HI-FI CHOICE

LOUDSPEAKERS

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A major independent research company proved that the ADC XLM MKII incurred no perceivable record wear over the life of your records!
Since then ADC's massive research programme has created a new state-of-the art, top of the line model–the ZLM Aliptic–designed for ultimate stereo performance combined with the concept of zero record wear.

Greatly reduced tip mass

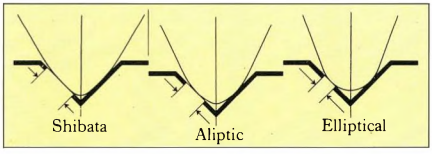
The ZLM has a tiny nude diamond with a ·004" x ·008" rectangular shank.
This achieves more lateral strength than the fashionable ·006" square shank, plus a 10% reduction in mass.
The diamond is mounted on a new tapered stylus, which again reduces mass.
In fact, the ZLM has only half the tip mass of the famous ADC XLM MkII.

Less massby patent

The patented ADC Induced Magnet system, where the magnet is suspended over the moving stylus arm instead of being attached to it, inherently means less mass for the record groove to move. This, coupled with major innovations in the pivot block stylus suspension (which have solved deficiencies in the old system), has resulted in greatly improved frequency response characteristics.

New low-wear ALIPTIC shape

The ZLM has a new tip shape that combines the advantages of the elliptical and Shibata shapes, while eliminating their disadvantages.



It is basically elliptical (·0003" x ·0007"), but its bottom radius has been modified to extend the vertical bearing surface on the groove wall by 100%.
Large enough to greatly reduce record wear, while still small enough to prevent dirt particles being reproduced. This new shape is called ALIPTIC.™

The best polish available

We decided it was worth the extra cost to get the ultimate polish for the ZLM.
The method involves a cam action to shape and polish evenly while forming the elliptical surfaces simultaneously with the other radii. This Pathe-Marconi method is expensive, but the result makes another important contribution towards reducing record wear.

Spatial sound

You'll notice a distinct difference in sound quality. Words such as 'open,' 'spatial,' 'uncoloured' and 'true' spring to mind. Individual instruments are easily identified, and there's no hint of listening fatigue.
That's strictly for the competition with its peakier response.

The new ZLM Aliptic

The culmination of all ADC's research has resulted in the new ZLM Aliptic.
Its specifications below are some of the most impressive around, and with each cartridge you receive an individual, signed, frequency response testimonial.
Certain ZLM's fall within a range of ±½db 10Hz to 20kHz and ±1dB out to 26kHz.
These rare cartridges are called ZLM Select and are only available on special order.

The best cartridge we've ever made

The ZLM is without doubt the best cartridge we've ever made, but it's well worth taking a closer look at the new ADC XLM III which incorporates all of the reduced mass accomplishments of the ZLM, but with a tiny elliptical diamond. This also includes an individual specification.
Complementing the range, we have the new four-cartridge QLM Mk III series, incorporating our new design criteria and exciting innovations like the Diasa (diamond + sapphire) elliptical tip.

ZLM Aliptic specifications

Diamond tip	Nude Aliptic
Tracking force	½ to 1¼ gram
Frequency response	10Hz to 20kHz ±1dB 20kHz to 26kHz ±1½dB
Output	1.0mV per cm/sec
Output balance	1dB max. diff.
Channel separation	30dB at 1kHz/20dB at 10kHz
Inductance	580mH
Resistance	820 Ohms
Load resistance	47,000 Ohms
Load capacitance	275pF
Cartridge weight	5.75 grams
Accessories	Stylus brush, screwdriver, all mounting hardware and signed frequency response curve.

Please write for our illustrated brochure.

The new ZLM Aliptic™ cartridge. The difference between playing your records and wearing your records.

ADC

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Hi-Fi Choice No 10 Loudspeakers 2 by Martin Colloms

Contents

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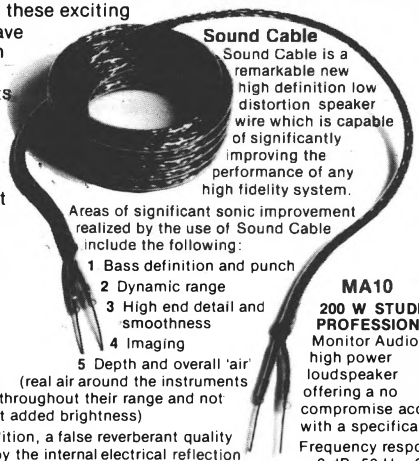
Any enquiries or correspondance regarding the content of this book should be made to Hi-Fi Choice Editorial, 14 Rathbone Place, London W1P 1DE. Enquiries cannot normally be dealt with by telephone.

BIG News for 78 from Monitor Audio

After many hours of painstaking research and development, Monitor Audio announce the big news of 78, three brand new hi-fi products.

To give you the best, these exciting new hi-fi products have been engineered with perfection in mind. During extensive tests all surpassed even Monitor Audio's already high standards of quality.

We are confident that this announcement will be the biggest news to hit the hi-fi world in 78.



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Sound Cable is a remarkable new high definition low distortion speaker wire which is capable of significantly improving the performance of any high fidelity system.

Areas of significant sonic improvement realized by the use of Sound Cable include the following:

1 Bass definition and punch
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4 Imaging
5 Depth and overall 'air' (real air around the instruments throughout their range and not just added brightness)

In addition, a false reverberant quality caused by the internal electrical reflection in regular speaker wire is eliminated.

Typical characteristics
DC resistance: 12 ohms/metre
Inductance: 0.155 micro henry/metre
Impedance: 8.4 ohms

MA10

200 W STUDIO PROFESSIONAL

Monitor Audio's new high power loudspeaker offering a no compromise acoustic performance with a specification to match.

Frequency response: ± 2 dB, 50 Hz 20 kHz on axis
Voltage sensitivity: 2.83 volts will produce 87 dB
Distortion: Less than 1% even at high pressure levels 96 dB, 1 metre
Impedance: Nominally 8 ohms
Dimensions: 80 cm high × 38 cm wide × 38 cm deep

ET500

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This product is the result of two years' research and has three very special features: **Lead laminate plinth, Separate power supply** and an **Interchangeable arm facility.**

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Each edition of *Hi Fi Choice* tries to provide a comprehensive guide to a particular link in the hi-fi chain. It is designed to be useful to both the novice and the professional, and can serve as a simple 'buyers guide' or a valuable reference to to the product currently available.

The *Editorial Introduction* sets the scene for the project as a whole, giving some of the reasons for decisions that had to be taken, and some warnings concerning interpreting the results.

The *Consumer Introduction* is written mainly for the layman with little knowledge of the whys and wherefores of loudspeakers. It explains in simple terms what a loudspeaker is required to do, and goes on to describe how this is normally attempted, explaining some of the different approaches designers take to the problems. It then discusses the methods we have used to examine the loudspeakers, and explains in general terms the reasons why we have chosen to use these techniques.

The *Technical Introduction* goes into the testing methods in more specific detail, explaining as precisely as possible the test conditions, and giving information which is essential to anyone attempting to interpret the laboratory data. Loudspeaker evaluation is a far from exact science, and while we have aimed to follow internationally recognised standard procedures as much as possible, there are a number of interesting and pertinent areas for which no such standards exist. Consequently some of data has been derived in an arbitrary and commonsense way, and the reader should understand the assumptions that have been made before making any interpretations. The *Glossary* summarises the conditions of measurements used in the individual reviews more concisely, providing a useful reference point when reading them.

The *Loudspeaker Review* section, some 120 pages in all, gives all the basic data on the 60 different models, plus design details, comments on the panel listening sessions, interpretations of some of the test results, recommendations for achieving optimum performance, and a brief summary on the strengths and weaknesses of the particular designs.

The *Conclusions* gives the reviewer an opportunity to take a wider view of the test programme results, picking out common factors and trends which a survey of this kind is uniquely able to point out. The *Best Buys and Recommendations* section examines the strengths and weaknesses of the loudspeakers in relation to their typical prices, giving appropriate 'value for money' recommendations and pointing out the inevitable 'trade-offs' that should be taken into account by prospective purchasers.

The *Comparison Chart* is an attempt to collect together all the important information on all the models, which enables their performance to be compared in any particular area. Naturally this 'shorthand' method of presentation inevitably over-simplified some results, and the reader is advised to refer back to the main text for fuller information. In addition, the chart can provide hours of fun for the amateur statistician! Keeping in mind the maxim that there are 'lies, damned lies, and statistics', it is possible to derive a marking scale for any or all of the parameters. For example, the 'value judgement' factors fall into six categories: poor, accetable, average, good, very good and excellent; so one could ascribe an appropriate mark between one and six. Likewise, the measured results could also be given a six-point scale by making categories with equal graduations between the 'best' and 'worst' results. Each parameter can then be 'weighted' by a multiplication factor, according to the importance ascribed to that factor by the individual concerned, and when these are all added up, a 'factor of goodness' can be derived according to the individual's chosen weighting. Thus the individual can short list a number of speakers that best suit his requirements.

One of the great strengths of *H-Fi Choice*'s scale of reviewing is that all the items are assessed under the same conditions, so direct compairsons are valid. We should point out, however, that standards and conditions vary so much within industry that it is thoroughly misleading to try to compare these results with those quoted by manufacturers, or indeed to try and compare one manufacturer's quoted performance with another's, or perhaps another reviewer's.

Is it Ella, or is it Memorex?

The incredible Ella Fitzgerald. Her amplified voice has such perfect pitch it can shatter glass.

And anything Ella can do, Memorex cassette tape with MRX_2 oxide can do.

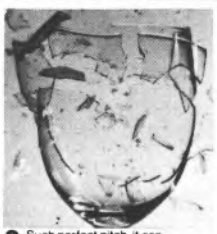
So we recorded Ella on Memorex cassette tape.

And played it back: Memorex too shattered a glass.

An incredible demonstration of Memorex fidelity.

Next time you record, use Memorex. You'll ask yourself....is it live?

1 The amplified voice of Ella Fitzgerald



2 Such perfect pitch, it can shatter glass

3 We played back a recording of Ella on Memorex tape

4 Memorex too shattered glass. Incredible!

MEMOREX Recording Tape

Is it live, or is it Memorex?

Memorex (U.K.) Ltd., 50 Salisbury Road, Hounslow West, Middlesex TW4 6JN. 01-570 7716

The reviewing of loudspeakers has always been a controversial matter, and this is inevitably exaggerated when one deals with a large number of models in a comparative manner. Indeed any loudspeaker review involves compromises: the 'one-off' type of review has the undoubted advantage of allowing extended listening under a variety of conditions, but the corresponding disadvantage of being unable to place the design in a realistic commercial context, which has become more and more important as the market has proliferated and become increasingly competitive in recent years. It is important to bear in mind the strengths and limitations of the review compromises when reading, and for that reason I will describe the development of the project in this introduction, even though I myself was not involved in the early stages.

It was decided to follow a similar overall format to the previous *Hi-Fi Choice Loudspeakers* (written and carried out in that instance by Angus McKenzie), although there are significant detail differences in the way measurements were conducted, so specific results in the two books are not directly comparable. A change in style for the listeing tests included the incorporation of live-*vs*-recorded sessions, while a single panel investigated the stereo performance on various types of music, instead of using separate panels for classical and pop. A meeting was held to discuss the project with members of the industry, and a number of designers were able to attend and give us the benefit of their advice and experience. One particular point that arose from this was the need to take into account the characteristics of the listening room, which should correspond at least approximately to IEC Standards; the efforts made in this direction are described in the *Technical Introduction*.

As far as it is possible so to do, I believe this book represents the fairest and most honest attempt to take an overview of the loudspeaker market within any reasonable budget and timetable. The technical testing has been exhaustive, covering most of the areas that are generally considered to be important, although certain aspects that are currently being debated have not been specifically measured: the overall phase characteristics of the speakers have not been determined; the claims for superior imaging that are sometimes attributed to 'linear phase' designs were examined in the light of the panel listening test results, but evidence suggests that other factors may be rather more important. A second area that we were unable to measure adequately is delayed resonances, as this usually requires the use of sophisticated computing equipment; a sweep of delayed response *vs* frequency was made at a single time interval after excitation (app. 1ms), but merely to assist the reviewer in getting a better perspective on the models. Once again, delayed resonance problems should be detectable on the listening tests, if not specifically identified. A third area of loudspeaker performance that we have not attempted to evaluate concerns certain dynamic effects in speakers for the simple reason that no satisfactory explanation for the mechanisms or measuring methodology yet exists; suggestions have been made that speaker systems themselves are restricted in their ability to resolve signals which simultaneously cover a wide dynamic range, but until more information becomes available this area too will have to be left to subjective assessment.

So having delineated some of the limitations of the lab measurements, what are the corresponding weaknesses in the subjective assessments? By using 'blind' listening conditions, one ensures the panel's impartiality to the product being tested, but not of course its prejudices in terms of particular personal dislikes or expectations. However the very fact that a panel was used, with its variety of individual tastes, helps to minimise bias because the comments expressed are a consensus. Only the user of the book is able to establish whether this consensus approximates his or her own tastes. In essence, the listening tests have concentrated on the identification of coloration, frequency imbalance, and stereo image problems, which are all well known and important areas of speaker performance. I suspect that a fourth area to do with dynamics and detail transmission will become increasingly important in the near future, although I would

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TECHNICS SB202	POA
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concede that a change in perception of detail *can* be caused merely by frequency imbalance.

One major, and virtually unanswerable, criticism of any review is that one does not get a representative result by tesing any one example of a product, particularly when such a product (like loudspeakers) is vulnerable to variations in quality control. The only answer is that we have at least assessed the minimum potential of the product tested, and that this is at least likely to be related to its maximum potential, even though one must allow for some disparity in absolute comparitive judgements. Every effort has been made to ensure that the products tested were not faulty in any way, variations between the speakers of pair being one obvious and useful clue, and if suspicions were aroused the manufacturers were contacted (or in the case of models that we obtained independantly, further examples were checked out.) Nevertheless, in the final analysis, sample variations are bound to affect the results to a degree, so it is vital that this book be regarded as a guide rather than a definitive authority.

Some of the most important, and necessarily arbitrary, decisions in any review concerns selection of the actual models to be included. The loudspeaker market now contains so many products that it is quite impossible to cover them all, and our decisions were made in order to include a representative selection of the most interesting and recent models without too often duplicating reviews in the previous volume.

In retrospect it might have been desirable to include more products from the Far East, or more examples from the larger manufacturers who dominate the market in volume terms. Our apologies then to **Sony** who would have had a second model represented but for our administrative error. Perhaps we should also have included some models even cheaper than those we have tested; but some interesting surprises have shown up by spreading the net as wide as we have, even though one's long-term prejudices are often confirmed.

No **Tannoy** Loudspeakers were included as the existing range had been well represented in the first volume, and a new product line was in course of preparation but was incomplete when this project got under way. The Harman organisation is however well represented with four models from the Bolivar and JBL ranges. Unfortunately no **Mission** loudspeakers were included as samples were not delivered in time to meet the 'last deadline', which was the dates on which the anechoic facility at Garston had been hired.

The behaviour of **Celef** was strange indeed, despite the very good showing they made in the previous volume. A pair of *Domestic Ones* were originally supplied by this company, and initial subjective assessment indicated a mild problem. At Celef's own suggestion that the speakers may not have been fully checked on production and were thus substandard, they were collected by the manufactureres who promised to replace them and also bring another design, the current version of the Celef Monitor. In the event, the company failed to supply replacements, new models, or return the original pair for further assessment.

Certain new models were tested in pre-production form, and where possible these early samples were checked against production samples to ensure consistency of performance or note any changes, and appropriate comment has been made in the text of the reviews.

The *Chartwell 210* underwent a crossover change, and the results have been incorporated, while rather more radical changes were made to the *Isophon,* a little late for full examination. The *Isophon* report has been kept in, but should be regarded more as a 'state of development' report than as a representative review. We are also a little uncertain whether the *Eagle* model is representative of final production. The *Sansui, Sanyo,* and KEF *R105* models were all from early production batches, but we have no reason to expect other than minor cosmetic changes (the KEF model being from a batch sold to dealers primarily for demonstration purposes.) These reviews must therefore be read with appropriate caution; unfortunately in some cases we were not told ourselves about these provisos until after work had been carried out! While we have attempted to cope with the odd design change and 'problem' sample, the complexity of simultaneously changing entries in several different chapters of the book can sometimes prove too much,

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For instance, this magazine; which recommended these Sanyo products and voted them best buys. Take a closer look at Sanyo – it's worth it!

DCA 1001 Stereo Pre-main Amplifier provides 50 watts of continuous power at 8ohms with both channels driven.

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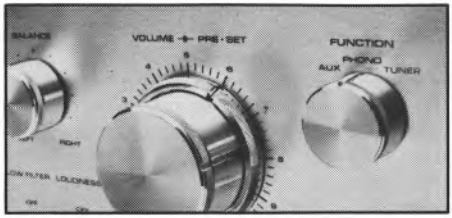

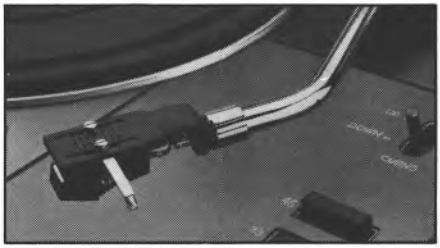

TP 1100 Direct Drive 2 speed stereo turntable. Direct driven platter is operated by a brushless DC Motor. Recessed stroboscope, cueing and anti-skate devices.

BEST BUY HI-FI CHOICE TURNTABLE

G2711 Super 2 Music Centre. Features 2-speed turntable, MW, LW, FM and FM Stereo waveband radio. Versatile built-in Dolby cassette recorder/player.

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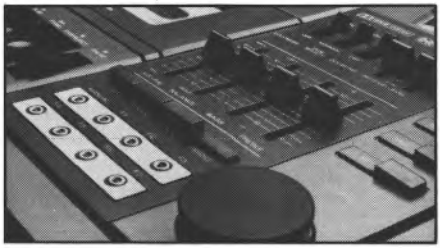

G2811KL Music Centre. Features belt driven 2-speed turntable, magnetic cartridge and diamond stylus. LW, MW, SW and FM wavebands can be sensor touch pre-selected.

RECOMMENDED HI-FI CHOICE MUSIC CENTRE

RD 4260. This Stereo Cassette recorder combines sleek styling with sophisticated technology and, like all Sanyo products, offers quality and value for money.

BEST BUY HI-FI CHOICE TAPE DECK

SANYO

at the touch of a switch

and inconsistencies may creep in where we have mentioned such difficulties in the text.

One problem that arose in the planning of the book was that a number of manufacturers decided not to submit their products. As this involved certain major firms that exercise important influence in the market, we felt that it would not be fair to our readership to leave them unrepresented, so we made our own arrangements to obtain their products. Naturally the normal opportunity for consultation in the event of a possible fault was not open, so we exercised particular care to ensure that the tested samples were typical of those generally available.

A criticism that has been made of the project concerned the choice of Martin Colloms as the reviewer, due to his occasional involvement in the loudspeaker market as designer. In the event none of the models in the report were ones for which he was responsible, and as far as listening preferences are concerned, he was only one member of a panel and all listening was done 'blind'. To use anyone with *less* experience would be to court disaster, and I am completely certain that Mr. Colloms' involvement in loudspeakers was entirely to the advantage of the undertaking and in no way prejudices its results.

So while this editorial may read like something of an apologia for the project, I feel it also acts as its justification, by intercepting and answering many possible criticisms, admitting the limitations, yet at the same time showing that these limitations are probably far less than those that normally apply in reviews. The overall tenor of the reports might be described as 'optimistic', the absolute performance being largely defined by the models which performed best in the group; naturally this may need revision if loudpeakers in general improve, while in the meantime this is if a constructive and positive approach, realistically gauged to the current 'state-of-the-art'.

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There seems to be a great deal of controversy today over whether or not loudspeakers should be reviewed. Why is this?

Everyone is agreed that there are good and bad loudspeakers, just as there are good and bad cars, good and bad cookers, good and bad vacuum cleaners, and so on. Where the difference between good and bad is plain, for instance where a loudspeaker won't handle the power that is claimed for it without burning out, then most people are agreed that exposure of the fact in a critical review is in everyone's interest (except, of course, the speaker manufacturer trying to put a fast one over on the public). But just as there are cookers, cars and vacuum cleaners with both good and bad points, so there are loudspeakers that aren't truly bad but have disadvantages and shortcomings. And this is where the difficulties start to emerge.

