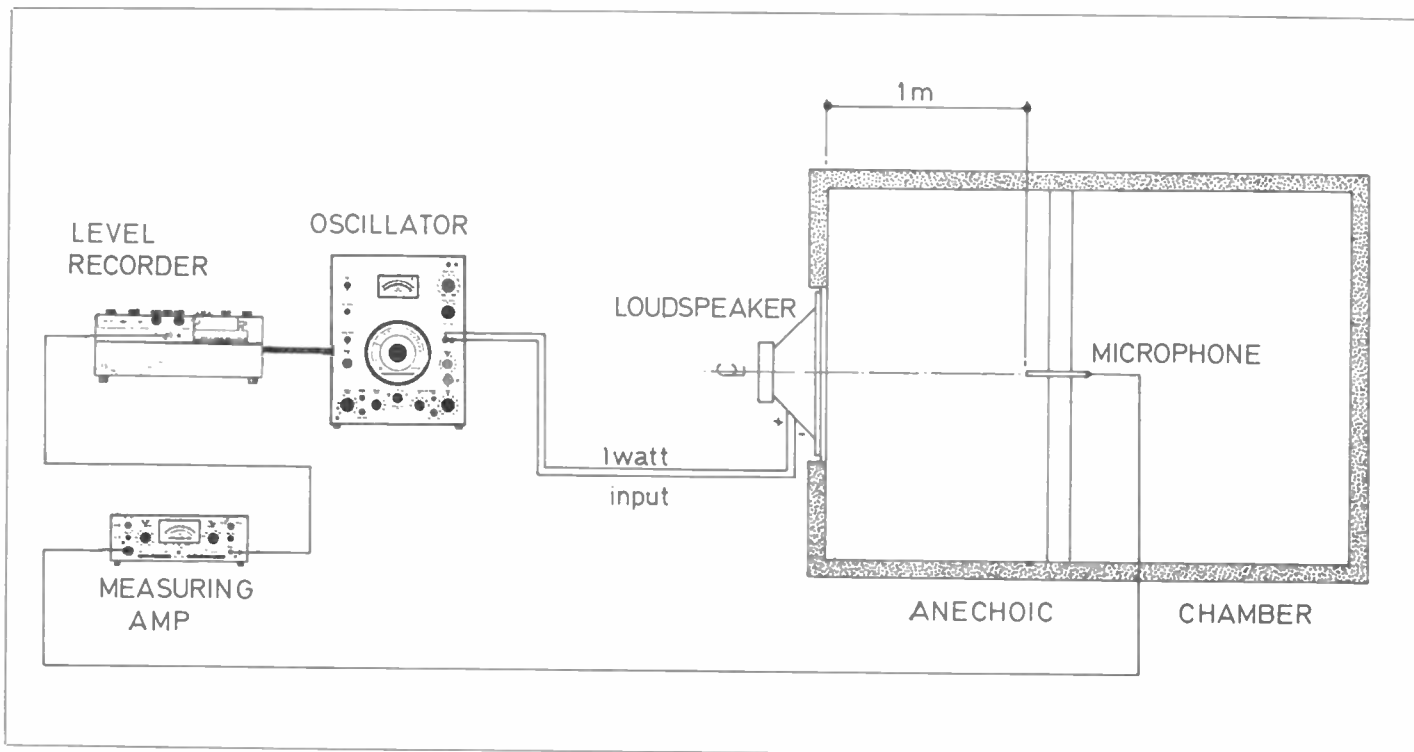


Figure 4. Diagrammatic layout for frequency response and sound pressure level measurement

The majority of speaker manufacturers incorporate the same common fixing dimensions, so that one will readily replace another, but certain models, including in particular, some of the more expensive American speakers, have their fixing holes situated on a different diameter (PCD). As far as we are aware, only one maker - Fane, with their 12" and 15" diecast chassis - caters for both sets of dimensions by including alternative sets of fixing holes in the same chassis. (The new range from Maplin also makes this provision).