Whereas it is fairly cut and dried if a car proves economical on petrol but gives a rough ride over bumpy roads, if a cooker has only a primitive timer, or a vacuum cleaner isn't shaped to reach the corners of a room, no such obvious descriptions can be placed on a *comme ci, comme ca* loudspeaker. Perhaps it may sound markedly worse when used with some amplifiers (which would also imply criticism of the amplifier), or perhaps it has a habit of emphasising the high frequencies, which may make it sound gritty and unpleasant when used with a gramophone cartridge which is also a little over-bright, but very acceptable with a cartridge that puts out rather less relative high frequency output in the first place. A speaker may sound fine when played loud, but produce muddled sounds at low volume; or it may sound clean and smooth at low volume but break up under any kind of power, such as might be required for a party for instance. Or a speaker may sound fine on its own, in a mono, single speaker situation, but produce a very poor stereo image when used in pairs. It may even produce a good stereo image in a very limited listening area, but fall down badly for any listener sitting outside the area. There are any number of similar examples that one can give, but they all point to the same conclusions — that intelligent comment about how a loudspeaker sounds or performs can be of value, provided that it is qualified by some explanation about the criteria adopted for judging.

Is everyone agreed on what makes a speaker wholly "good"?

No. It's impossible. Because what makes a speaker good for one person may make it inadequate or unsuitable for another. Take the case of electrostatic speakers, for instance. For years now they have been regarded as a potential reference point for judging other speakers. This is because an electrostatic speaker can in theory (and sometimes in practice) produce a very clean, neutral sound; that is to say, it can change the electrical signals coming from an amplifier into sound with minimal losses or additions. But electrostatic speakers, at least those within the price range of ordinary mortals, are inherently incapable of producing large volumes of sound, especially in the bass end. What this means in practice is that a pair of electrostatic speakers cannot produce the sheer volume of overall sound, and especially the bass oomph, that a rock fan will want from them. If they are driven too hard the diaphragm inside the speaker quite literally hits its end stops, or there is electrical sparking between the electrodes; either way, the sound is spoilt by sharp, audible cracks as soon as the amplifier volume is turned up too high, and damage may be caused to the delicate diaphragm. Another minor consideration is that electrostatics need to be energised by connecting them to the mains, quite independently of the amplifier. For either or both of these reasons, some people may not like an electrostatic speaker; it doesn't make it less *good,* but it makes it less *desirable* for some people and situations. In fact, that's the key to the whole business of loudspeaker reviewing, and it's the point that's at the root of the current dispute over whether or not loudspeakers should be reviewed at all. Everyone has their own, individual needs and their own, individual likes and dislikes and in addition, loudspeaker sound quality is very much influenced by the shape, size and furnishing of a room. Add to all this the fact that there is no agreed standard for reviewing loudpeakers 'at least which is within the scope of any review team with less than half a

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million pounds at their disposal to replicate IEC standard rooms and install IEC recommended measuring equipment,' and you see how it is essential to compromise when reviewing speakers.

Assuming unlimited funds were available, how would reviews proceed?
As mentioned above, there are IEC standards agreed (and they have quite recently been updated) for defining loudspeaker performance under a given situation. But there are still problems, even assuming that the IEC recommended situations and equipment are available. For one thing, no one has seriously yet suggested that it is possible to evaluate a loudspeaker, even with a blank cheque for equipment, simply by using electronic test techniques. It is agreed that, because a loudspeaker is intended to be *listened* to, a fair proportion of the evaluation must involve listening.

Who is to do the listening?
This is an important issue. Individuals have different attitudes to what they hear and it may even be that different nationalities have different overall preferences. For instance in Japan, speech is generally more high pitched — there are fewer deep voiced Japanese than English or Americans. We all build up a mental memory bank from childbirth through listening to speech, and inevitably find our judgement of an ideal sound pre-conditioned by everyday experiences. So loudspeaker likes and dislikes may even be hereditary — like white skin, dark skin, slant eyes or blond hair and blue eyes. The fact that Eastern countries have relied for many generations on musical scales which differ from those of the West may also be relevant. Gross differences in audio taste between different nations may disappear (witness for instance the manner in which English and American tastes in loudspeakers are merging in the manner of a mid-Atlantic accent) but there is still a wealth of difference between individual listener preferences.

How significant are these differences to a review project?
Think, for a moment, about your family and friends. Do they all like the same kind of music, played at the same level and in the same way? I'll bet that some prefer hard rock with plenty of bass, while others can't abide what they regard as a headache-making thump. What's more, as the level of sound being heard changes (in other words as it gets louder or quieter) so the human ear tends to hear different frequencies at different relative levels; at low volume, the high and low frequencies may sound disproportionately quiet, whereas at higher volumes the bass and treble start to become increasingly forceful. Note that this is experienced even though in pure physical or electronic terms the balance between low, middle and treble frequencies is kept the same at all the volume levels. So what price agreement between lovers of loud and soft reproduction on frequency balance? It's also a sad fact that many of us have been trained over the years to live with, and finally appreciate, poor sound. To take an extreme example, a lifetime spent listening to a juke box will eventually accustom the listener's ear to the excessive, thumping bass content almost inevitably found in these devices. After that, anything without thumping bass sounds inadequate in the bass. You can try this for yourself: turn up the bass boost on your amplifier and listen for a few minutes, then pull back the bass control to normal and see how the bass now sounds anaemic. This in turn points up a pitfall for reviewers, however diligent they may try to be. If an attempt is made to compare one loudspeaker directly with another, in switched A/B fashion, then if one loudspeaker is too heavy in the bass and the other normal, the listening panel may inadvertently criticise the normal speaker for having inadequate bass performance!

All this makes it sound virtually impossible to review anything other than very obviously bad loudspeakers — is this true, then?
To play Devil's advocate, yes, probably it is impossible to review anything other than clearly, obviously bad loudspeakers, with one hundred per cent accuracy and fairness. And as the manufacturers of really bad louspeakers would never submit them for review anyway (they prefer to rely on glossy advertising), it is all too easy to see why some people now say

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loudspeaker reviewing is a dead duck. But look at the alternatives. If there are no reviews of loudspeakers then the door is immediately wide open for each and every hopeful to launch on the market an impressive-looking but mediocre product. The fact that the impressive-looking loudspeaker contains rubbishy components, clumsily put together with no real understanding of electronic or acoustic design priciples, may not come to light until large numbers of the public have been stung and lost their money.

Firms don't always sell rubbish at a low price; sometimes they put a high price on cheap rubbish, because there are always enough people around who firmly believe that you only get what you pay for, and will thus feel reassured by a high asking price. Of course sooner or later the truth will circulate, probably through the correspondance and advice columns of a hi-fi magazine, and the honeymoon will be over. But by then our speaker firm will have made its money and will simply move on to another product under another name.

Also, if sincerely designed and budget-priced compromise speakers aren't reviewed, then some people who buy them will be happy and others disillusioned. A useful review, pointing up the advantages and disadvantages, will inevitably save some disappointments. Without doubt the most difficult review area to justify is that of the 'good' speaker. Over recent years mainstream speaker design has consistently progressed, and although there were indeed some fine speakers around a decade or more ago, there is no doubt that most people would agree that the overall standard of speaker performance has improved. I recently attended one demonstration where a company enabled the press to hear its new range in direct comparison with its products of fifteen years ago. Although the old products scored in one respect (being designed for low powered, valve amplifiers they had greater efficiency and so produced more sound per electrical watt fed into them) they sounded clearly inferior to the modern breed. A loss in high frequencies, less distinct separation between instruments, and more floppy bass, were all clearly evident within a few minutes' listening. But when those speakers were first made and sold we welcomed them as the nearest thing to perfection. Most of the speakers in the reviews which follow rate as "good"; we'll deal in detail later with the techniques adopted to assess their performance in a manner calculated to be of value to potential purchasers.

Will today's "good" loudspeakers sound inadequate in years to come?

It is impossible to say. If loudspeakers were to continue to improve in overall quality, then of course this would be so — as proved by the above-mentioned demonstration — but it is difficult to make hard and fast predictions. Loudspeakers in general still have obvious limitations, particularly when compared to a live source, and it is worth mentioning some of the avenues that are being, and are likely to be explored. The most distinct trend over the years has been that quality Loudspeakers have got smaller, and (we shall see when we later discuss efficiency) have consequently needed more powerful amplifiers to drive them. Of necessity the voice coils need to be able to take more power without burning out. There is bound to be a healthy demand for the small loudspeaker, but it seems quite likely that these will be improved still further, becoming more efficient and capable of producing higher sound levels. Anyone who uses a live instrument in the same room as a loudspeaker will realise that few speakers are able to achieve comparable sound levels without using a very large amplifier.

Another area of probable improvements conerns the way the loudspeaker works in a room. Most speakers are quite sensitive to their particular location in a room, and moving them can significantly change the sound; obviously it would be desirable to reduce this dependance, and some firms are working in this direction. Similarly the way a loudspeaker radiates it's sound is very significant, and the ideal would probably be for the Loudspeaker to work as a point source! Attention paid to the *dispersion characteristics* (the way the sound spreads out from the Loudspeakers) seems to be paying dividends for some manufacturers, and we have attempted to give some indication of

these characteristics in the reviews.

It is of course possible that a wholly new type of loudspeaker, to replace the current almost universal moving-coil unit, will be designed. But over the years there have been all manner of alternatives proposed for the moving coil speaker, notably the electrostatic types already mentioned, ribbon units, piezo-electric units, and even a modulated corona discharge. All have had something to commend them and something to provoke misgivings. The spark discharge unit, for instance, produced clean sounds but generated ozone, which is a health risk! future development may even include the use of large surfaces such as walls or windows as the actual loudspeaker!

So what is the current consensus of informed opinion on the reviewing of loudspeakers?

One professional studio magazine has for many years not reviewed loudspeakers. This is a considered decision, based on points like those made above. So inevitably any new studio monitor speaker must achieve a reputation by word of mouth, trial testing in a studio situation by the prospective purchaser, or sheer force of sales publicity. This situation may not be ideal, but it gets by, given the very special circumstances of the professional studio world. Studio monitor speakers cost a great deal of money, so individual trial by a studio before purchase is a practical possibility and the makers or agents for a monitor can afford to loan a pair out for trial. Likewise, the profession is small, and word of mouth carries a great deal of weight. Even so, it is interesting to note that most British recording studios use either JBL or Tannoy loudspeakers to monitor while they are recording — and have done for many years. Who knows whether the situation would have been different, had studio monitor speakers been regularly reviewed and the accepted units compared with others which have become more recently available? But in the domestic situation (in other words, the situation of readers for whom this publication is intended) the price structure is on a smaller scale. The demands on a domestic speaker are lower than on a professional speaker, both in terms of performance and consistency of production. If you play a speaker at studio levels in your home you are likely to receive a writ from the neighbours! Likewise, it will not be of major consequence if the performance of the speakers you may buy differs minutely from that of another pair bought by a neighbour. But in a studio consistency is everything. It is absolutely essential for the engineers to know that every pair of supposedly identical monitors are indeed truly identical. Reviewers of domestic speakers have to bear this in mind when judging value for money.

Most audio journalists (self included) glibly advise readers to always try and hear a pair of loudspeakers in their own home before purchase. This is sound advice, because the size, shape and furnishing of a room really can make a considerable difference to how any given speaker sounds. So, incidentally, can the position of the speaker or the furnishings in a room. Reflections from a wall or corner can add to, or cancel, some bass notes but not others. This can make a speaker that measures well and sounds fine in one position of the room, sound bass-light or bass-heavy in another. But although we recommend home tests before purchase, we know in our heart of hearts that this is not always possible. As often as not, the shopkeeper won't play ball. At one and the same time, this shows both how useful a review can be to a prospective customer, and how misguiding it can be if the reviewer and prospective purchaser don't use their speakers in a similar manner and situation. And of course, because we all live in different sized houses, different sized rooms and with different furnishings, it is inevitable that the purchaser will use what he buys in a manner that differs from the manner in which it was reviewed. So to be useful a review must clarify and interpret the significance of the acoustic situations under which listening test were held, and a prospective purchaser should bear these in mind when selecting the best speaker for a given domestic situation.

I better understand now the problems of reviewing and the need for reviewing. I also see that a degree of compromise in all reviews will be inevitable. What compromises will be involved in the present reviews?

Well the compromise adopted by some

manufacturers has been to withold their products from the review altogether! In a nutshell, those products witheld from the current review schedule are made by manufacturers who believe that the only way to review accurately and fairly is to adopt IEC standard procedures. They also believe that if the half-million-or-so pounds necessary to provide the facilities are not forthcoming, then there should be no review. This point of view is understandable, especially as at least two of the manufacturers no longer willing to have their speakers reviewed have invested that order of money in research and evaluation equipment to guide their own research. In other words they argue that a product should be reviewed only by a reviewer as well equipped as the manufacturer. But by this token, virtually no mechanical and electrical product made by a large company. By the same token, although some of the firms now refusing to allow the review of their products will agree only on listening tests carried our in an IEC standard-sized room, it can equally well be argued that no reader of a published review lives in an IEC standard-sized room.

Arguments like these could go on all day, with no positive outcome. In an effort to arrive at a reasonable compromise that would be as fair to prospective purchasers of equipment as to the equipment manufacturers, we arranged a round table discussion at which the manufacturers willing to co-operate with the review project were able to air their views on how a satisfactory compromise could be arrived at for both subjective (listening) and objective (measurement) tests.

(In some cases, because it was felt that the inclusion of speakers from non-co-operative companies was essential to a balanced review of this size, samples have been purchased or hired "off-the-shelf" from dealers.)

What was agreed for the listening tests?

It was agreed that a 'real life' domestic listening room as near as possible to the IEC recommended size would be used for stereo program listening tests. After all, people who buy loudspeakers use them to listen to stereo program material in real live domestic listening rooms. It was further agreed that there would not be any of the now traditional switched comparisons or AB tests. So instead of switching between one speaker and another to show up differences (and thereby risking the confusion mentioned above which can occur when two speakers of different frequency response are directly compared, whereby it may turn out to be the more accurate loudspeaker that is made to sound wrong and penalised), each speaker was tested over the same full set piece program. This gives the listening panel an opportunity of establishing an overall opinion of its character, from a variety of musical material. There is however another important type of listening test, this is called 'live-*vs*-recorded', and was conducted in mono.

What is the point of the live-vs-recorded test and why is it in mono?

It is acknowledged that many recordings that we buy today in the shops bear no real resemblance to live sound. They are made using microphones placed close to the individual instruments, with the sound often doctored electronically to produce an "impressive" quality sound. This suggests that tests comparing live and recorded sounds are obsolete, but every day the human ear hears live sounds, especially speech, and the reproduction of recorded "live" sounds thus gives an ideal reference point from which to judge the performance of a loudspeaker. Indeed, probably the severest test of all for a loudspeaker is to record the sound of a human voice and play back that recording alongside the live sound of the same voice, so that there is a direct side-by-side comparison of live-*vs*-recorded sound through the loudspeaker. It is widely believed that the electronics of modern recording and domestic amplification equipment are now so good that usually by far the weakest link in the chain ofspeech comparison is the loudspeaker. This comparison test is best carried out in mono, because in each case the sound is issuing approximately from a point source — in one case the loudspeaker and in the other case the mouth of whoever is speaking the words. Male speech is particularly revealing as a test, because it has a reasonable bass content. In

addition to speech, the live-*vs*-recorded tests will involve the comparison of several other sounds, especially acoustic (i.e. unamplified) musical instruments.

How are the recordings made, because surely acoustics will affect this also?
The recordings are made with very little reverberation or echo, because when the recording is reproduced by a loudspeaker in a room, the acoustics of the listening room will add to the acoustic character already on the recording. Ideally, the recording would have no reverberation or individual acoustic whatsoever. In practice, this is impossible; but a dead recording, made with a microphone reasonably close to the voice or instrument in an acoustically dead room, is an accepatable compromise.

How is the recording replayed, so as to provide a fair test?
The loudspeaker under test and the musician or live speaker are placed in the test room behind a sound-transparent but visually-opaque curtain. For speech tests, a carefully recorded phrase is replayed through the loudspeaker and this is repeated by the same phrase spoken live. In all, several phrases, in unknown order, are reproduced and produced, and the panel asked to judge for accuracy and coloration. The same technique is used for musical instruments. To avoid any confusion due to tape hiss, or other electronic noise, the tape and amplifier are left running all the time. This means that the recording must contain gaps which are filled by the live speaker or musician. This is only one of many practical problems which make a live-*vs*-recorded test far harder to set up in practice than one might expect. It is, for instance, essential that the instrument or voice be as close as possible to the loudspeaker, so that no difference between the two is created by factors other than loudspeaker performance.

What do such tests reveal?
Live-*vs*-recorded tests can, if carefully set up and carried out, tell a great deal about the ability of a loudspeaker to perform accurately in the mid-range — that is especially the speech frequencies. Such tests are less revealing about low frequencies, mainly because of the inability of most small domestic loudspeakers to produce anywhere as near as much power in the low frequencies as a live instrument. But this in itself is revealing of inadequacies in modern loudspeakers. Indeed, a carefully organised live-vs-recorded test can tell as much, if not more, about the characteristics and quality of a loudspeaker than any other subjective or objective test — even though it requires no electronic measuring equipment and can be made reasonably independent of the room acoustics.

Why, then, is the stereo programme test so necessary?
As mentioned above, most recorded music today is artificial in character, in that it has been recorded with close microphones and electronically doctored, often with artificial echo added to compensate for the non-reverberant sound of the close-miked recording. Only purist or Blumlein crossed pair recordings are likely to capture a truly natural sound, and these are unpopular with many listeners, expecially those who have grown used (addicted?) to the artificial sound of close-miked recordings. Because we are evaluating loudspeakers for domestic use, it is clearly essential to test them with the kind of program material that most domestic users will play through them. Also, it is important that a loudspeaker, when used in pairs, should be able to produce good stereo. Some loudspeakers are far better able to produce a clear stereo spread than others, and it is a characteristic of some loudspeakers that they produce good stereo only over a very small listening area. Indeed, this is another reason why no attempt is being made to make direct A/B comparisons between speaker pairs. It is impossible to set up even two pairs of loudspeakers in a domestic situation and switch between them, without altering the stereo effect for stationary listeners. This, inevitably tends to produce unfair comparative results when stereo imaging is under test.

What kind of programme material will be played in stereo?

There should be full orchestral music, to show how a speaker can cope with full-bodied, full dynamic range sounds. Points to note are whether the speaker tends to muddle the instruments together as the volume increases or decreases, ie whether the instruments stay cleanly distinguishable at all volume levels. Does a bass drum thump affect the clarity of the fiddles? Does the speaker sound 'break up' audibly at an orchestral climax? Is there a realistic image spread between the stereo pair? And so on. These a,re all questions that will be revealed by full orchestral music played in stereo. A choir and solo voice are particularly revealing of clarity, and a cathedral organ will readily show up any bass rattles. Folk bands tend to be recorded without too much electronic doctoring and are thus also revealing of any lack of clarity. Likewise a piano recording, one of the most difficult instruments to reproduce, shows up the ability of a speaker to handle transients without distortion. Because a large number of those who buy speakers use them to reproduce rock music, at least two samples of rock need be played — and at high level too, because, that is how rock is meant to be heard. Because some of the speakers on test are 'phase compensated' at least some of the program material will have been recorded using a simple microphone technique, ie a Blumlein crossed pair, so that it contains coherent phase information as well as amplitude information.

Are phase-compensated speakers the same as minimum phase or linear phase or time-delay compensated loudspeakers?

Essentially yes. They are all phrases intended to describe a speaker which preserves the phase relationships of the audio signal input, that is to say if bass and treble notes are 'in phase' in the original signal they are 'in phase' in the reproduced sound. But note well that this effect will only hold good over a limited listening area, and the beneficial effects are subtle and easily masked by any other inadequacies of design, for instance coloration. The main advantage of phase compensated louspeakers should be in stereo imaging, expecially of program material recorded with a simple microphone technique (eg Blumlein crossed-pair mikes) which captures the phase relationships of the original sound being recorded. There is currently much discussion and argument over the importance or otherwise of phase distortions in loudspeakers, and as yet the arguments are unresolved. It was with this in mind that some of the program material chosen for the listening tests was recorded with phase-coherent microphone techniques.

What kind of quality was the program material?

On the whole, the reproduced program material was of the highest quality, either direct-cut disc or original master tape. This is necessary, because many commercial disc recordings contain distortions and anomalous effects that can either mask or accentuate the inadequacies of a loudspeaker. But at the same time, it is unrealistic to play *only* high quality material, because high quality material inevitably brings out the best in any loudspeaker. (This is indeed why everyone seems to use master tapes or direct-cut discs to demonstrate their products at every audio show and exhibition). Even a mediocre product can sometimes be made to sound surprisingly good by feeding it with high quality program material. For this reason at least some comparatively low quality, somewhat distorted program material was also used; after all, this is more representative of what the average domestic user will, of necessity, be using much of the time.

In fact much of the program material which is played over a domestic hi-fi as a matter of routine, either from records, tapes or off-air, is of quite appalling quality — far inferior to the potential of most good loudspeakers. An accurate loudspeaker can sometimes sound worse on poor program material than a poor loudspeaker which 'masks' some of the deficiencies of the program material. Clearly these are points that need to be taken into account when judging the characteristics of a loudspeaker and it's suitability for a variety of domestic situations.

Who was the listening panel, and how did they judge what they heard?

The listening panel was a mixture of trained and untrained ears. This is intended to ensure

that the results are neither naive nor geared to 'golden ears' who listen by nature for inadequacies that will be of no consequence to most people. Either excessive naivety or excessive experience on the part of a listening panel can produce results of limited practical value. And, very importantly, the panel had no knowledge at any time of what they were hearing. This will overcome the main bugbear of many past reviews, built-in listener prejudice. Over the years there have been various loudspeakers that, through word of mouth and good recommendation, have become accepted as some kind of Greenwich Mean Time reference for all other loudspeakers. If at a listening test one of these 'reference' speakers is noticed by the panel, there will be an inevitable, albeit subconscious, tendency to judge everything in terms of that reference. So at no time during the tests was anyone told or shown what they were hearing. To ensure that prejudices do not creep in despite this (for instance if one of the panel thinks he recognises a loudspeaker by its character and remembers that on past experience he shouldn't like it!) control tests were continually dropped in, unknown to the panel. For instance, a loudspeaker that proved surprisingly unpopular or popular would be re-introduced without the panel's realising that they were hearing a repeat performance. This control technique also minimises the risk of panel inconsistencies arising, for instance, from fatigue. The panel was asked to give a numerical mark to each loudspeaker, as evaluation of its general impact, and errors or attributes of frequency balance. For instance numerical marks were used to denote judgements like clarity, accuracy, too much treble, too little treble, too much or little mid-range, too much or little upper bass and so on. At the same time the panel were asked to identify (again with numerical marks) the colorations they could hear.

What is meant by 'coloration'?

There are in fact two causes of coloration. First, unless a loudspeaker is able to reproduce every frequency with equal level or balance, it will inevitably produce some frequencies with more or less efficiency than others. The resultant sound is unbalanced or coloured overall by inadequacy or excess at some frequency. An extreme case is a juke box, with some of the bass notes booming out far louder than others. Such overall coloration or imbalance is easily measured as well as heard.

But other colorations are more subtle and, although audible, are hard, if not impossible, to measure. A root cause here is unwanted resonance. If you tap an object or blow over the open mouth of a bottle it will 'ring' at a particular frequency, a natural resonance. The various parts of a loudspeaker, be they cabinet panels, the volume of air trapped inside, or any structural components that can be made to ring, however quietly or briefly, then that ringing can well spoil the overall sound. Bear in mind that a loudspeaker system playing music will be reproducing sounds of most frequencies much of the time, and is thus frequently exciting its potentially undesirable resonances, and you have some idea of the magnitude of this problem. It may be too subtle an effect to be immediately identifiable for what it is, but it can nevertheless make the difference between a good and an indifferent loudspeaker. Electronic circuits, like cross-overs, can ring or resonate purely electrically, to sustain signal peaks and create much the same effect as mechanical ringing.

Previous tests have shown that most people tend to use the same words to describe the same types of coloration, so we are standardizing on them. Where there is a bump in the frequency response or a resonance at around 50-80 Hz, the sound produced is described as 'boomy'; between 100-150 produces 'chesty' or 'plummy' sounds; at 150-300 the sound is 'boxy' or 'hollow'; and between 400 and 600 the reproduced sound seems to come from a "tube" or "tunnel". With a bump or resonance at around 700Hz to 1.2 kHz, the sound is 'cup-like' or 'honky', and at 1.8-2.5 kHz it is 'nasal' or 'hard'. At 2.5-5 kHz it is 'metallic', and between 5 and 8 kHz it is 'sharp'. A bump or resonance at the very top end of the frequency spectrum, between 10 and 15 kHz, produces a 'fizzy', 'gritty', or 'spluttery' sound. By using numerical marks to denote these sounds, it is possible to run a statistical analysis of what the panel hears and thinks of what it has heard.

But it must be emphasised that the review aim is not to be dogmatic. The intention is to be constructive and informative. If a loudspeaker proves especially capable of reproducing human speech, by coming well out of the live/recorded tests, but emerges from the stereo program listening tests as rather inadequate in the bass (this could well be the case for a well designed, small cabinet loudspeaker), then it is not for us or anyone else to say that that speaker is *good* or *bad*. For some users, for instance with limited domestic space and no ambition to shake the room with deep bass, it may be *ideal*. But for someone who has a fair amount of space and is more concerned with booting meaty bass lines than mid-range accuracy on speech, the same loudspeaker can be a *disaster*.

Can we continue in predominantly non-technical terms with a brief run-down on basic loudspeaker design?

Most loudspeakers are based on moving-coil 'transducers' or 'drive units'. A transducer, by the way, is an all-embracing term for any component that converts mechanical energy into electrical energy, or electrical energy into mechanical energy. So a microphone (which converts sound waves into electrical signals) is a transducer, as is a gramophone cartridge. A loudspeaker is a transducer, because it converts electrical signals into sound waves. In the commonest form of loudspeaker transducer, which, incidentally, was invented towards the end of the nineteenth century by Professor Lodge of University College, Liverpool, a coil of wire is suspended in a permanent magnetic field and attached to a diaphragm. When a fluctuating electric current, i.e. an audio signal, is fed through the coil, it creates a changing magnetic field which reacts with the permanent field from the magnet. This reaction causes the coil to move. The moving coil moves the diaphragm and the diaphragm moves the air around it. This creates sound waves, which the listener hears. Almost all current loudspeakers rely on this basic principle, albeit sometimes in heavily modified and elaborated form. A conventional coil and cone speaker uses a modified paper or synthetic plastics cone or sheet as the diaphragm.

Incidentally, in an electrostatic unit a thin flat diaphragm is placed between two electrodes in the manner of a giant capacitor. The audio signal is used to create changes in the electrostatic field (rather than the magnetic field of a moving coil unit) and the diaphragm moves in the changing static field, to make sound waves in the air. In a piezo-electric unit the audio signals are fed to a piezo-electric material which is coupled to, or part of, a diaphragm. Piezo-electric materials have the property of generating electricity when squeezed (as in a crystal pickup cartridge or a piezo-electric spark gas lighter), or conversely changing size when fed with electric signals as in a loudspeaker.

Let's revert now to be moving coil unit and see how the basic raw, or "chassis", transducer is constructed. The cone carries the coil and must be secured in some way to keep the coil centred on a rest position in the middle of the permanent magnetic field — but allow the coil and cone limited freedom of movement. So a suspension or 'spider', usually of resin impregnated cloth, is fitted between the neck of the cone and the voice coil to locate and control the coil movement. To prevent sag, absorb vibrations within the cone itself, and assist the suspension, a flexible surround, usually shaped with a fold or roll, is attached to the metal frame and cone periphery. Obviously a cone which can only move a short distance will only be able to shift small volumes of air and will not be able to produce loud sounds. But if the coil is able to move the cone too far, then the coil will pass out of the magnetic field and will no longer behave in a linear fashion. In other words, an increase in audio input will no longer produce a corresponding increase of sound output. Also, the suspension must exert a return force on the coil, to ensure that as soon as a brief audio signal pushing the cone out has ceased, the cone will move swiftly back to its central, rest position, ready for whatever signal next arrives.

The stiffness of the cone surround must be tailored to the loudspeaker system as a whole. This is an important design consideration. One result of poor system design is low frequency or bass boom, as was often the case with old style bass reflex cabinets (more of this

later). All manner of other design considerations apply and interact; the cone and coil must for instance be neither too light nor too heavy. If they are too heavy the speaker system will be insensitive, that is to say a low powered audio signal will not be able to produce sufficient volume to be heard. On the other hand it is difficult to produce a light coil that can cope with heavy audio currents without burning out. So although a light coil will be sensitive to subtle sounds, it risks destruction by louder ones. And then there is the problem of what material to use for the moving parts. Originally paper was used for the cone, but unless carefully treated it tended to age over the years and soak up moisture on damp days; this of course altered its weight and performance characteristics. Modern 'paper' cones are so heavily treated and modified that they are more accurately described as resin-impregnated fibre or pulp, while some now include carbon fibres. Various synthetic plastics are used as an alternative to paper, as is metal.

Likewise a variety of materials are used for the cone surround, which is required to flex backwards and forwards, in the manner of a spring, literally millions of times during just one playing of a gramophone record. To devise a spring that can go on bending in that manner day after day, year after year, without altering its elasticity and at the same time providing the correct acoustic termination for the cone, is a very tall order. It's an even taller order when you bear in mind that most plastics tend to degrade far faster in sunlight (due to ultra-violet light) than in darkness. So all the plastics in a moving cone unit in a speaker with a removable or transluscent grille need to be treated to make them UV resistant; complicated isn't it? And these are only the most obvious considerations which the raw chassis unit designer needs to take into account. Less obvious considerations are cone size, weight and stiffness. The gap between the coil and the magnet must be as small as possible, but within manufacturing tolerances, or the one may scrape on the other. The strength of the magnet must also be carefully chosen, to provide a balance between good power output and flat frequency response.

Can we now look at the different types of cabinet in which a speaker unit may be installed?

For the time being we will assume that it is possible to design a moving-coil and cone unit that will cope with the whole frequency range, and that there is only a need to install one unit in each cabinet. This certainly *isn't* the case, at least so far as hi-fi is concerned, but it's easier to work on that temporary, hypothetical assumption.

There are a number of reasons why loudspeaker units need to be mounted in cabinets, but of these reasons one is arguably more important than all the rest put together. This is that a moving cone unit inevitably and invariably pushes out as much sound from the rear as it does from the front. As the cone moves back, the air out front is sucked back. Usually this is referred to as compression and rarefaction, and at the same time there is an opposite situation at the back of the cone. As the cone moves forward, the air at the back is compressed. Thus exactly similar sound wave patterns are produced at the rear as at the front (of equal amplitude or volume, and of equal frequency or pitch), but the one sound pattern is exactly out of phase or out of step with the other. As air at the front is being pushed, air at the rear is being pulled, and *vice versa*. Now the shortest distance between the front and the rear of the speaker unit is round the edges and surround of the cone, and at all but high frequencies this distance is very small compared to the wavelength of the sound being produced. So sound leaking round from the front to the rear (or *vice versa*) is still almost exactly out of phase with the sound it meets at the other side. It is a basic fact of physics that when two out-of-phase signals, be they electrical or sound, mix, then the result is cancellation. So if you place a raw loudspeaker unit on a table and put low frequency sound through it, you will hear very little bass because the bass waves from the front are cancelling out the bass waves from the rear, and the total bass output is minimal. This is why an unmounted, chassis loudspeaker sounds so tinny and terrrible; it can't produce bass.

Now there are various ways of putting a stop to this cancellation, and they all involve

mounting the speaker in a cabinet. One way is to make the distance between the front and rear of the loudspeaker infinitely long. The speaker is mounted to 'fire' through a hole in the middle of an enormous 'baffle' made of heavy wood, or other acoustically dense material. The sound from the front of the cone fires out through the hole, and the sound from the rear fires out behind the baffle. As the sound waves can't get through the dense baffle, the only way round from front to rear is now round the infinitely long path defined by the infinitely large baffle. So no rear sound ever gets round to the front. Of course there is no such thing as an infinitely large baffle. But a very large wooden sheet, perhaps made especially dense by forming it hollow and then filling the space with sand to absorb sound, can be regarded as an infinite baffle. Once in a while people have experimented with mounting a loudspeaker in a porthole-like window of a house. Half the sound fires into the room and the other half fires out into the street. The sound in the room will be good, but so will the sound in the street, and the neighbours and the local council inevitably complain. (An alternative approach is to mount the speaker unit in a dividing wall between rooms.)

Something similar to an infinite baffle (and often erroneously called an infinite baffle) is the sealed cabinet, or acoustic suspension type of loudspeaker.

How does the sealed cabinet design work?
As the name implies the loudspeaker is mounted to fire out of a totally sealed cabinet. The forward sound fires out of the box and the rearward sound fires back into the box. Provided the box is made of heavy material and filled with damping material which can physically soak up the rear sound, the overall situation is in many ways comparable to an infinitely large, flat baffle. But it is necessary for the designer to take into account the fact that the sealed box traps a pocket of air which acts as a spring, just as the air trapped in a bicycle pump acts as a spring when you blow up a tyre. The spring effect of the trapped air adds to the spring effect of the cone suspension and surround. Inevitably, at one specific frequency the cone will go into resonance with the trapped air, and move with unprecedented enthusiasm. This can produce too much sound at the pitch of the resonant frequency, and an audible 'honk' which colours the overall sound. But making the cone surround very flexible produces a low resonance driver which resonates at just that frequency at which the system's natural response starts to fall off. This boost assists the falling natural bass to provide an extended but essentially flat response. Clearly, however, incorrect design matching of speaker unit to cabinet can produce too little bass and an anaemic sound or too much bass and an unpleasant boom. Incidentally such sealed box cabinet designs suffer from the basic disadvantage of being inherently relatively inefficient.

Before moving on to other speaker types please explain speaker "efficiency".
Efficiency is simply a measure of the amount of actual sound that a loudspeaker produces for a given amount of electrical input from the amplifier. Most louspeakers are remarkably inefficient. Apart from all other considerations, the loudspeaker unit is pushing out as much sound at the rear as it is at the front, and in most designs virtually all the rear sound is lost. So only half the total sound produced by a speaker unit has any chance at all of reaching the listening evironment. It is easier to produce an efficient speaker, which produces a great deal of sound from relatively little input, if that speaker is required to produce sound from over a limited frequency range only. But this is the antithesis of hi-fi, and a good modern speaker will nearly always have less that 1% efficiency. This is in fact of little consequence beause over recent years, amplifier watts have become relatively cheap. Twenty years ago, 15 watts was a high powered amplifier, now it's peanuts! This is why efficient loudspeakers were generally more popular in the days of low-powered valve amplifiers than now. The deficiencies and inadequacies of those systems were tolerated as necessary evils and an inevitable trade-off for loud sound.

How does power handling relate to efficiency
Inevitably some loudspeakers can produce

more pure sound than others before they start to 'clip' musical peaks as if they are 'breaking up'. But in practice this has little connection with their efficiency. In fact if an inefficient loudspeaker starts to sound distorted when it is run loud, it is more likely to be the amplifier which is clipping than the loudspeaker. To check the power handling of a loudspeaker we shall simply listen to that loudspeaker, turn up the volume of the amplifier (which has plenty of reserve power) until the loudspeaker begins to sound noticeably unpleasant, and then measure this distortion threshold level with a sound level meter.

Please explain sensitivity?
Essentially sensitivity is the same as efficiency. If a speaker is efficient at producing sound output from an electrical input then it is regarded as sensitive, in that it can still produce audible output from even a small input. Our measurements are perhaps better regarded as sensitivity rather than efficiency measurements, because all our speakers are being fed with the same input and the output measured. As a guide to the kind of result likely to be obtained it is worth bearing in mind that one *acoustic* watt (which ought to be produced by a 100 watt amplifier running into a 1% efficient loudspeaker) will produce a **very** loud sound (110-120 dB) in an average room. As a guide our test involves feeding the equivalent of one *electrical* watt (referred to 8 ohms) into a loudspeaker, and measuring at 1 metre distance. A sound level of around 93 dB is likely to be produced by the most efficient, or most sensitive, speaker and a sound level of around 80dB is likely to be produced by the most inefficient and insensitive loudspeaker. Do bear in mind however that efficiency and sensitivity are only small pieces of the performance jigsaw. Super efficient and super sensitive loudspeakers may produce a great deal of sound for relatively little input, but that sound may be unacceptably coloured, or otherwise unacceptable. A 50 watt per channel amplifier should nevertheless be capable of quite satisfying levels (94-96 dB) from a pair of even the least efficient speakers reviewed here.

What designs are more efficient or sensitive than a sealed cabinet?
One way of producing very high efficiency output from a transducer unit is to mount it at the front of an exponential horn. The exponential horn was originally used for acoustic gramophones, where the relatively small amount of sound energy produced by a diaphragm being vibrated by direct contact with a stylus tracking a groove had to be boosted as much as possible. In many respects such a horn is an extension of the old speaking trumpet idea, the object being to match the physical charateristics of the small and semi-rigid vibrating diaphragm with the physical characteristics of the mass of 'soft' air in the room, so that there is a smooth transfer of energy from one to the other. The use of a horn for sound reproduction came into its own in the 1920s, just prior to the launch of electrical sound recording and reproduction. The principle has been variously redeveloped over the years by loudspeaker designers who of course now use a moving coil and diaphragm at the throat of the horn instead of a diaphragm moved by direct contact with a gramophone stylus. Without doubt, horn-loaded speaker units can produce large volumes of sound from a relatively small electrical input. Thus horn-loaded speakers are highly efficient; but they can suffer from serious disadvantages. First, a horn reproduces sound over a fairly limited frequency range and it tends to concentrate the sound it produces in a forward direction rather like a torchlight beam. Thus true fidelity is hard to achieve, and although there will be high levels of sound in the direct line of fire of a horn, these levels will fall off as the listener moves off its main axis. This can be of some disadvantage in a domestic situation because when the listener moves his position so the volume and tonal quality of the overall sound heard will change. For the same reason a pair of horn units will only be able to produce a good stereo image over a relatively small listening area. Horns of manageable size offer above average efficiency for reproducing sound in the middle and high frequency bands, but they can easily colour the sound produced with very characteristic reflection sounds and resonances. A system that relies

heavily on horn-loaded units, will often be instantly recognisable for what it is and may prove fatiguing to listen to over long periods.

Nevertheless despite these practical problems, horns have continued to have a steady minority following over the years, and are especially popular in Japan. Many horn users swear that this operating principle gives better transient performance and preserves the dynamics of music better than other systems, but this is an area where little research has been done. It is certainly true that exotic custom-built horn systems can be capable of outstanding results, but they are rather outside the scope of this book!

Bass reflex, or tuned port, designs can however represent a good compromise between efficiency and accuracy of reproduction.

How does a bass reflex or tuned port loudspeaker work?

The traditional explanation is simple to understand but is probably not strictly accurate. The speaker unit is mounted on the flat baffle front of the cabinet, a carefully chosen distance away from a hole or port leading into the cabinet. The port is of equally carefully chosen size. Traditionally it has been said that over one bass frequency range the air leaking out of the port (which of course comes from the rear side of speaker cone) is inverted in phase and thus *adds* to the sound from the front of the cone rather than *subtract* from it. In fact it appears more accurate to say that over this frequency range the cone virtually stops vibrating and the plug of air in the port takes over as a radiator.

In a reflex design a relatively light loudspeaker cone with a heavy magnet is used, which has the advantage of being relatively efficient in the mid-frequency band.

The light cone/large magnet combination would normally produce inadequate bass due to over damping (too much restraint on the cone for it to move sufficiently to create adequate bass) but the carefully controlled bass boost introduced by the resonating port compensates for this.

An ABR (an auxiliary bass radiator) is like a loudspeaker unit without a drive coil or magnet and works in a similar fashion, the passive cone or panel behaving something like a tuned port.

What other designs should I know about?

Another way of losing the sound from the rear of the speaker unit is quite simply to lose it in a maze. The labyrinth, or transmission line, loudspeaker takes the sound from the rear of the speaker unit and leads it off down a long channel, which is acoustically damped to prevent reflections and resonances like those produced an organ pipe. The channel is not sealed at its end so there is no trapped air, there is thus less problem over the elasticity of the cone surround combining with the elasticity of the air at the rear to produce an undesirably high resonance. Usually, to keep such a system of mangageable size, the transmission line is folded inside a cabinet, hence the term labyrinth. Sometimes the designer affords the user some degree of adjustment of line length, or perhaps an extra speaker unit is added along, or at the end of, the line. On the whole, and for reasons which should now be obvious, the transmission line or labyrinth type of loudspeaker tends also to be of relatively low efficiency.

How important and easy is it to match the speaker or transducer unit to the cabinet?

In every case the designer must choose the raw speaker unit, the cabinet overall dimensions, and any port size and location, in careful combination. To mount Speaker A in a reflex cabinet designed for Speaker B is likely to produce disastrous results, just as mounting Speaker B in a sealed cabinet designed for Speaker A will produce unacceptable sounds. Occasionally, working by ear, trial and error, and with a great deal of luck, a designer will produce an acceptable sound from a happy chance combination of speaker and cabinet. If he has good ears he will identify it as such and perhaps market the product commercially. The result may well be applauded by reviewers and public alike. But the applause will last only while the manufacturer is able to obtain supplies of exactly similar components. If the characteristics of the raw transducer units change, or the cabinet maker starts using different wood, or even different glue, then the once happy combination may start to

produce unhappy results. If the designer can fall back on technical skill to re-balance the combination (for instance by adding electronic or mechanical components to compensate for changes that are making themselves heard in the new batch of speaker units) he will prevail.