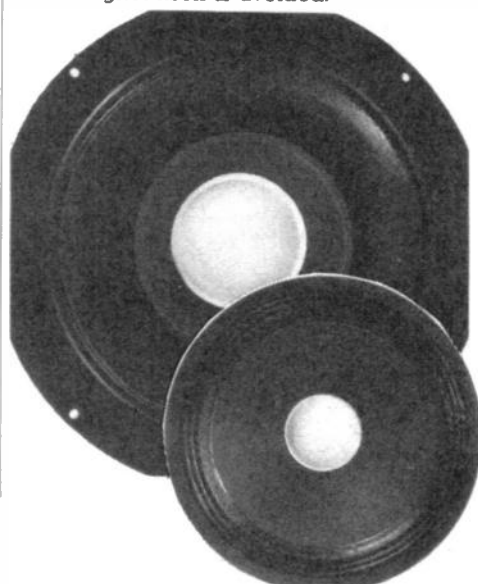
Under-size baffle holes are not too much of a problem, since they can be enlarged with a wood rasp, but if the fixing holes or bolts are incorrectly sited for your new speaker, they will have to be re-located using a hacksaw and a new set of fixing bolts.

Will it be Durable?

One way to get a general idea of durability is to look around and see which makes of speaker are fitted by leading equipment producers like Vox, Haney, Custom Sound etc. Such manufacturers do not repeatedly use speakers which have not proved totally reliable, since to do so could damage their reputations. But because, as mentioned earlier, some of those producers 'own-label' their speakers, it is not always easy to find out who is manufacturing them, and close examination of prospective replacement speakers is always advisable. First, consider the chassis. Diecast types are normally considered to be the best, and are employed for most up-market models, but there is nothing whatsoever wrong with pressed steel chassis providing that they are suitably designed and finished. In particular, study the finish, which should include a coating of protective stove-enamel paint over the plated

surface. Who has not seen those piles of defective rusting, unpainted speakers behind the local repair shop? Plated steel looks fine and bright when it is new, but the atmosphere can play havoc with it after even quite a short time. How long do those unpainted steel areas of a car body last, for example? Not a perfect parallel, perhaps, but a speaker has to be able to withstand a very wide variation in temperature and humidity, and a layer of tough stove-enamel certainly goes a long way in extending its lifespan.

Another external point to note is magnet protection. Ceramic magnet material is really quite fragile and can chip or crack if subjected to knocks. For this reason, some speaker manufacturers fit a protective cap over the magnet, or some form of ring or moulding around the vulnerable magnet edges. This is evidence of care and attention to detail during the design stage which will probably reflect upon the internal design structure as well, but the absence of such magnet protection will not affect speaker performance providing that damage to the magnet itself is avoided.



Internally, a good high-temperature voice-coil is an essential, to cope with modern amplifiers and extended high power usage. High temperature coils are commonly based upon a tube or former of aluminium, which is a durable material but has certain restrictions in respect of performance. Certain types of plastic former have also been used with varying results. Undoubtedly, one of the best materials for high power coils is glass-fibre, which has all the advantages but only one drawback - cost. A glass-fibre coil requires special high-precision techniques for its manufacture and is therefore both time-consuming and relatively expensive to produce. Thus, few speaker makers use it, although in practical terms they know of no better material. At the other extreme, it is best to disregard any speaker fitted with a paper-laced coil. These can suffer from all sorts of problems and usually have a very short working life.

Under this heading of durability, it is also pertinent to deal with the subject of guarantees. If a speaker fails during its guarantee period for some reason other than misuse, the chances are that it will be due to some fault in materials or construction, and that the speaker manufacturer will ultimately have to foot the bill for replacement or repair. If a product has a track record of unreliability or of a short working life, the manufacturer will naturally escape as much liability as possible by offering the shortest warranty he can get away with. Conversely, if a product has proved to be durable and reliable, its manufacturer can afford to offer a longer guarantee. The most common guarantee period is 2 years, although one manufacturer at least offers 5 years, and one English manufacturer provides an incredible lifetime guarantee, which by definition is unbeatable!