If he has no technical expertise, he will very soon join the ranks of amateur speaker designers who have found out the hard way that luck and a good pair of ears are just not enough in the long run. To produce consistently good production runs, in the face of inevitable component fluctuation, requires not only hard learned practical experience but also a good understanding of physics, electronics and acoustics. This is one reason why so many large firms are now spending more and more on loudspeaker research and development, even to the extent of acquiring computers to analyse their prototypes and production models and checking cross-over performance.

What is a cross-over?

Now is the time to abandon our working concept of a single unit loudspeaker. Portable radios, televisions, cheap audio systems and in-car entertainment use single units to reproduce the whole frequency range. But as we shall see it is virtually impossible to produce, or even design, a single moving coil unit that will reproduce the whole frequency range with equal efficiency and without interaction or muddling of sounds of widely differing frequency. Budget systems get away with using a single loudspeaker unit because they are not intended to reproduce sound at high volume levels over the full frequency range. That is to say they can't cope with power down into the deep bass and up into the high treble. Cheap systems perform adequately in the middle range, and that is enough for the reproduction of intelligible speech and a reasonable approximation to the sound of music at fairly low levels. But hi-fi is not about reasonable approximations at unrealistic levels. It is about perfection, or as near to perfection as it is possible to get. And this means equally clean power levels over the full sound spectrum. This is the key to one aspect of design that can be readily reviewed. If a speaker unit is to produce good, solid, bass sounds, it will need to move a large volume of air in the room. To move a large volume of air requires a large diaphragm or cone (to get good bass from a horn requires a very large mouth for the horn), and the coil and magnet motor driving the large cone must be of heavy duty construction and able to cope with high currents. Fair enough, but to produce high frequency sounds requires only a relatively small movement of the diaphragm, and one which is very rapid. Immediately we have a contradiction of requirements. Whereas a transducer producing a deep bass not will be vibrating at around 50 or 100 times per second, a high frequency unit cone will need to vibrate at a rate of 15,000 times per second or even more. To achieve this high rate of vibration requires that both the cone and the coil be physically light in weight, because clearly, it is more difficult to make a heavy object vibrate quickly and controllably than a light object. So the requirements for producing good, solid bass and clear, high-pitched treble are by definition mutually contradictory. If high frequencies are fed into a speaker unit designed to handle low frequencies, then the large heavy cone, which is an essential part of an LF unit, will be asked to do the impossible — that is move fast to radiate high frequencies. If low frequencies are fed into the tiny light coils and delicate diaphragm of a high frequency unit, the coils will either burn out or the diaphragm will be ripped out of it's mounting — whichever happens first. A mid-frequency unit, as used in portable radios and car systems, will audibly distort or 'break-up' if fed with bass or high notes that it cannot manage. Moreover an HF unit must be carefully shaped to disperse the high frequencies which it is creating.

Whereas bass frequencies radiate in more or less every direction from their source, high frequencies tend to beam like light. This creates an unpleasant effect for the listener and means that good stereo will only be heard in one part of the room, where the HF beams from the two speakers of a stereo pair intersect.

Designers seeking to produce proper dispersion of clean and reasonable volume levels of sound over the full frequency range

(around thirty or forty Hz to up to around 20 Hz) must arrange to split the frequencies fed to the loudspeaker cabinet from the amplifier into several different frequency channels and feed them to different speaker units mounted in the cabinet which have been designed to work best at the frequencies of the signals they are to receive. In the simplest multi-speaker system there is a bass unit (LF unit woofer) and a high frequency unit (HF unit tweeter). In a more elaborate system there is a woofer, tweeter, and a mid-range or MF unit, as was once (but very seldom now) called a squawker. The signal from the amplifier is split into the requisite frequency bands by a 'crossover' unit. For a two-speaker system, the crossover is two-way, and for a three-speaker system, three-way. Superficially it sounds ideal and simple. Route the high frequencies to the HF unit, the mid frequencies to the MF unit and the bass frequencies to the LF unit. That way no unit has to handle frequencies outside its normal working range. Unfortunately it isn't that simple. First and foremost, it is impossible to design an electronic crossover circuit which will sharply cut off the incoming wide band signal into two, or three, separate narrower band signals. You just can't design a filter to cut a signal like a knife at a fixed frequency. If you try, you end up with all manner of distortions and echoes ('ringing') in the chopped signal. It is necessary, instead, to have the filter work gradually and "roll off" at around the ideal crossover frequency. There are various types of filter available, some of which roll off more steeply than others, and there are advantages and disadvantages in using both steep and gradual filters. A gradual filter starts to roll off well before the crossover frequency and carries on feeding signal through long after the crossover frequency. So unless there is to be a wide operating gap between two speaker units (for instance the LF and MF units) both the units will have to be happy handling a fair load of each other's frequency range. In other words, the MF unit will have to handle a fair amount of LF signal, and the LF unit will have to handle a fair of MF signal. Once again, then, the designer must consider all components together, not think just of the crossover and ignore the speaker units. He must be sure that the speaker units he chooses to use with the selected crossover can cope with the demands placed on them by that crossover. It might seem that steep cuts are best because the steeper the filter operation the less load sharing there will need to be between the different speaker units. But as already implied, the steeper the filters the more distortion there is likely to be of the signal that they are handling. Particularly important, as a signal is passed through a steep filter it will tend to have its phase characteristics altered, so that phase discrepancies may arise between adjacent speakers in a cabinet. This can cause unwanted cancellation or boosting of some frequencies more than others (with coloration of the sound) and a muzzing of the stereo image (similar to that produced by reproducing stereo from a pair of loudspeakers wrongly connected out of phase). Also, a steep filter can produce other anomalous effects. For instance if a musical note played on a single instrument rises or falls in pitch it may appear to jump sharply between one area of the speaker cabinet and another, as it is routed by the filter first to one unit and then another. Clearly such anomalies can be revealed by listening tests or measurements or both.

As previously mentioned, the current breed of phase compensated loudspeakers seeks to preserve whatever phase coherence may exist in the original recording. These designs also seek to compensate for the known fact that even when high a low notes are reproduced in phase if they emanate from different units on one and the same flat loudspeaker baffle, they will reach the listener out of phase. This is for the simple reason that the practical starting time of the notes will not be identical. There is more inertia in a large speaker cone than in a small cone, so cone inertia delays the starting time of the lower notes more than the higher notes. This is the reason why stepped, or slant, baffles are now being adopted by some loudspeaker manufacturers, the starting points of the different notes being thereby broadly staggered to compensate for their time delays due to inertia. But clearly any such approach is a compromise, because the system must cope with an infinite number of musical frequencies and there are only two, three, or

perhaps at the most four, units in a cabinet that can be staggered. While on the subject of phase coherence, it is worth bearing in mind that in an effort to achieve this one manufacturer is now using a 'filler driver', which is an extra speaker unit in addition to each pair of standard units. The extra filler driver fills in the otherwise awkward acoustic gap left by a specific type of crossover unit designed to feed two conventional units with phase coherent signals.

I have noticed the word impedance much used in reviews — what does this mean?

Every electrical circuit has a resistance to electricity passing through it. But in the case of a loudspeaker this is an especially complex consideration because the speaker's overall resistance (or more accurately it's impedance) is a combination of pure resistance, capacitance and reactance. These last two produce different effective resistance depending on the frequency at which an audio signal fed through them is alternating. As all audio signals are by definition of varying AC, the impedance of a loudspeaker unit will inevitably vary with the signal being fed into it. Thus there is actually no such thing as an "8 ohm" or "4 ohm" loudspeaker, even though most speakers are advertised as if they have constant inpedance. Impedance measurement over the full frequency range is thus an essential part of any review. As a rough guide the more constant the speaker characteristic is over the full rnage of audio frequencies, the easier it will be to drive and the less likely it will be to upset (or even damage) some amplifiers.

How important is frequency response over the full audio range?

Ideally a loudspeaker should produce all audible frequencies with equal loudness (sensitivity and efficiency). But by now it should be clear why some compromises are always necessary. If a loudspeaker produces a 'flat' frequency response between 35 Hz and 16 kHz, then it can be regarded as a good performer. Incidentally by 'flat' one normally means with no sudden peaks or dips and no gradual rise or fall-off of greater than 3 dB (3 dB is fairly easy to detect). But note well that the frequency response of a loudspeaker will vary depending on the distance and angle from which its output is measured.

To make measurements meaningful, it is best ot check speaker performance at three different angles. The fixed distance two metres has been chosen as representative of a normal listening situation. Measurement results also differ depending on whether random noise or a steady tone is fed through the speaker, but we are using noise because it approximates more closely to a real musical listening situation. The tests are of course carried out in an anechoic (acoustically dead) chamber to eliminate the effects of reflections from wall, ceilings and floor and resultant standing waves. Incidentally a slight irregularity or ripple in the frequency response curve is better than an overall climb or fall. The latter would mean that all bass or treble frequencies are consistently too high or too low, and this could well cause overall coloration of the reproduced sound.

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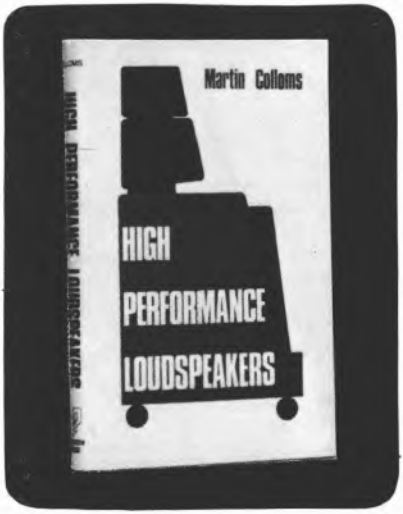

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Some of the points concerning the review methods adopted have already been outlined in the *Consumer Introduction*, but the following is a more detailed and technical description of all the stages involved. These fall into three distinct sections, the first two concerned with listening tests and the third with laboratory testing.

LIVE VS RECORDED TESTS

Most loudspeaker designers, while attempting to produce a commercially competitive model, will readily concede that a prime objective is to make the most accurate and hence natural sounding loudspeaker for the price. Indeed all the other components in the hi-fi chain are similarly engineered to produce the least alteration in program, whether it be disc, radio or tape. It follows that a highly relevant test is to compare a live sound (voice or musical instrument) with an accurate recording made of the same sound replayed via the test loudspeaker.

Testing for Fundamental Accuracy

Any model with pretentions to accuracy and neutrality should make a reasonable attempt to mimic reality. This test is undeniably difficult to set up, and it involves several compromises as well as relying to some degree on the skill of the recording engineer in accurately capturing on tape a satisfactory proportion of the natural character of a live sound. To this end, we used the finest microphones available, chosen on the basis of their minimal coloration, with a sensible spacing between live source and mike, namely 1-2 metres. The recorder was carefully aligned for the tape used, and was left free of any additional processing encumbrances.

Even reverse copying was considered, in order to eliminate the usual phase shift accompanying most recordings. The actual recording environment itself is also important; it should be very 'dry', ie possess a very short reverberation time, the latter ideally measuring zero, which corresponds to true anechoic conditions. Accordingly we decided to make use of an anechoic chamber to make the recordings, in this case, that at the GEC Research Centre, Wembley.

There are also other quite obvious problems; for example, the testing chiefly evaluates the energy and coloration of the speaker in the forward radiating angle, and tests little of the radiation off axis — a factor which may possibly affect the frequency balance of a speaker when used in a different listening room. In addition, the range of test sounds are, of necessity, restricted. Errors due to mike position, the differing radiating properties of the test speaker and live source, as well as the recording and amplifying processes are also present, but despite all this, the use of a live source has proved invaluable in the past in pinpointing coloration and frequency balance problems.

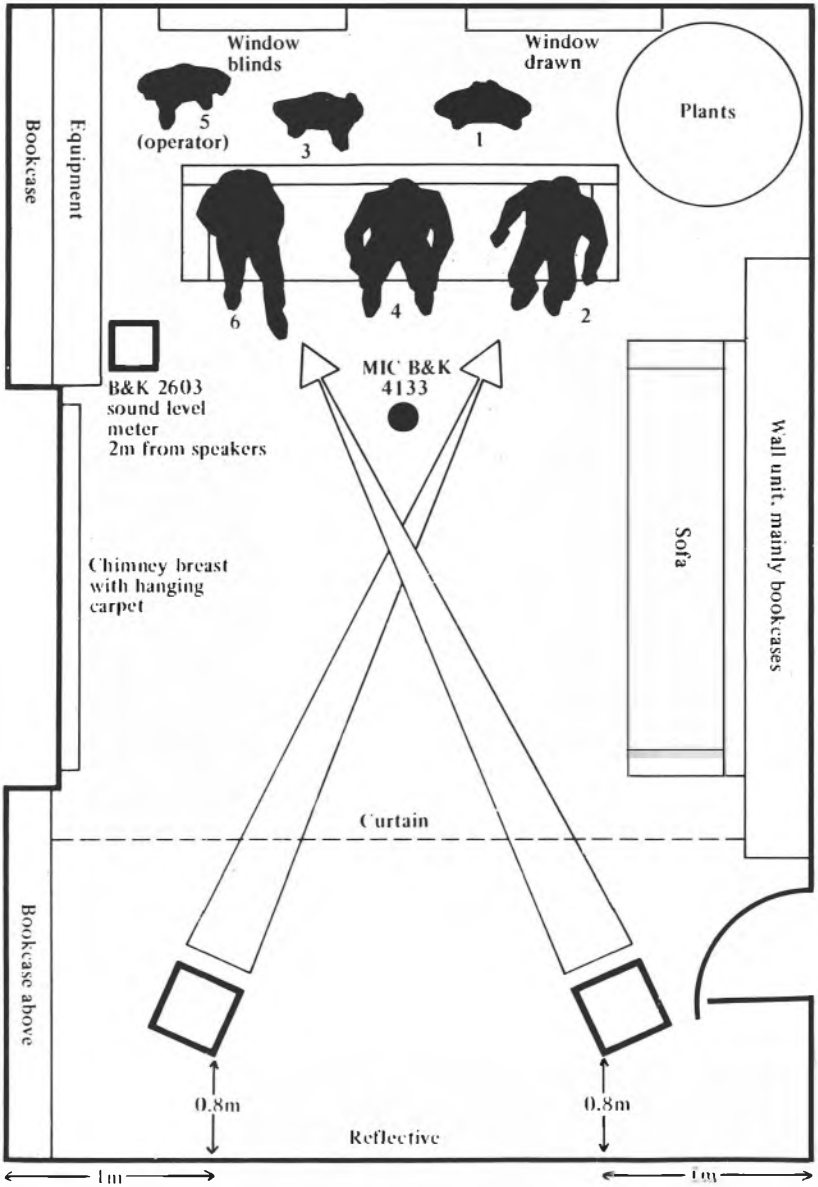
Replay environment

The recording was done in mono, for simplicity's sake as well as to improve localisation stability, and the replay environment was selected for a clean reverberation time, under which conditions the panel were able to judge quite accurately the characteristics of the test loudspeakers.

My personal listening room was analysed for reverb. character at the beginning of the project, and was found to be particularly favourable. Above 100Hz the Rt curve aligned closely to 0.3 of a second, indicating an even, balanced and uncolored characteristic. Inevitable irregularities below 100Hz were recorded but were considered to be well damped; for example the Rt did not exceed 0.51 at 50Hz. Rt data was recorded by two methods using 5 microphone position dispersed throughout the room. Real time high speed pen traces were taken, plus recordings of warble tone bands, which were also analysed. On the basis of the results, and as the room was large enough to comfortably accommodate the 6 panellists with a realistic distance between them and the test speaker, (2.5-3m) it was decided to use the room for all our listening sessions.

The Test Procedure

The test procedure adopted here involved constantly running the pre-recorded tape containing short verbal or musical phrases interspersed with blank sections, the latter filled in on test by the live performers. A carefully worked out entry sheet was provided



Listening room data

Actual dimensions: 9' 6"H x 13' 9"W x 18'4"L.
(IEC mean recommended dimensions:
9'H x 13.9"W x 22'L)
Actual reverberation time: 0.3 seconds ⁺20%, 100Hz; less than 0.6 seconds at 50Hz.
(IEC recommended reverberation time: between 0.3 and 0.65 seconds, mean 0.45).

Substantial Victorian house; suspended floor and ceiling (the latter heavily loaded by speaker loan stock above); heavy carpeting (3 ply) on floor. Over 50% of surface area of walls lined with book shelves; wall adjacent to loudspeakers reflecting, wall behind listening panel mainly absorbtive. Dominant absortive furniture, two large Chesterfield sofas.

for each panellist so that he or she could mark within an agreed scaling and framework of comments and characterisation. In addition to numerical scaling for accuracy or naturalness-of-reproduction, other factors such as coloration and frequency balance were also assessed. The obligatory curtain (acoustically transparent) separated the panel and sound source, thus concealing the identity of the loudspeaker under test, while the very nature of the musical sounds themselves forced us to take certain other problems into consideration. For example, in the case of a cymbal recording with a dominant frequency range from 2kHz-15kHz, the microphone position was adjusted to capture a balanced sample of the instrument's output, but by its very construction, a cymbal radiates in all directions, and its sound in a listening room would thus be a combination of direct and reflected sounds. However, with the exception of the Bose 601, the speakers reproducing the recording will predominantly radiate in the forward plane over this frequency range, and hence will not produce a significant output of wall-reflected energy. Accordingly when forward radiating speakers were auditioned, this discrepancy was dealt with by providing temporary absorption over most of the rear wall surface behind the instrument.

Choice of source material

The choice of exactly what sounds to use was a difficult one to make, as they all needed to be easily reproduced, but at the same time carry sufficient information to allow worthwhile judgements to be made. First on the list was male voice; hardly surprising, since our hearing systems are fundamentally designed to analyse speech. Acoustic guitar was also included, having proved useful on previous tests; both it and voice are sensitive indicators of midrange quality. Another revealing sound with great percussive transient quality was that of a side drum, both with and without snare. The treble range was allocated to an instrument which many speakers changed out of all recognition, namely the aforementioned cymbal, and a wooden xylophone was also used, producing a quickly damped percussive note with characteristic timbre. We decided to emulate a test first used successfully by Acoustic Research some twenty years ago, which relied on a simulated test source. In this case, pink noise is fed into a wide band single unit dome loudspeaker, possessing particularly low coloration. A recording of this was made in the anechoic chamber, and as with the musical instruments, the quality of 'test' reproduction as compared with the original source, could be readily assessed. Finally, as an accurate recording of bass instruments is difficult to achieve, and in order to offer some basis for judgement in the low frequency range, a live electric bass guitar was played through all the speakers in turn. Those readers familiar with a Fender Precision Bass instrument will appreciate its characteristically even and predictable output, from bottom E (45.7Hz) upwards, with a clean transient start to the plucked note and a recognisable tonal balance. Although admittedly a somewhat limited test, the bass quality of each speaker was assessed in terms of range, evenness, power distortion and finally, coloration. Bass judgements also appear in greater detail in the stereo tests.

Assessing Maximum Acoustic Level

The live-vs-recorded session provided an arrangement whereby the 'maximum acceptable' sound level available from each speaker could be assessed. A well balanced tape section of rock program was played at increasing level, until either the loudspeaker began to sound distressed — rattled or distorted — or the amplifier clipped. A 500W amplifier was employed (per channel rating, 8 ohms), with simultaneous monitoring of peak program power, average program power and sound pressure level in dBA at 2m. The panel was also asked to judge the overall quality at high levels. For the record, the best examples were heading towards 110dBA at the maximum amplifier headroom, and surprisingly, a large number of relatively small systems tolerated up to 500W peak without complaint. In fact, the least efficient systems in the survey actually needed the full 500W headroom in order to reproduce the drum, cymbal and xylophone at the correct level, even though the real instruments were played relatively softly. This was undoubtedly a result of the careful recording technique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which retained much of the high transient peak nature of these instruments.

Control repeats
During the live-vs-recorded sessions, as with the stereo listening session, a number of repeats were incorporated, both to test and check the validity and consistency of the methods employed, as well as to investigate panel marking variations and possible extraneous influences on results such as session timing, morning or afternoon, etc.

Data analysis
The usual statistical analysis was applied to the numerical data, including mean and standard deviation, which allowed the basic ranking order to be established, the error factors to be assessed, and consequently the groupings on the basis of sound quality to be established. A Normal distribution curve was assigned to the data in order to roughly subdivide the group on the grounds of their subjective performance, such groupings being undertaken *prior* to the author being appraised of the name of the model concerned. Furthermore, the general comment on subjective quality is drawn directly from the panel assessments as written on the individual test sheets.

DOMESTIC STEREO LISTENING TESTS

These sessions proved more arduous for the panel, as the members were required to provide a considerable amount of information for each loudspeaker. In addition to particular comments on frequency balance and coloration (these mainly drawn from a recommended table of characterisations), in all the panellists needed to give a numerical judgement on a total of 5 factors: overall accuracy and/or realism; frequency balance or subjective response flatness; clarity and detail; coloration; precision and depth of stereo image.

Again concealed behind a curtain, each pair of speakers was presented to the panel, care having been taken to observe the optimum mounting conditions (correct height, angle, and also position relative to local reflecting surfaces). A programme lasting approximately twenty five minutes was reproduced at a realistic 93-95dBA maximum sound pressure (measured at 2m), with the average level in the 80-90dBA range.

Several amplifiers were auditioned for use in this test, and of these, the Naim 250 proved to be the most neutral. Peak levels were monitored to ensure that the amplifier was not clipped (the less discriminating high level tests were incorporated in the live-vs-recorded sessions).

A reasonable balance of taste was presented by the program excerpts, which included large pipe organ, piano, violin, choir, female spoken voice, full orchestra, female singing voice, two rock sections and a folk band. The sources were mainly original or copy master tapes, with three sections drawn from discs. The recording techniques that had been used were mainly crossed-pair, but multi-mike recordings were also included.

Data analysis
The test sheets were analysed in two ways, firstly for scoring on each programme excerpt, and secondly for each performance parameter, independant of program. Possible program/speaker interactions were also investigated and duly taken into consideration.

LAB TEST PROGRAMME

The measurements were undertaken at one of the largest anechoic chambers in Europe, which is located in the Government-owned Building Research Station, at Garston, Watford. Every attempt was made to undertake measurements generally held to be of the greatest relevance to sound quality factors.

The Characteristic Forward Response
This primary measurement concerned what is termed 'the integrated, averaged, forward frequency response; using $\frac{1}{3}$ octave filtered measurement of a broad band 'pink' noise (constant energy per $\frac{1}{3}$ octave) output from the speaker. The axial, 10° vertical and 30° horizontal (lateral) responses were recorded, and for comparative purposes, all three are reproduced on the same graph. Where a

speaker showed significant lateral assymmetry, curves in both left — and right + directions were taken. In addition the vertical response was set 10° above a small enclosure, but 10° below a tall one.

Traditionally, such measurements have been undertaken at a mike-to-speaker distance of 1m, but for this project it was decided that the characteristic forward response should be measured at a 2m microphone distance, which corresponds more closely to a normal listening distance in a domestic environment. Due to limitations of the pink noise averaging technique at this range, the extreme low frequency portion of the graphs should not be interpreted too strictly. For a more accurate indication of performance at LF, the reference sine wave curve (taken at 1m) should be inspected; the quoted LF cutoff values in the data relate to this surve. 1m and 2m curves will differ somewhat, since at 2m cabinet diffraction affects are reduced, and the outputs of several driver will begin to integrate more effectively.

A good performance in terms of the characteristic forward frequency response can be outlined as follows:

1 An even, wide and balanced *axial* response, well within the major ±3dB.
2 A 10° vertical curve deviating by no more than 2-3dB from the axial response, up to 15kHz or so.
3 A 30° lateral curve deviating from the axial response by no more than 3-4dB up to 15kHz.
4 Close symmetry of response in the left and right hand directions.

A loudspeaker meeting these requirements would be classed as one with a smooth and uniform output over the 20° vertical by 60° horizontal listening 'window' and, potentially, it should be capable of a natural sound with good stereo imaging, if its coloration, and to a lesser extent distortion, is sufficiently low.

Reference curve

All loudspeakers (both left and right-hand models) were measured on sine wave at 1 metre. This provided an accurate representation of the low frequency response (for hi-fi purposes the Garston Chamber is accurate to 30Hz), and also gave a reference trace which coincides with the conditions of measurement used by most manufacturers. Furthermore by overlaying the curves of left- and right-hand speakers, the pair matching could be checked, and finally this measurement set a reference level against which the distortion readings could be scaled (see *distortion),* and the quoted lab sensitivity established.

Distortion (3rd harmonic)

In the event it was not found possible to duplicate all the distortion measurements given in the previous issue of Hi Fi Choice Loudspeakers (namely 2nd and 3rd harmonic plus swept intermodulation). Working on the basis that 2nd harmonic is relatively harmless due to its subjectively innocuous character, it was decided to measure the 3rd harmonic content, at a 96dB pressure level and 1m. Two points are however worth mentioning: first, the mechanisms in loudspeakers which produce odd harmonics such as the 3rd are also those which relate to intermodulation, so indirectly, IM aspects are also included. Secondly, it will be seen that the harmonic measurement is continued to the microphone response limit at 36kHz, (ie the 3rd harmonic of 12kHz) even though this is beyond audibility. This was done simply because if significant 3rd harmonic is generated, it is also likely to produce difference intermodulation products which could be audible.

Ideally 3rd harmonic distortion levels of well below 1% are desirable at mid frequencies, and while some rise is inevitable at low frequencies below 100Hz, even here a target maximum of 2% is worthwhile, rising perhaps to 5% below 50Hz.

The stated 96dB sound pressure level at 1 metre is a fairly high one, and whilst the larger medium efficiency models only required a few watts to attain it, the smallest lower efficiency designs found it rather a strain. In such cases the test level was reduced to 90dB, and the change noted. A percentage scale has been printed for convenience sake, but note that correction must be made for significant changes in level on the reference trace; this is particularly relevant at the lowest frequencies where the axial power falls away.

Impedance
Using constant-current drive from the B&K sweep oscillator, the modulus of impedance of the loudspeakers was plotted, the 25dB logarithmic potentiometer range conveniently encompassing the great majority of variations. The 0dB or baseline is set at 3.3 ohms which gives 10 ohms at +10dB, and 33 ohms at +20dB. This curve represents the electrical combination of resistive and reactive parts (whether capacitive or inductive), and to assess the magnitude of the reactive component, measurements were also taken of the phase angle of the impedance over the nominal 20Hz-20kHz range. When a loudspeaker shows low impedance and or high reactive components in combination, it is regarded as difficult to drive and could well cause matching problems with amplifiers designed primarily for an 8ohm nominal loading.

Constructional quality
All the enclosures were inspected both inside and out to assess the quality of their construction, the grade of components used, and the general standard of their engineering. During all tests, any buzzes or rattles were noted and where possible their source identified.

In fact, a surprisingly large number of systems did produce spurious noises on clean low frequency signals. Their causes ranged from inadequately secured crossover components and boards, poorly fitted rear terminal assemblies, and frail driver mountings, with in some instances no real attempt made to seal either the panels of the cabinet itself, or the drive units to the front baffle.

Sensitivity and power rating
From the reference curve, a mean mid-band sensitivity figure was recorded, this corresponding to the sound pressure at 1 metre from the enclosure, while energised by 2.83V (sine). A nominal 8 ohms draws 1 watt from this voltage, and lower impedances draw more power, on a pro rata basis. Since amplifiers (within their limits) are theoretically voltage sources, this method of specifying voltage sensitivity is a sensible one. Likewise, as no loudspeaker presents a constant impedance value, a power input sensitivity rating is rather a pointless one.

From the power handling, sensitivity and impedance data, a recommendation can thus be made concerning the loudspeaker's minimum and maximum amplifier power rating (per channel, 8 ohms). It should be appreciated that this is only a recommendation, and will be modified in practice by individual taste; ie a requirement for high or low listening levels as well as by the size and acoustics of the particular listening room involved. The minimum amplifier power that is quoted relates to a typical maximum sound pressure level of 96dB (2 metre) from a stereo pair of speakers in an average room of volume 80 cubic metres.

It is almost impossible to specify a maximum power rating, as a complex relationship exists between the type of program, the maximum power input (peak and average) and how long this maximum level is maintained. In this test we found most of even the smallest speakers could sustain a 500W peak, 250W mean power input on solo instruments in the mid band, provided that its duration did not exceed 15 to 20 seconds. On highly transient signals a 500W peak could apparently be indefinitely tolerated if the mean power was low — in the case of the levels required to reproduce the live instruments, the *average* power was often below 5 watts.

A strange contradiction was apparent in terms of amplifier size, with the larger models appearing to be safer than smaller ones! Take for example the case of the Spendor BC1. It incorporates a Celestion HF 1300 treble driver which is rated at not more than a few watts, and yet the system as a whole survived the high level test at a full 250 watts mean for over a minute, and easily tolerated 500W peaks. However, partner this system with a smaller 35-50W amp, and drive the latter beyond its limits into clipping, and there is a good chance that the treble unit will blow, as many BC1 owners will testify, having tried to use the speakers for a party! This example clearly illustrates the difficulty of defining speaker power ratings.

Acknowledgements
Bruel & Kjaer, for the loan of the gating unit and for advice on measurement techniques.
Mrs. M. Barker.
Roy Brooker, of GEC Hirst Research Centre.
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Catherine Colloms, for loan of musical instrument.
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Paul Crooke, for invaluable assistance throughout the project.
Enigma Records Ltd, for loan of Dolby 'A' unit.
Tony Faulkner, of Enigma Records, for considerable advice on recording techniques, and loan of material for the stereo test sessions; also for his role as a panellist and independant critic.
Fender Sound House, Soho Square, for the loan of musical instruments (snare & side drum, cymbals, electric bass guiatr).
Steve Jacques, for considerable assistance in live-v-recorded sessions.
Lentek, for loan of moving-coil pre-amp and Entre cartridge.
Paul Messenger, for loan of Naim NAP250 amplifier.
Monitor Audio for loan of Sound Cable.
Pioneer, for loan of tape deck, RTU11/TAU11.
Rank Audio Visual, for loan of Rotel RTB5000 amplifier (500W per channel).
Sansui, for loan of amplifiers BA/CA2000.
S.M.E., for loan of SME 3009 111 pickup arm.
David Stebbings of Chartwell, for reverberation measurements in my listening room.
Technics (National Panasonic), for loan of tape deck, 1500.
Yamaha (Fallowfields), for loan of amplifiers B2/C2 and ILV speaker cable.

Listening panel
Marianne Colloms
Martin Colloms
Tony Faulkner
Alan Harris
Adrian Hope
Paul Messenger

Additional data provided by Paul Crooke, who was the main test sequence assistant

Location
Laboratory tests: Building Research Establishment, Garston, Watford; test equipment supplied by author. Subjective testing: author's listening room (for details see technical introduction).

Equipment used
1 Domestic stereo listening tests
Dolby 'A', 361 x 2
Lucas ILV speaker cable
Naim NAP250 amplifier
Pioneer TAU11/RTU11 tape deck
Realistic Sound Level meter (referenced to B&K S.L.M.)
Sansui BA2000 amplifier and CA2000 pre-amp
Technics 1500 tape deck
Modified Thorens TD160 turntable with SME 3009 111 pickup arm and Entré cartridge.

2 **Live-v-recorded tests**
B&K 4133 12.5mm precision microphone
B&K 2603 microphone measuring amplifier
Calrec microphone and phantom power unit
ITT LPK M130 simulated noise source on baffle
Pioneer TAU11/RTU11 tape deck (pre-aligned)
Rogers pink noise generator
Rotel RB5000 power amplifier
Sansui CA2000 pre amplifier
Sound Cable and Lucas ILV cable
Technics 1500 tape deck

Instruments
Ludwig snare drum, courtesy Fender Sound House.
Paiste hi-hat cymbal and stand, courtesy Fender Sound House.
Fender precision electric bass guitar, courtesy Fender Sound House.
Epiphone acoustic guitar, courtesy Steve Jacques.
Wooden xylophone.
Noise source.
Male voice (Steve Jacques).

Technical Introduction

Lab testing
B&K piston phone calibrator, courtesy Building Research Establishment.
B&K 4133 precision 12.5mm microphone
B&K 2603 microphone amplifier and recorder drive
B&K 1614 f-octave analyser
B&K 10m microphone remote cable
B&K 2305B high speed level recorder
B&K 1014 BF sweep oscillator
B&K 4440 delayed measuring gate specially modified for trailing pulse trigger
B&K 25dB, 50dB and linear 110 mV potentiometers
Digital phase meter, courtesy Bob Stuart, Meridien
Calibrated reference resistors for impedance scaling
ITT LPK M130 phase reference
Lucas ILV cable
Levell TM11 electronic multimeter
Rogers pink noise generator, (specially aligned)
Sansui BA2000 power amplifier
Telequipment D83 oscilloscope

Programme used for stereo listening tests
The extracts comprised a selection of 10 tracks, recorded in Dolby 'A' mode.
1) Jennifer Bate, Liszt, **organ recital,** Royal Albert Hall, crossed-pair technique, Enigma VAR1051A.
2) Maurice Hasson and Ian Brown. **Violin and Piano duet,** crossed-pair technique, Enigma VAR1025A.
3) Elton John, Yellow Brick Road, **pop from disc recording,** DJLPD 1001.
4) John Lill, **solo piano,** crossed-pair technique, Enigma VAR 1006B.
5) George Malcolm, Northern Sinfonia, Handel Concerti Grossi, **classical orchestra,** Enigma VAR 1045A.
6) Prokofiev, Peter & The Wolf (Angela Rippon, Owain Arwel Hughes, RPO), **classical orchestra,** Enigma VAR 1041A.
7) Leo Sayer, Endless Flight, **high level pop.**
8) Sibelius 5th Symphony (Von Karajan, BPO) **(distorted disc,** end of side track on moderately worn record) DGG SLDM 138973.
9) Steeleye Span, Rocket Cottage, **electric folk band.**
10) Westminster Cathedral **Choir,** Enigma VAR 1016A.

Tony Faulkner's Introduction
Listening through an extended programme of domestic stereo and of live versus reproduced speaker audition tests is a very taxing activity, particularly with such a large number of different units. What made this particularly interesting was that at no time was I told the identity of any system I had heard, right up until after completing the writing-up. This is indeed a cruel test, but nonetheless important to preserve lack of preconceptions and bias.

As with any individual, my feelings are strictly personal and will undoubtedly be disagreed with by some, but I can assure the reader that they are the sincere opinions of one particular pair of 'professional ears'. What I look for in a speaker is clarity throughout the audible range, without fatiguing characteristics such as excessive mid-band coloration, boomy bass, ragged extreme top, and wandering, unstable stereo images — these particular problems tend to become very wearing during the course of a day's work. My job is concerned solely with classical music, and I am quite prepared to monitor at less than ear-splitting levels in order to avoid the compromises in speaker performance usually necessary to achieve high sensitivity and power-output.

I have to listen to quite a variety of loudspeakers in my trade, and I can say in all honesty that my only reference as such is what I hear (or think I hear!) in the concert-hall. To rely too much on one monitor loudspeaker design is, I believe, a mistake since familiarity breeds contempt, and one can end up tailoring one's recordings to minimize the design problems of the monitors one chooses (with equalization, etc.). To refresh my 'acoustic memory', I attend a large number of concerts, and I would suggest to many readers, and also speaker designers, audio critics and recording engineers, that that is the only way I have yet discovered of managing to keep one's 'feet on the ground'. In my world of classical music, reference to live sound is of great importance, however the world of rock and middle-of-the-road music has no similar reference, and I have very limited experience in this field of recording. Nonetheless, design difficulties apparent in classical music and live-versus-recorded speaker tests will very often be just as

noticeable in rock music, although the high-levels sought by many enthusiasts will generally have to be achieved through extra compromises in speaker design to gain efficiency, unless one has a very deep pocket for high-power amplifiers.

In summary, my comments have been included separately in each review in order to give one particular person's findings rather than just an amalgam of the whole panel's comments. The adage 'one man's meat is another man's poison' will not be inappropriate for some readers (and doubtless manufacturers!) when they read what has been said by the *Hi-Fi Choice* team throughout the book. But this book is intended as a stimulant for readers and enthusiasts to go out and judge for themselves, as well as noting our findings. After all the final purchaser of a pair of loudspeakers has to listen through his own ears, not those of a listening panel or a B&K test microphone.

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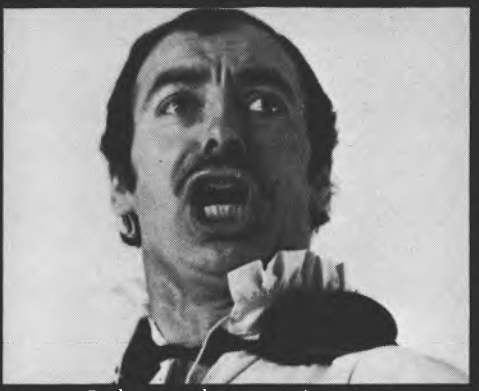

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Rola Celestion Ltd., Ditton Works, Foxhall Road, Ipswich, Suffolk IP3 8JP. Telephone: Ipswich (0473) 73131. Cables: Voicecoil Ipswich. Telex: 98365.

Dispersion: This term describes the uniformity of the forward directed sound output over the frequency range in this context, and is derived from the noise-averaged responses at a 2m mike distance, within a forward radiating 'wedge' of 20° vertical x 60° horizontal.

Sensitivity: This relates to a visually derived *mean* sound pressure level (SPL) of the axial response at 1 metre, for a 2.83 volt (1 watt, 8 ohm) input, and is considered to be more sensible than the oft-quoted figures for a single frequency sensitivity. For reasonably flat loudspeakers, the db'A' reading is of the order of 2.5dB less than the 'linear' sensitivity quoted in the reviews.

Maximum sound output: The 'A' weighted sound pressure figure is a somewhat arbitrary indication of the maximum sound output available from a pair of speakers under domestic conditions (microphone distance, 2 metres.) The figure quoted was arrived at when either the 500W amplifier used was close to current limit or voltage clipping, or else more often, when the sound quality of the speaker concerned had noticeably deteriorated before clipping, due to the onset of loudspeaker overload (rattling, cracking or other related effects.) However, there were a few speakers whose sound quality with increasing volume was so unpleasant that the panel was forced to set their own 'maximum tolerable' loudness level, before either the amplifier clipped or the speaker overloaded.

Maximum power for matching amplifier: This figure corresponds to a per-channel continuous rating, assuming that speech or music is the signal. It is based on a combination of several factors, namely power handling data derived from the maximum sound output tests; on the manufacturer's own rating where this is adequately specified, and on other considerations such as sensitivity of distortion, as well as speaker type and design.

Minimum amplifier power: Working on the same basis, the minimum amplifier power is estimated from the sensitivity, related to a satisfying 96dBA maximum sound level from a pair of speakers under normal domestic listening conditions.

LF Rolloff (—6dB point): To give some comparitive and numerical indication of the depth of low frequency output from the speakers, the —6dB point has been tabulated, (referenced to the nominal sensitivity). At the lowest frequencies some anechoic chamber irregularities are inevitable, but the overall basis of comparison still holds true.

Overall Frequency response: The qualifications attached to the loudspeakers relate to the assumption that a reasonably wide and uniform response is a desirable attribute.

Coloration: This rather vague term can encompass the subjective effects of both unwanted resonances as well as spectral imbalances in a speaker. For example, a system with a uniform frequency response might sound 'boxy' or 'tunnelly', these characterisations associated with hidden resonance effects in say the 200-500Hz frequency range. Conversely another system, which in engineering terms is essentially free of such coloration inducing resonances, might still suffer from much the same problems, in this case due to a non-uniform frequency response; for example, one prominent by an average of 3dB in the aforementioned frequency range. In fact the most commonm coloration in louspeakers is akin to that produced by a person speaking into cupped hands, although many other sounds are also recognisable, and may be loosely categorised as follows (these being the main terms used by the *Choice* panellists for the listening sessions.)

Coloration term	approx. applicable frequency range
Boomy	40-80Hz
Chesty, plummy	100-150Hz
Cupboard, hollow, boxy.	150-300Hz
Tubelike, tunnel	400-600Hz
Cupped, honky	700-1.2kHz
Clangy, nasal, hard	1.8-2.5kHz
Metallic presence range	2.4-5.0kHz
Sharp, sibilant	5.0-8.0kHz
Fizz, grit, splutter	10.0-15.0kHz

Other characterisations used by the panellists and which relate more specifically to spectral balance included 'thick', 'dull', 'thin', 'bright', 'present', 'distant', 'middy', 'suckout', 'airy' and 'shut-in'. Distortion-related comments included 'rough', 'aggressive', 'rattles', 'knocking', and possibly 'fatiguing'.

Amplifier loading: A good rating represents a nominal 8 ohm impedance, as defined by a 6.4 ohm minimum resistive component of the impedance modulus. Reactive components are taken into account. The less demanding loads received higher ratings than did the more demanding; for example, 'poor' is accorded systems with a 3.3 ohm minimum. Essentially, amplifiers are regarded as voltage sources, and the current demanded by the speakers is the key to their loading factor.