Doubling your sound output is no use if that super output is only going to last 5 minutes! It has to stand up under all playing conditions, and to last – hopefully – a lifetime.

Impedance Matching

The new speaker must be a correct impedance match to whatever amplifier it will be used with; it must have the correct number of OHMS! 8 ohms and 16 ohms are the most common, but be sure to get it right. If you fit a 16 ohm speaker where the amplifier needs 8 ohms, the sound output will be reduced. Conversely, using an 8 ohm speaker where a 16 ohm one is required can cause amplifier damage. All speakers should be marked with impedance, but if your old one should carry no marking, any electrical specialist should be able to measure it for you, using a special meter.

Is it Designed for the Job?

Some speakers are designated 'General Purpose', which means that they are designed to withstand any kind of normal usage and to give decent results under all conditions, whereas others are designed to do a specific job to the exclusion of all others, and to do it really well. (See figs 2 and 3 for example). There are outstanding models in both categories, depending upon whether you need the speaker for, say, a lead guitar combo or for general music reproduction together with periodic vocals or guitar playing. There is a huge variety of choice in both categories, but when deciding to look for top performing replacement speakers, the field can be considerably reduced before you start by deciding whether you need a specialist or a general purpose model.

Conclusion

Having read this far, you will now be in possession of the basic criteria required for increasing the output level and quality of your sound at minimum cost, by **respeaking**; and you will know how to go about selecting a suitable replacement speaker without risk of disappointing results and wasted money. Space precludes mention of every available brand of speaker, but here are a few pointers to set you in the right direction. If you have money to burn and price is no object, you can consider the highly reputable offerings from JBL, Gauss or Electronica, all from the USA. Most of these feature cast chassis, magnet protection and a high general level of finish. Many use aluminium based coil formers. Sound output levels are usually on the right side of 99dB, but no higher than many British-made speakers. Be extra careful about fitting dimensions, and remember that a surprisingly high proportion of the cost of these speakers is represented by import duty and shipping costs from the USA, plus the importers profits. Spare parts



costs are usually horrendous. Good speakers certainly, but at two or three times the price of a British equivalent, which largely defeats the object of **respeaking** as opposed to buying a whole new equipment. Coming nearer home and considerably down in price the Celestion Company, which is well-reputed in the Hi Fi field, produces general purpose speakers, some early models of which (the ones with metal magnets and covers) were used to good effect by rock guitarists of the early 60's. The modern range includes some useful guitar speakers, but Celestion no longer provide any magnet protection and their steel chassis are not stove-enamelled. Fane Acoustics have a massive range, including both diecast and steel framed models, and feature both magnet protection and stove-enamelling. Sound pressure levels are mostly upwards of 100dB, including one 12" model producing an incredible 105dB! They have both general purpose models, and specialised up-market models produced by their professional division. Goodmans speakers are rather harder to find than they used to be, perhaps because that company has been concentrating heavily in the areas of Hi Fi and radio and TV speakers in recent times. Of the younger companies, ATC produce heavy-duty models, mainly featuring cast

chassis, whose performance characteristics, lean heavily towards the PA and studio field. In particular, their special bass speakers, though not unduly loud, are well worth exploring for stage systems. HH Acoustics has recently been through troubled times and a change of ownership. Their professional models were good value for money, but be assured of the future of spare parts and servicing if you come across them. McKenzie speakers have featured unduly in the disco field and some are of useful sensitivity; but this company has been known to use paper-based voice-coils; and many McKenzie models have no edge protection for the magnet ring.

An exciting newcomer to the speaker field is the Maplin company, which has announced an exclusive and completely new range of high performance power speakers, made to their own specification by one of Europe's leading professional design specialists. All design parameters and specifications look to be exactly right for a most exciting new option in speaker up-grading. Bearing in mind the obvious high quality, prices too, seem most attractive, and anyone looking for high output sound at sensible cost should certainly investigate these exclusive new speakers.