Third harmonic distortion: For all medium and large enclosures, the test level was 96dB at 1 metre; in the case of the smallest and least efficient speakers such as the LS3/5A and the like, it was reduced to 90dB, and for the diminutive Visonik Davids, by 10dB to 86dB. The measurement threshold in this test was established at just under 0.4% and fair correlation can be shown between this 3rd harmonic analysis and a swept intermodulation test. Distortion values consistently near to, or exceeding, 1% above 100Hz were considered potentially harmful to sound quality; below 100Hz higher values are in fact tolerable, but even in this instance should not exceed c.3-4% at 50Hz.

Overall subjective quality: This takes into account panel comments and scoring, and was assessed 'blind'; ie prior to the author knowing the identity of the speaker concerned. Particular strengths or weaknesses regarding coloration, stereo image quality, and truth-to-life accuracy are also given separately.

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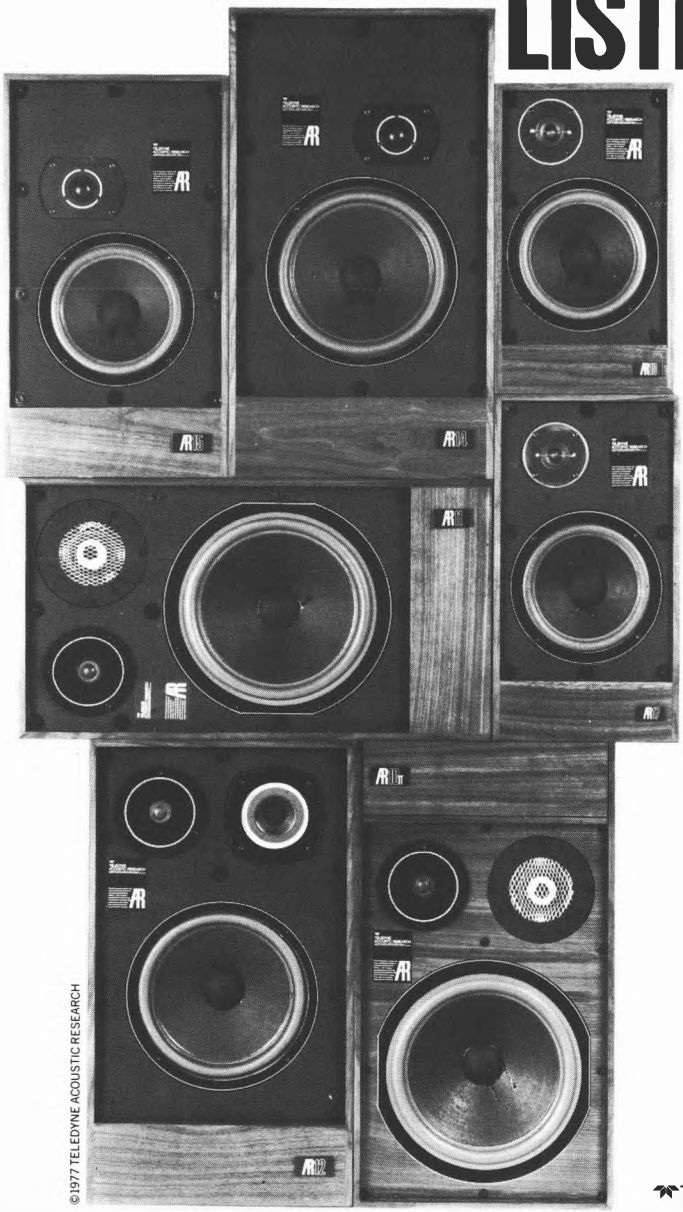
TRUTH IN LISTENING



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Acoustic Research AR 17

Teledyne Acoustic Research, High Street, Houghton Regis, Beds. LU5 5QJ.
(0582) 603151.

The AR17 uses American drive units, but is assembled at AR's British plant at Houghton Regis, Bucks. All the company's systems now come finished in American walnut veneer with black cellular foam fronts, and, in general, they are designed for shelf or close-to-a-wall mounting, the *17* proving no exception. The instructions supplied with the speaker do however suggest that stand mounting 0.3-0.5m clear of a wall is also permissible. Flat and normal response positions are available, the latter producing approximately a 3dB drop in output above 4kHz, to help cope with bright or reverberant rooms.

Technical details

This is a relatively small sealed-box system with a nominal 200mm pulp cone drive unit covering bass and mid-range up to 2kHz. The crossover consists of a single capacitor plus attenuating resistors feeding the 32mm cone high frequency unit, the latter incorporating ferro-fluid loading in the motor coil assembly, which helps to control resonance as well as greatly increasing the power handling.

Lab results

The left and right enclosure responses aligned closely. showing very good pair matching; no more than 1dB of difference was discernible throughout the spectrum. At 1 metre the corresponding sine wave curve indicated a 47Hz nominal rolloff point, which is in fact usual for this size of enclosure. Typically near 0.5%, the third harmonic distortion content was classed as 'good', but did rise to 1% in the 200Hz-500Hz range.

From the impedance curve the sealed box resonance can be seen to be at 48Hz. With an average value of 6ohms, and minima of 5.3ohms at 150Hz and 8kHz, no amplifier match problems are envisaged, although the relatively low 86dB/W sensitivity does mean that a minimum of 20 watts per channel would normally be required to drive the system. The high 105dBA maximum level confirms the loading tolerance, also indicating that the system will permit large power inputs.

The response showed a well integrated characteristic, which was not overcritical of listener position. Under 4π anechoic conditions (ie measuring in 'free space') it is dominated by a mid-prominent region, but as AR make it clear that 2π or wall mounting is the design condition, the relative low frequency loss would to a large degree be compensated for by bookshelf mounting, and rather less so by the alternative stand position.

Sound quality

The overall subjective sound quality was classed as 'acceptable', and while this may not sound too inspiring, it should be viewed in the context of the *AR17's* price relative to that of the group average. Both bookcase and stand mounting were tried (the latter used more frequently), and while the low-mid balance improved with a shelf position, this was accompanied by a relative loss of treble and an increase in coloration, while the bass range also sounded less uniform.

A more detailed analysis of the panel comments showed that the *AR17* responded well to the live-vs-recorded tests, gaining an 'above average' rating, but its results on stereo

programme were disappointing. The panel noted numerous effects, some of which were allied to the characteristic response curve; for example, a mild dulling corresponding to the deficiency in treble output. More serious though was the description of hollow, boxy-type colouration, which while not excessive nonetheless gave a lightweight character which progressively hardened at the higher listening levels. It was however considered to remain relatively clear and detailed with increasing volume and could not be 'cracked', but no great depth or precision could be attributed to the stereo imaging, which appeared constrained by the audible coloration.

T.F. Comments

This speaker was much better in mono than stereo for me, as it gave a rather 'phasey' stereo image. Slightly 'squeaky' extreme HF and 'cupped hands' coloration made the speaker rather small sounding.

Summary

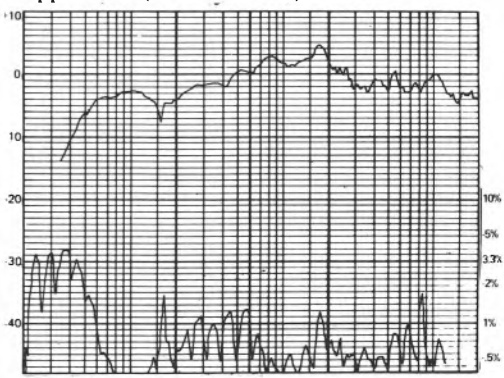
This loudspeaker is clearly free of any obvious failings and might suit some systems and some locations. The results suggest that a combination of an unbalanced frequency characteristic plus coloration effects prevent it from sounding as accurate as many other models of the same price.

Size	47.3(18.6)H; 25.4(10) W; 22.2(8.7) D; cm(inches)
Weight	7.7(17) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 100W
Recommended placement	shelf — near ear level
Frequency response within ±3dB (2m)	NA*
Low frequency rolloff (—6dB) at (1m)	47Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£125

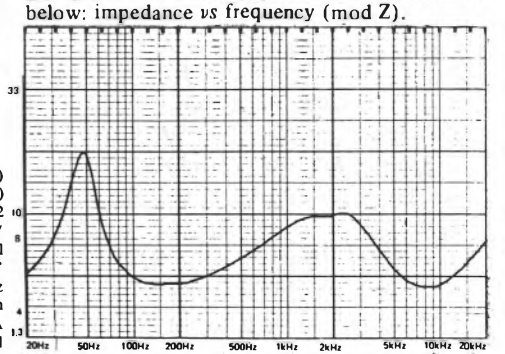
*See text

Note: The photo shows the model tested; current production has slightly different styling but a claimed identical acoustic performance.

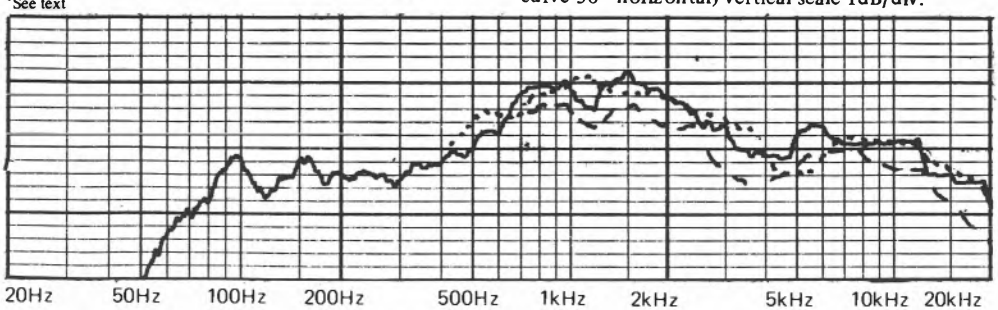
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Altec Model 5

Highgate Acoustics, 38 Jamestown Road, London NW1 7EJ. 01-267 4936.

The *Model 5* is a medium sized enclosure, just one of a wide range produced by Altec Lansing, a long established American company.

No specific instructions as to speaker positioning were included, and accordingly the system was vertically stand-mounted, with the treble units near to ear level. The brochure does however indicate that the driver arrangement will also permit horizontal mounting, presumably on a shelf or bookcase.

Technical details

The bass drive unit is specified as having a frame of diameter 305mm (12″), but in fact it possesses a cone and moving assembly much closer to 250mm (10″). This pulp cone operates up to 1.5kHz, the driver loaded by a vented enclosure with the port in the form of a cylindrical duct. The remaining range is covered by two small pulp-cone treble drivers, these being asymetrically located on the front baffle.

Lab results

Over the bulk of the frequency range the pair matching was very good, but above 8kHz the balance deteriorated, with up to 3dB differences noted. The low frequency rolloff was measured at 47Hz which is acceptable for this size of enclosure. The third harmonic content was low enough over the main part of the range to warrant a 'very good' rating,

Never falling below 6 ohms and offering a low reactive content, the *5* rated as easy to drive and hence acquired a 'good' loading comment. While the sensitivity was fairly high at 89dB/W, some restriction was encountered on power handling which held back the maximum sound level to an 'average' value.

Analysis of the sine wave frequency response at 1 metre revealed further important features. A prominent bass area centred on 75Hz, some 5dB above the adjacent sections, was in fact some +3dB up over the whole mean response. This finding conflicts with the brochure which states 'the Five eliminates the "boominess" so prevalent in other speaker systems in its price range'.

The characteristic response was rather disappointing for a system at this price level. Its considerable unevenness, together with the wide off-axis deviations imply that the sound quality in front of the speakers will vary rather dramatically with position. For example, at a fairly moderate 30° in the lateral or sideways axis, a deep 15dB suckout developed, half an octave wide at 4kHz. At a moderate 10° angle above in the vertical plane, the treble range began to phase out, with an 8dB loss at 10kHz. The sine wave response trends already noted were repeated in the $\frac{1}{3}$ octave 2 metre axial response, and such characteristics are all likely to colour the sound, even if coloration inducing resonances in the accepted sense are absent.

Sound quality

It would be honest to say that on sound quality grounds the *Model 5* made very little headway against the average performance of the group as a whole, despite, or perhaps partly because of, its relatively high price in the UK.

In general the panel considered its performance in reproducing live sounds to be poor, and while it improved on the stereo test, a final rating of only 'acceptable' was attained. Problems were noted with the stereo imaging, which I put down to the poor off-axis uniformity. The panel frequently noted a dull quality, together with emphasised upper- and deficient lower-bass. The latter could be heard to produce buzzes on quite low power inputs (4W mean of bass guitar), and despite the dulling effect, program hiss and sibilants showed emphasis. Piano and voice reproduction were marked well down and 'chesty', 'boxy' and 'hard' comments were often recorded by the panellists. At high volumes, it was not considered very pleasant.

T.F. Comments

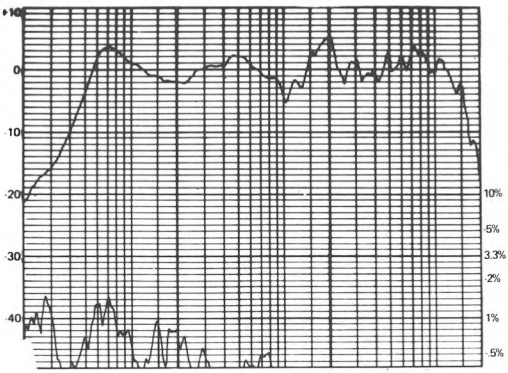
Slightly below average, this speaker was nonetheless pretty clean. The stereo image was hampered by the dispersion problem, and the balance tended to favour brassy sounds.

Summary

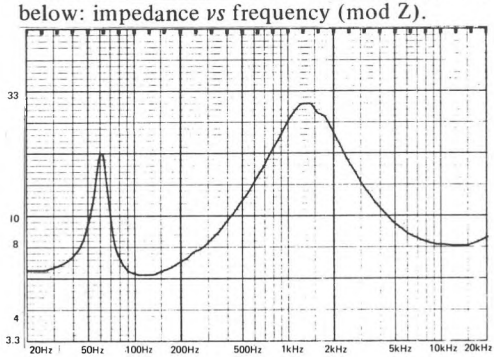
At this price level the frequency response of the *Model 5* is considered both uneven and restricted in range. With poor asymetrical off-axis responses and significant coloration effects, there appears to be little to recommend this model.

Size . . . . . 64.8(25.5) H; 36.8(14.5) W; 30.5(12) D; cm(inches)
Weight . . . . . 14.5(32) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) . . . . . 20 to 100W
Recommended placement . . . . . stand
Frequency response within ±3dB (2m) . . . . . 70Hz to 15kHz
Low frequency rolloff (—6dB) at (1m) 47Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) . . . . . 89dB at 1m
Approximate maximum sound level (pair at 2 metres) 103dBA
Third harmonic distortion (96dB at 1 metre) . . . . . v. good
Impedance characteristic (ease of drive) . . . . . good
Forward response uniformity . . . . . poor
Typical price per pair inc. VAT £325

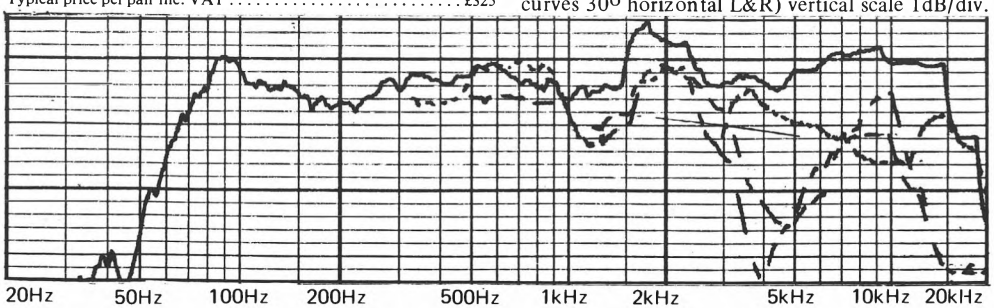
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



RECOMMENDED

Audiomaster MLS1

Audiomaster Ltd., 33 Bridle Path, Watford, Herts. WD2 4BZ. Watford 33010.

In common with many other speakers, this small UK enclosure uses drivers made by the French company, Son Audax. A low efficiency design, ideally the matching amplifier should be relatively large, in the 30-50 watt region, and while the speaker favours free space mounting, an open shelf should also work quite well. In both locations the speaker should be positioned vertically.

Technical details

The sealed box cabinet is fitted with a low resonance bextrene-coned driver of 160mm nominal diameter. Above approximately 3kHz the high frequencies are handled by a 25mm fabric-dome driver, and a complex crossover totalling 9 elements equalises and integrates the driver sound outputs.

Lab results

The pair matching was pretty good, with 0.5dB typical L-R difference, and a mid band region 500-2kHz where an increase to 1.5dB was recorded. These results were however a little inferior to a pair of *MLS Is* recently reviewed in *Hi-Fi for Pleasure* (Jan 78). The sensitivity was undoubtedly low at 84dB, although no worse than other similar systems in the report. The low frequency cut off was established at 57Hz which is fair for this size of enclosure, with the impedance curve indicating that the low frequency resonance occurs at 63Hz. Nowhere does the impedance value fall below 7.5ohms, and this result, together with the lack of severe reactive impedance components,suggests that the *MLS1* is easy to drive.

The characteristic frequency responses were well above average, indicating an even, well-balanced design with no obvious irregularities, and the close alignment of the off-axis curves with those taken on the main axis can be seen. The drivers are thus well integrated, making listener position relatively uncritical, as well as benefiting stereo imagery.

At 90dB, the third harmonic distortion was considered to be very good, particularly above 100Hz, while the rise below this level is not unexpected in a speaker of this size and is quite reasonable. Some buzzes were heard on bass signals during listening, but these did not show on the graphs.

Sound quality

On balance, and without making any allowance for price and size, the *MLS1* was rated as well above average.

It was however undoubtedly strongest on the stereo programme, where it attracted precious little criticism. Slight 'lack of low bass', 'tizz', 'fizz', and 'boxy' effects were noted, but as such, the coloration rating is 'good'. Stereo imaging was found to be precise with a good depth impression, and the speaker had an airy open balance which was liked by the majority of the panellists.

On the live sound comparisons, however, those coloration effects that were present seemed to be more obvious. The speaker sometimes sounded 'small' with a dulled impression on transients, while on pure bass sounds a buzzing, possibly caused by the rear panel, could be heard at relatively low volumes. While it could be driven to quite high

RECOMMENDED

sound levels (101dBA), the output was found to harden noticeably and was less pleasant in consequence. Some panellists felt that there was a slight emphasis in the high treble, while the extreme treble was deficient; the former can be in fact observed on the response traces. Nevertheless, the rating on this test remained at 'average', which is no disgrace.

T.F. Comments

I liked this speaker a great deal in the stereo tests, considerable clarity exposing program faults and great musical detail. In mono it was marginally below average due to some 'boxiness' and rattles.

Summary

Bar a slight reservation concerning the pair marching of these particular samples, the *MLS1* is considered to be a fine example of a compact low coloration speaker, possessing good distortion and frequency response characteristics and a natural sound balance.

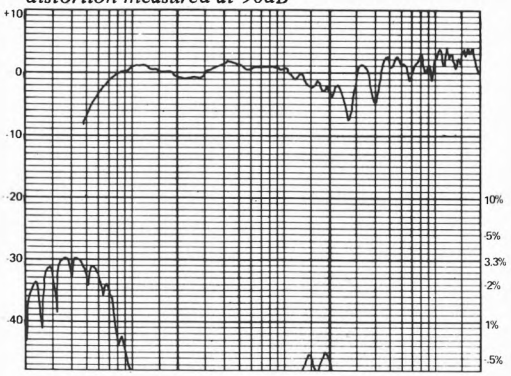
Its main limitation is understandably in bass extension and sound output, but its general quality in the mid and treble ranges compares favourably with far more expensive systems.

The speaker is well engineered and finished, and when its price is taken into account, its overall sound quality justifies firm recommendation.

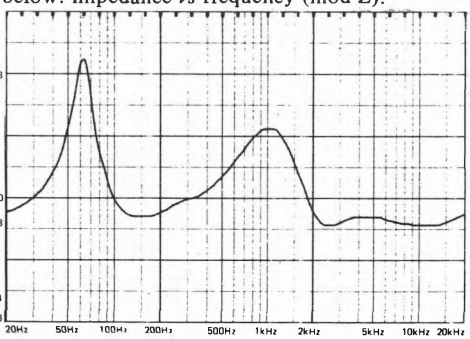
Size	37.2(14.5) H; 23(9) W; 19.2(7.5) D; cm(inches)
Weight	5.3(11.7) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	57Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£90

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

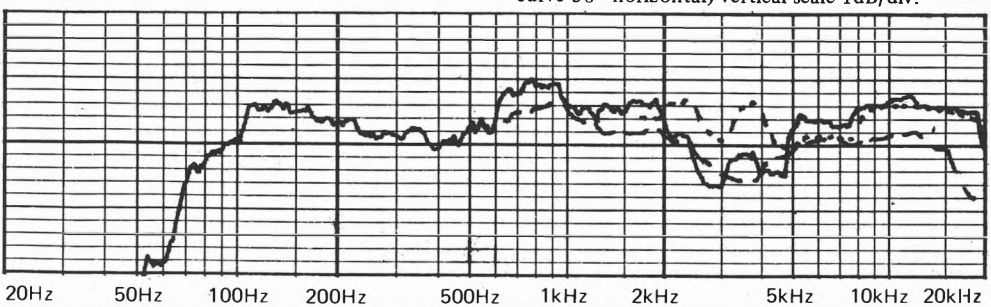
distortion measured at 90dB



below: impedance *vs* frequency (mod Z).

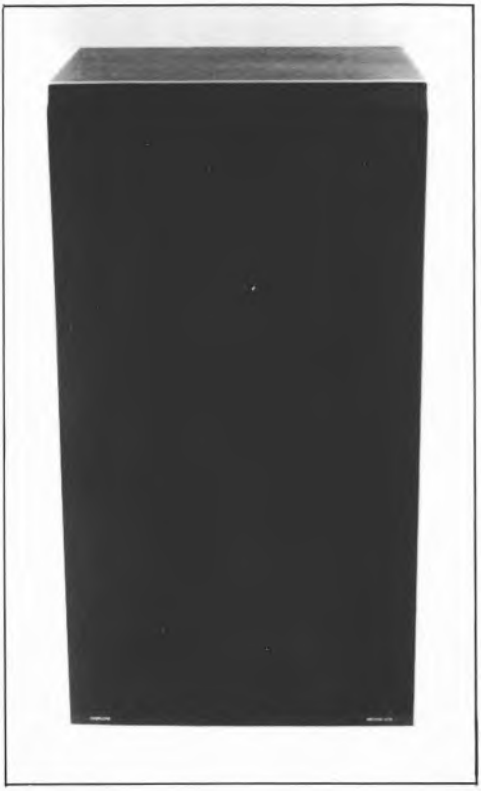


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Bang & Olufsen M75 II

Bang & Olufsen U.K. Ltd., Eastbrook Road, Gloucester GL4 7DE. (0452) 21591.



This Mark 11 version of an established B&O model uses a 'filler driver' system which forms part of the Company's approach to minimum phase design. An overload protection system is built in, and via a relay, this switches off the speaker temporarily if it is overloaded. Finished in rosewood veneer, the speakers came supplied with a pair of substantially welded steel stands of attractive appearance, which facilitated their correct angling and orientation for listening.

Technical details

This slim enclosure employs a moulded plastic front panel of high strength and good acoustic properties, whose facets serve to align the drivers correctly with respect to the listener. A sealed box model, four drivers are used, namely a 250mm paper-pulp cone for the low frequencies and a wide range 100mm cone unit which acts as a 'filler' between the LF and a 50mm soft-dome mid-range unit. The high frequencies are handled by an Audax soft-dome 25mm unit, and a symmetrical, vertical-in-line formation has been adopted.

Lab results

Within 1dB throughout, the L/R pair matching was very good. Sensitivity was low at 86dB, particularly in view of the impedance values that were measured. For example, a minimum of 3.5 ohms was recorded, with an average of 4 ohms over the entire range. While this is in agreement with the B&O spec, by the standards of the *'Choice'* group, this model was classed as 'difficult' to drive. The fundamental enclosure resonance was recorded at 55Hz, with the —6dB point well extended at 40Hz. On the loudness test the maximum attainable was 101dBA, as beyond this point the protection came into effect.

While at low frequencies the distortion was good, with 3% at 30Hz a typical value, above 100Hz the results were less satisfactory. From 100 to 200Hz, the distortion remained at approximately 2%, and did not descend to a satisfactorily low 0.4% until 300Hz and beyond.

The 1 metre sine wave response was irregular, suggesting phase anomalies as much as intrinsic level changes at this distance. For example, the 8dB dip on the reference sine wave curve was partially suppressed at the 2m mike distance (the $\frac{1}{3}$-octave averaged characteristic response). The dip was almost gone 30° off-axis, and aside from this problem area, the lateral response showed good conformity with the axial curve, although the high treble could be seen to roll off fairly early: —3dB at 10kHz, to —15dB at 20kHz. The need for listening on axis was apparent from the 10° vertical response; here another phase cancellation inserted an 8dB dip at 4kHz, near to the upper crossover frequency. However, by largely taking into account the lateral response, the speaker does achieve a 'good' rating on dispersion.

Sound quality

Overall the sound quality was classed as average. The stereo imaging properties were not highly rated; a disappointment in view of the low phase error aspects of its design, which are specifically intended to improve stereo imagery (see conclusions to whole report).

Coloration was certainly evident, and was of the type which gave an average rating on the live session, but which worsened the performance to 'below average' on the stereo programme. Some emphasis of distortion on disc passages was noted, together with 'hollow' and 'boxy' effects, an uneven low frequency range, emphasised sibilants, and some high frequency beaming. Although many other models behaved in a similar fashion, power in excess of 10watts of bass guitar produced rattles, and panellists also noted an uneven sounding frequency balance.

T.F. Comments

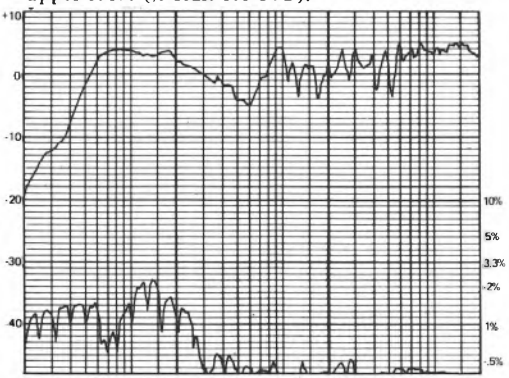
The treble and bass sounded curiously isolated from each other, and I found the stereo image rather confused. Extreme HF was rather directional, and the bass somewhat 'tubby' and limited.

Summary

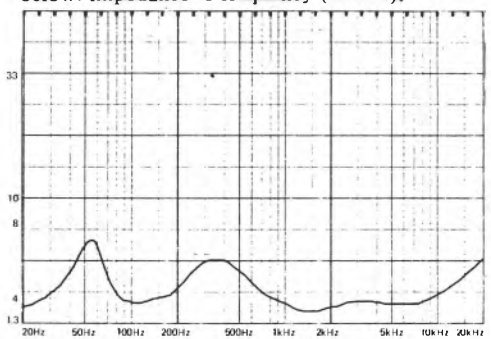
There is little one can say about this rather expensive speaker. It must be pointed out (relevant or not) that it is one of the most superbly finished in the group, possessing an immaculate appearance. On sound quality grounds it only rates as average; it is also relatively inefficient and is not easy to drive.

Size	65(25.6) H; 35(13.8) W; 27(10.6) D; cm(inches)
Weight	17(37.4) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	poor (3.6 R min)
Forward response uniformity	good
Typical price per pair inc. VAT	£375

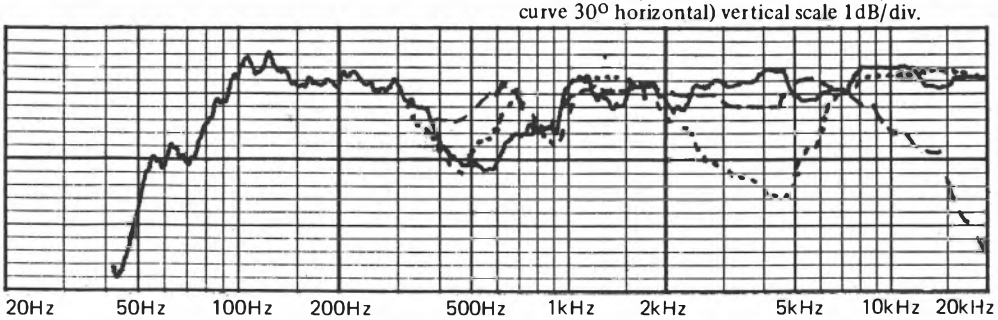
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Bang & Olufsen S45

Bang & Olufsen U.K. Ltd., Eastbrook Road, Gloucester GL4 7DE. (0452) 21591.

In common with the larger *M7511*, the *S45* follows B&O's linear phase philosophy by incorporating a filler driver. Stand or wall mounting is permissible; ideally a vertical orientation should be adopted, but horizontal placement is also suggested by the manufacturer, with some reservations. The instructions also describe the range of satisfactory radiating angles which are rather wider than I would expect; a ±15° vertical window is specified, and this seems a considerable area over which to develop a 'linear phase and a linear frequency response', to quote B&O.

Technical details

Sealed box LF loading has been adopted, with the driver panel formed of a rigid, synthetic material moulded to the facets required. Bass and mid-range are carried by a 200mm Peerless pulp-cone unit, and the treble registers by a Philips plastic dome of 25mm diameter. The junction between the two is linearised by a 75mm SEAS pulp-cone unit, with an applied surface doping layer.

Lab results

With respect to pair matching, up to 4dB of L/R discrepancies were noted in the important 500Hz-2kHz range. This is not very satisfactory and the typical 1dB difference outside this range is insufficient compensation. At 90dB, the sensitivity was good, and measured a full 4dB up on the *M75 II*. In view of the low impedance (3ohms minimum at 4kHz) this is a necessary advantage to help make best use of available amplifier power. The impedance values mean that the speaker, like its more expensive brother, is also classified as difficult to drive. The enclosure resonance was recorded at 66Hz, which is rather high, with a corresponding —6dB fall in output at 60Hz.

The 1 metre response showed certain phase problems in the 2kHz-5kHz region (but note that this is not the designer intended mike distance for measurement.) The treble band is clearly elevated, and the restricted low-frequency range includes an isolated +3dB hump at 100Hz. At 2 metres, which is closer to the manufacturer's measurement position, the speaker still illustrated response irregularities in output, notably a 4dB suckout in the presence band, and a clear difference in treble 'brightness' between the axial and the +10dB vertical positions. Dispersion was much improved on the 30° lateral axis, and the extreme high frequencies showed little roll off, still holding to within —3dB at 15kHz.

As with the *M75 II*, the distortion results were none too good. Several regions of 2-2.5% third harmonic were noted, notably at 700Hz, 1.5kHz and 100Hz. Below the latter frequency a rapid rise can be seen.

Sound quality

If anything, the panel considered the overall sound quality of the *S45* to be marginally better than the *M75*, irrespective of the two-to-one price discrepancy. Coloration effects were judged to be less severe, and this, together with its more favourable frequency balance, allowed an improved rating to be attained on the live sound comparisons. A surprisingly high 103dBA was recorded on the

loudness test, where the quality was rather aggressive but free of obvious rattles or breakup. On the other hand, around 10watts of bass guitar was sufficient to induce some mild rattles, although the sound quality was reasonable, allowing for the restricted response extension. Coloration effects that were observed included moderate 'edgy,' 'sharp', 'hard', 'wiry' and 'fizzy' components, allied with the light balance plus a prominent midrange and excessive treble. Some 'airiness' was also lacking, which may correlate with the measured deficiency in the lower treble band. An average rating was denoted on the stereo tests, with no significant evidence of enhanced image quality.

T.F. Comments

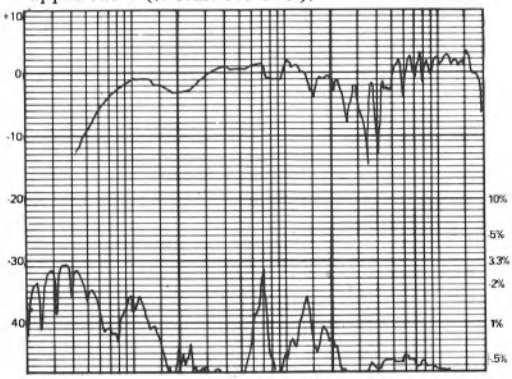
Overall above average, this speaker performed better on mono than on stereo tests, and tended to sound small, thin and slightly shrill.

Summary

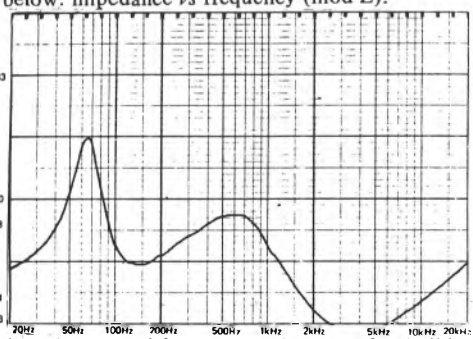
Although its bass response is limited and its distortion is higher than average, the *S45* clearly represents better value for money than the *M75 II*. Its light balance suggests that wall mounting is to be preferred, and while the sensitivity is good, the speaker is not likely to be easy to drive, and for the best results a 4ohm specified amplifier is advisable.

Size . . . . . 48(18.9) H; 26(10.2) W; 21(8.3) D; cm(inches)
Weight . . . . . 7(15.4) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) . . . . . 20 to 100W
Recommended placement . . . . . stand
Frequency response within ±3dB (2m) . . . . . 90Hz to 20kHz
Low frequency rolloff (—6dB) at (1m) 60Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) . . . . . 90dB at 1m
Approximate maximum sound level (pair at 2 metres) 103dBA
Third harmonic distortion (96dB at 1 metre) . . . . . fair
Impedance characteristic (ease of drive) . . . . . poor
Forward response uniformity . . . . . average
Typical price per pair inc. VAT £170

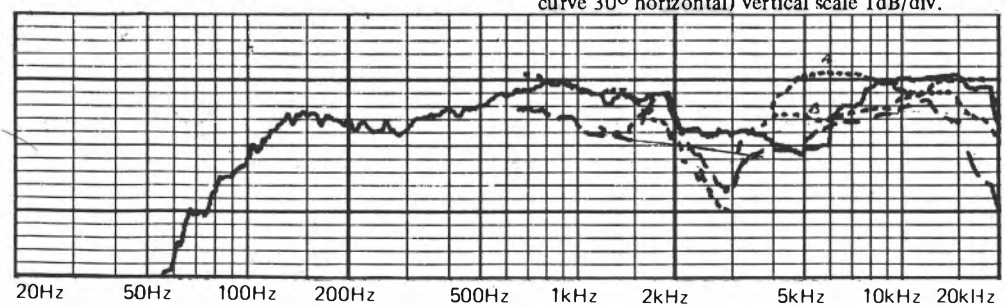
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).

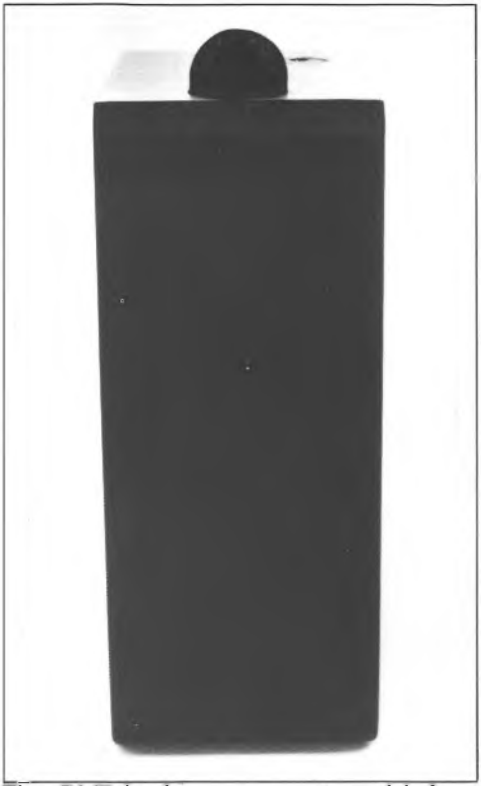


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



B&W DM7

B & W Loudspeakers Ltd., Meadow Road, Worthing BN11 2RX. Worthing 205611.



The *DM7* is the most recent model from B & W, and comes complete with a cylindrical pillar stand and heavy base plate which is to be assembled during the unpacking procedure, using a set of bolts supplied. The speaker is exhaustively specified, its unusual appearance stemming from the isolated treble unit, located under an open-mesh dome planted on the top surface of the cabinet near, but set back from, the front baffle. A recessed four-position tone control switch is also located on this top plate.

Technical details

Essentially a two way system, the *DM7* uses a 32mm fabric-dome HF driver and a 180mm synthetic cone bass-midrange (made from a polyamide fibre matrix with PVA impregnation). An additional passive panel radiator provides reflex loading at low frequencies, while a complex 13 element crossover integrates the two drivers at approximately 3kHz. The enclosure is very heavy, cross-braced, and damped.

Lab results

On many parameters the *DM7* measured well. For example, pair matching was excellent, and held to within 0.5dB up to 17kHz. The —6dB point at 40Hz confirmed a reasonable bass extension, and the 86dB sensitivity was classed as below average.

The distortion readings at 96dB were higher than expected, the third harmonic remaining at 0.6% over most of the range up to 8kHz. At the low frequency end an early rise was apparent; for example, 2% at 125Hz steadily increased to a level of 10% third harmonic content at 30Hz. The impedance characteristic showed that the system should be easy to drive.

At 1 metre on sine wave excitation the response exhibited a gentle rise around 100Hz, together with a slightly recessed upper midrange and a broad ˚3dB prominence centred on 3-5kHz. Above this, the treble range also possessed some irregularity. The 2m averaged response was commendably even and basically well integrated over the 10° vertical and 30° lateral angles. Some phase loss was shown at 10° above in the 2.5-7kHz range amounting to about a 4dB droop, while the lateral uniformity was fine.

Sound quality

A contrast betwen the measured and the subjective data soon became apparent. Upon decoding and analysing the panellists' results, it was a surprise to find that the DM7 had not done well. In view of its pedigree it was reinserted in later listening sessions to check but the results were little different.

On live comparisons it was rated as 'poor', with a number of criticisms being made by the panel. The treble range was considered to be both distant and unnatural, with 'edgy' and 'fizzy' effects, and an almost 'ringing' quality to the treble sound. The presence band was considered dulled, and this emphasised the moderate 'boxy' and 'nasal' character found on male voice. The low frequency range was not favoured and a 'thick' quality was ascribed to it. Bass power handling was restricted, with 10W average of electric bass guitar exciting buzzes.

Faring slightly better on the stereo sessions, the *DM7* was still described as slightly deficient in low bass, with a noticeably 'boxy' effect in the midrange an uneven treble characteristic, and a tendency to produce 'fizzy' effects and emphasise distortion. It was thought that perhaps this pair were faulty, but their lab performance clearly refutes any such suggestion. We also checked a second pair, but these showed a markedly dimmer balance, measuring some 2-3dB down in the midband and treble ref the first pair, and were not preferred on listening tests.

T.F. Comments

I must confess to being put off this speaker on principally one account; I found the treble colored and inclined to ring, which produced some curious whistling sounds, particularly when program contained tape hiss.

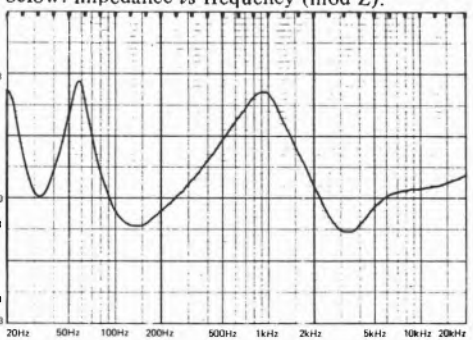
Summary

We can only regard the *DM7* as rather a disappointment. Expecting good things from such an interesting design having an innovative appearance and employing advanced design technology, the listening results under our conditions do not appear to justify the engineering effort that has obviously been expended.

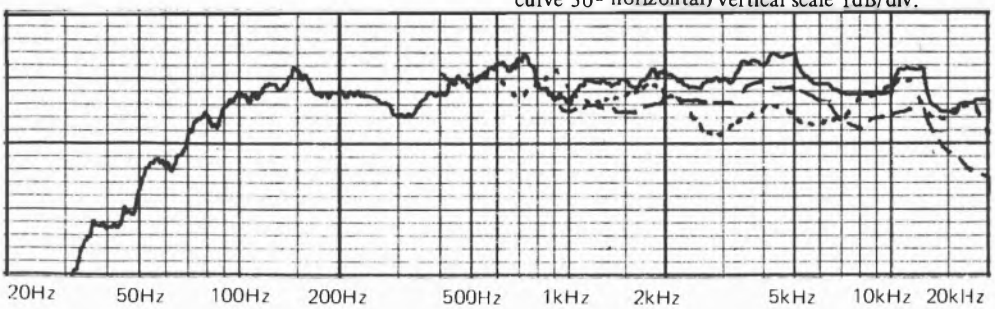
Size	90.3(35.5) H; 27(10.6) W; 36.7(14.5) D; cm(inches)
Weight	30(66) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 200W
Recommended placement	supplied stand
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	100dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£375

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



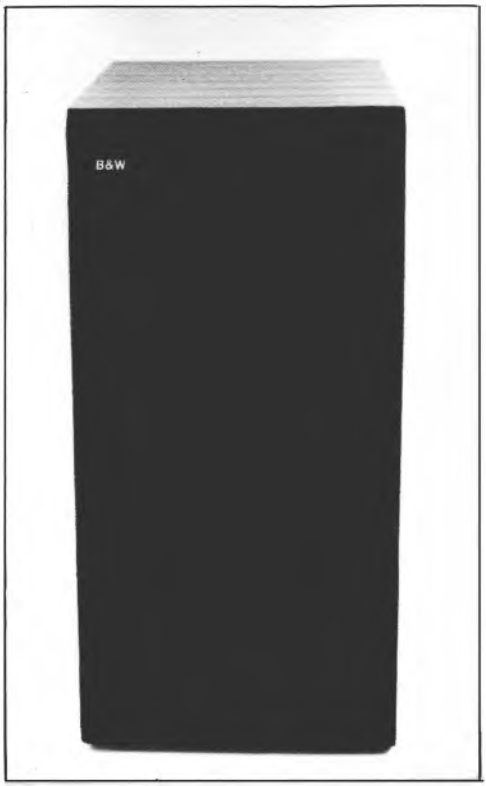
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

B&W DM5

B & W Loudspeakers Ltd., Meadow Road, Worthing BN11 2RX. Worthing 205611.



I first tested this model some eighteen months ago during a group test for another magazine, at which time it came out well above many of its competitors. A compact design, the *DM5* is intended for bookshelf mounting, and accordingly the frequency response has been partially tailored to suit this application.

Technical details

A two way sealed box enclosure, the *DM5* uses drive units of B&W's own manufacture. A 150mm bextrene cone unit covers the range up to 4kHz, crossing over *via* a high quality third-order network to a 18mm fabric dome unit. The cabinet has been treated with resonance damping panels — a feature uncommon in this relatively cheap price bracket.

Lab results

Pair matching was pretty good, and typically held within 1dB, with a limited area around 2kHz where a 1.5dB difference was apparent. The sensitivity at 87dB was fairly high for a small box, but offset against this result were some fairly low impedance values. During the previous review I criticised the speaker for its poor impedance at high frequencies, and was informed by the manufacturer that this would be corrected on future production. With these new samples, however, I measured a minimum of 3 ohms at 15kHz, and so apparently no change has occurred. This is despite B&W's specified nominal impedance of 8 ohms.

The power handling was good for a small speaker, allowing the full 96dB spl to be used for distortion analysis. The important mid-band (200Hz-2kHz) gave low values not exceeding 0.5% third harmonic until below resonance, when a rise to 15% at 40Hz was observed.

The sine wave 1 metre response showed a strong rising trend, totalling 8dB from 60Hz to 400Hz. The midrange was prominent, exposed by the falling presence suckout from 1.5-3.0kHz, while the treble range was dominated by the +5dB emphasis from 10-20kHz.

The 2 metre averaged response showed good integration of the off-axis curves but some loss (—5dB) in the crossover region around 5kHz. The dispersion at very high frequencies was outstanding; for example, only 2dB down at 20kHz, 30° off axis. The characteristic upper treble prominence, 'middy' balance and presence loss were all still apparent. Shelf mounting will in practice help to augment the upper bass and provide some compensation.

Sound quality

The *DM5* actually fared better than the more expensive *DM7* on the listening tests, attaining an overall rating of 'average', which is no mean achievement at the price.

Its particular strength lay in the live sound comparisons, where it attained an 'above average' rating (which is largely in agreement with the findings of the previous review). A usefully high (102dBA) maximum sound level could be reached, and the low frequency range was well controlled, accepting up to 40watts of bass guitar without distress and with surprisingly good definition. Some coloration was apparent, evident in the form of moderate

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'boxy', 'tunnel' and 'tizzy' effects. The presence band dulling was fairly obvious to the panel, as was the mid prominent balance and the treble emphasis. On cymbal, for example, there was too much 'fizz' and too little 'ring'. Voice sounded a trifle tubby and sibilant.

On the stereo tests the light balance and lack of deep bass became more obvious, the speaker exaggerating disc distortion, thereby suggesting that amplifier treble cut might be useful. The stereo image quality however was highly rated.

T.F. Comments

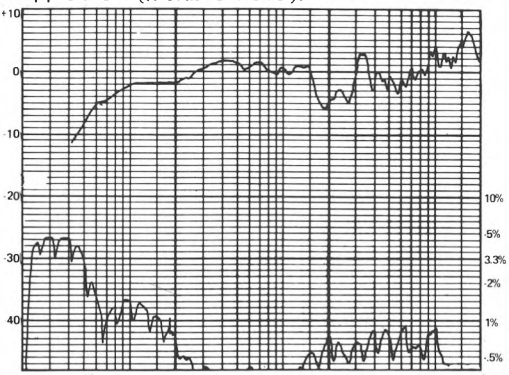
Satisfactory at the price, this model achieved average marks throughout, with above average imaging. There was some lack of bass and a slightly 'horny' treble.

Summary

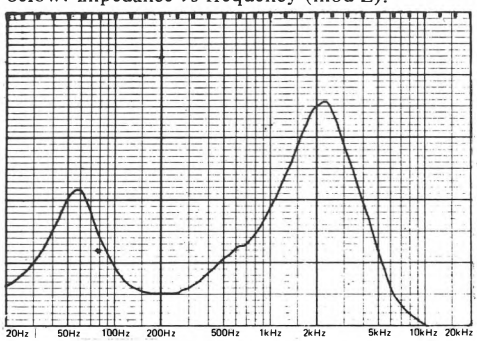
At its price level this speaker has a number of attributes, including low distortion, good power handling, especially at low frequencies, and a high maximum loudness. It is marred by noticeable treble emphasis and coloration, and to a lesser extent, by its poor impedance characteristic.

Size	45.5(18) H; 27(10.6) W; 36.7(14.5) D; cm(inches)
Weight	30(66) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 100W
Recommended placement	shelf/stand
Frequency response within ±3dB (2m)	70Hz to 11kHz
Low frequency rolloff (—6dB) at (1m)	54Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	87dB at 1m
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedancecharacteristic (ease of drive)	poor
Forward response uniformity	good
Typical price per pair inc. VAT	£110

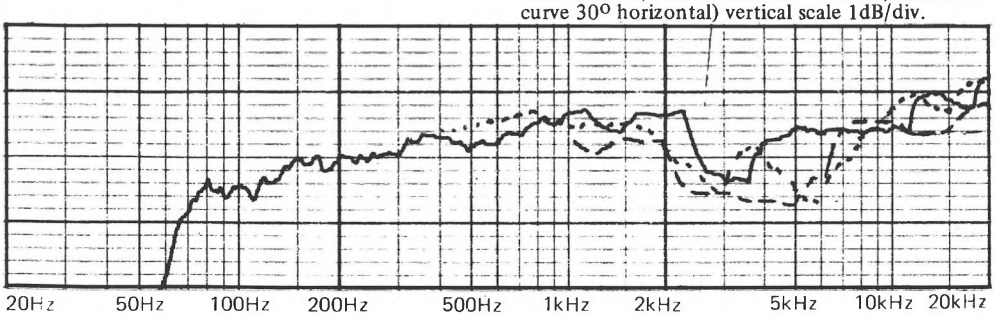
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Bolivar 64

Harman (Audio) U.K. Ltd., St. John's Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049-481 5221.

While the Bolivar division of Harman International (JBL, Tannoy etc.) is located in Tennessee, USA, the speakers intended for the UK market will in future be built in Scotland, using British cabinets and imported U.S. drivers. As this particular speaker fared quite well in a recent group test of three models that I conducted (*HFP* Feb. '78), it was interesting to see how it would stand up in a survey which included a far larger number of systems.

Technical details

This three-way bass reflex design uses a 250mm LF driver with a rigid pulp cone, a 100mm pulp-cone midrange unit, and this in turn crosses over to a 38mm pulp-cone tweeter. Level controls for both mid and treble are provided, mainly to give 'cut' although a little 'boost' is also available. The drivers are mounted vertically-in-line to enhance stereo imaging.

Lab results

Low and mid frequency ranges showed very good pair matching. The difference increased to 2dB above 8kHz, but this could be easily corrected if necessary, by an appropriate level control adjustment. A high sensitivity of 92dB was recorded, which was not unduly prejudiced by the speaker's impedance characteristic. Low reactive effects were recorded, with a typical impedance value of 7 ohms and an isolated minimum of 4.5 ohms at 9kHz.

The low frequency range was reasonably extended, with a —6dB point at 42Hz. On sine wave the axial response showed a very mild mid prominence and a slightly ragged treble band, with a rise in the 6-7kHz region.

On 2 metre averaging, the responses were commendably uniform, with good lateral integration and symmetry. At 10+ vertically above axis, a phase loss of 5dB occurred from 2-8kHz, and a listening position close to the main system axis is clearly preferable. At high frequencies the 30° lateral response was well maintained to 10kHz, above which it fell fairly rapidly to —10dB at 15kHz and —16dB at 20kHz.

Third harmonic distortion was very good; generally below 0.5%, with outstanding values of under 0.8% maintained throughout the working bass range. The only minor rise consisted of an isolated 1% reading at 800Hz.

Sound quality

Marked as 'average' on the truth-to-life comparisons, the *Bolivar 64* sounded much happier on the domestic stereo tests, gaining a 'very good' rating. A high maximum output level of 105dBA was recorded, at which point the sound was still clear and free of breakup, although rather hard. It accepted considerable bass power from the electric guitar without complaint, the sound showing good extension with above average evenness.

Although not entirely absent, coloration was held to moderate levels. The treble range was a trifle harsh and rough, this showing particularly on the cymbal, and occasionally some hardness was also observed, together with a 'boxy' rounded quality. The overall findings were difficult to put into words;

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perhaps 'sounds pretty good but lacks subtlety' is the fairest approximation.

The stereo quality (depth. precision etc) was fine, with the 'flat' mid position and 'full' treble settings on the controls giving the best balance. Stand mounting suited it well.

T.F. Comments

In the live tests the Bolivar was not toally convincing, being close to average; the top sounded slightly 'horny' while there was also some midrange coloration. Stereo listening results were good with clear imaging, while power-handling and efficiency were also good.

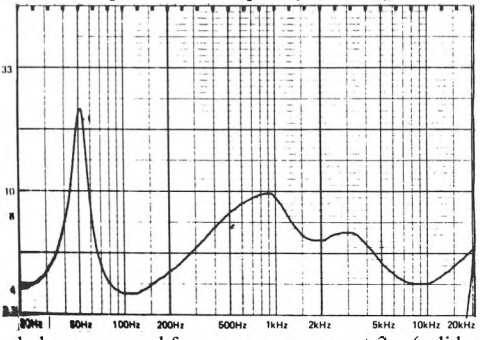
Summary

Offering a generally above average sound quality with a wide, even response, good stereo, moderate coloration and high power handling, the *64* gains an obvious recommendation. In addition, the high sensitivity permits its use with amplifiers down to 10 watts per channel and undue amplifier loading problems should not be encountered.

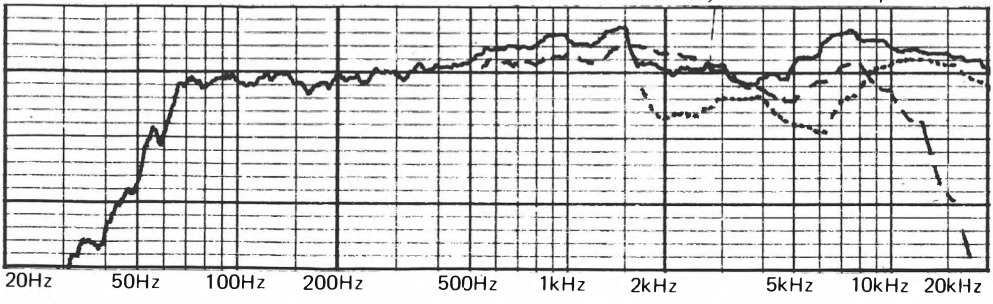
Size	67(26.4) H; 31.2(12.3) W; 35.6(14) D; cm(inches)
Weight	20(44) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 200W
Recommended placement	stand
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	42Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	92dB at 1m
Approximate maximum sound level (pair at 2 metres)	195dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£260

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



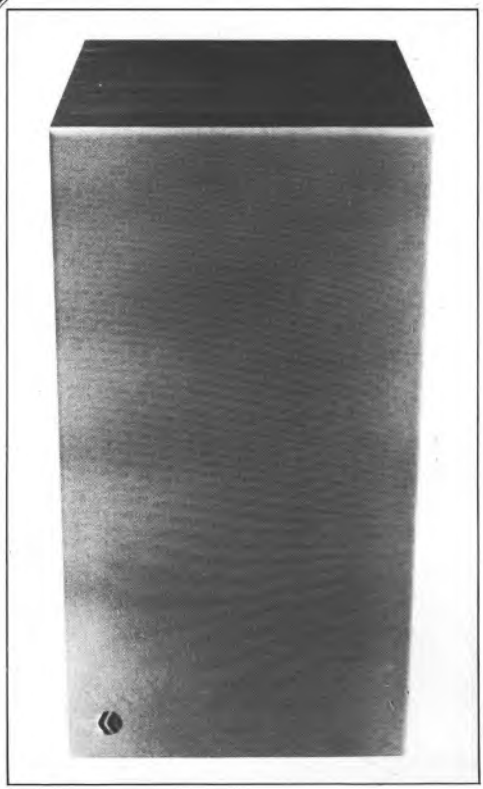
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Bolivar 125

Harman (Audio) U.K. Ltd., St. John's Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049-481 5221.



The *125* is the more compact three way brother of the *Bolivar 64,* and apart from a smaller cabinet the lineup is much the same. However, the 250mm LF driver of the *64* is here replaced by a 200mm unit. The company offers a two year warranty on this speakers as well as on all the other models in the Bolivar range.

Lab results

The most noteworthy feature of this model's lab performance was the extended low frequency response, namely —6dB at 36Hz, which beats the *64* and is exceptional for its size. A 4dB drop in efficiency does accompany this result, although at 88dB the speaker was still rated as 'average'. A 4 ohm minimum impedance was recorded at 40Hz, but is far enough removed from the mid band not to cause any trouble. The typical value is of the order of 5-6 ohms, thus giving an 'average' rating for amplifier loading.

Pair matching held to within a fine 1dB throughout. Distortion levels were comparable with the bigger *64*, being less than 0.5% above 1.5kHz and slightly higher in the 600Hz to 1.5kHz range, with reduced values right down to 60Hz; the speaker measured under 2% at the lowest frequency with an effective output.

The sine wave response suggested that the factory settings for the treble range are a trifle high by some 2-3dB, but resetting of the 'flat' position on the HF level control should solve this problem in practice. Taking this into account, the response is quite even. At 2 metres with noise averaging, the characteristic responses were even and well integrated, bar a 2-5kHz dip on the 10° above vertical axis. This suggests that the listener should not sit above the main axis of the speaker. An off-axis rolloff at high frequencies above 10kHz was also observed, similar to that of the *64*.

Sound quality

Examination of the data tables for both Bolivar models shows that the performance of the *125* is little inferior to that of the *64*. Furthermore, a significant proportion of the criticisms relating to the *125* consisted of a moderate treble excess, thus confirming the lab measurements, and if a degree of HF cut is set on the appropriate control the sound improves somewhat. However, the following comments on subjective quality relate to the 'as received' settings.

An 'average' rating was denoted on the stereo tests, with a characteristic moderate hardness and wiryness to the sound. Some sibilant emphasis was observed plus 'boxy' and 'honky' effects, the elevated treble appearing to mask the depth of stereo programme.

The same rating was achieved on the live instrument comparisons. On occasion the speaker sounded 'small' with a 'papery' voice and some hard 'nasality'. At high level it became increasingly aggressive, with a maximum level of 100dBA. The bass power handling was pretty good, with an even character and good depth, but some mild buzzes could be induced with as little as 10

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watts average of electric bass guitar.

Overall, the *125* did not sound as 'full' as the *64*, even taking into account the treble lift.

T.F. Comments

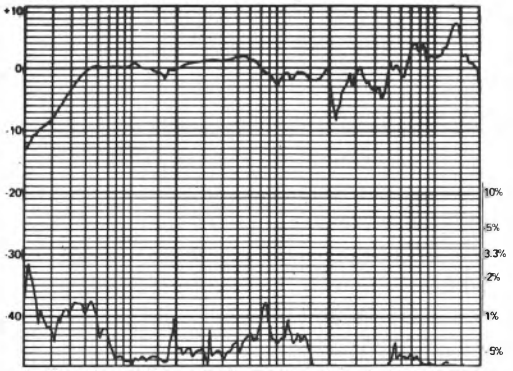
Only fractionally below average (ie good for the price) this system suffered mainly from a rather over-prominent treble, which tended to exaggerate surface noise on a worn disc.

Summary

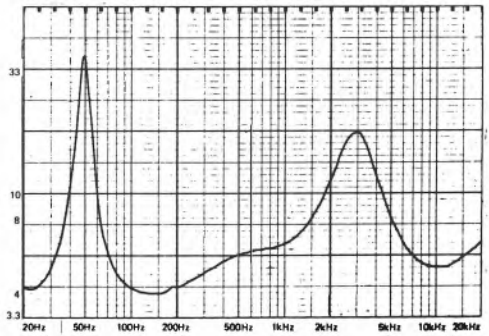
Scaled against the *64*, the *125* has clearly done well, and it will produce even better results if the user sets a more natural treble balance. The bass response is exceptional for the price, size and efficiency, the latter allowing amplifiers down to 15 watts per channel to be used. The maximum loudness is average, the distortion low, and its price realistic; as such, it clearly deserves a recommendation.

Size	58.4(23) H; 31.8(12.5) W; 27.4(10.8) D; cm(inches)
Weight	16.4(36) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	36Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	100dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£160

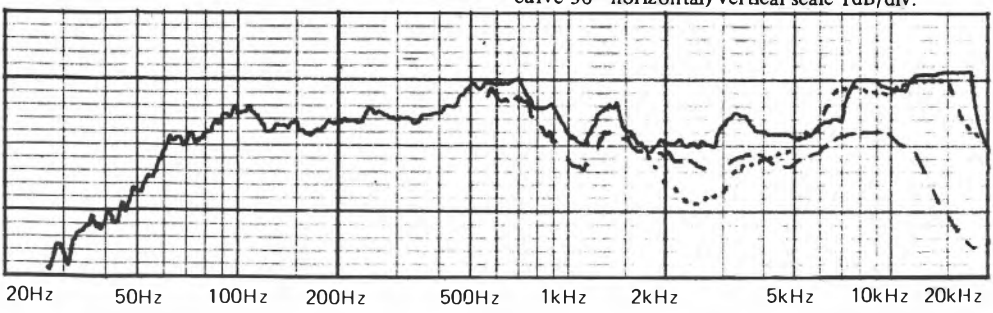
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Bose 601

Bose U.K. Ltd., Trinity Trading Estate, Sittingbourne, Kent ME10 2PD. 0795 75341/5.

This unusual floor standing loudspeaker is a development of the *501,* and follows the Bose tradition in employing both reflected and direct sound energy paths to the listener. Great care was taken during the tests to ensure that the manufacturer's recommendations were followed with regard to adjacent walls and control settings. However, I should point out that the anechoic curves will be of reduced significance and require careful interpretation owing to its special design, although the sensitivity and distortion figures given will be approximately correct.

Technical details

Two 200mm pulp-cone bass-midrange units are employed, working in parallel. These are reflex loaded, the range above 2kHz being handled by 4 angled 80mm cone tweeters. The enclosures come in mirrored pairs to take account of the symmetrical or asymmetrical choice of radiating patterns, the latter intended for use when side wall reflections are in force.

Lab results

A comparison of the sine wave curves for the two enclosures showed that up to 5kHz the pair matching was very good, but a 2-3dB discrepancy developed at the higher frequencies. Rated against the predictable mid-frequency band, the sensitivity measured 91dB at 1 metre, which is quite high. The corresponding low frequency cut off of, —6dB point came in at an average 45Hz.

Referenced to the 1 metre sine response, the distortion results are commendable at under 0.5% throughout the range, even to as low as 40Hz. Only minor departures from this value were recorded at 220Hz and 750Hz. The *Bose 601* should prove easy to drive, with a low reactive content, a typical impedance value of 10 ohms, and a minimum no lower than 6 ohms.

As mentioned above, some interpratation is required to obtain meaningful information from the 2 metre $\frac{1}{4}$ octave averaged response. This analysis relies on the assumption that approximately 3dB or 50% of the upper mid and treble energy is directed off-axis, but would reappear in the correct listening environment, due to reflection from adjacent walls. On this basis the *601* can be seen to offer a pretty even response up to 500Hz on axis, and a fair balance beyond, assuming an integration of outputs in the 700-1500Hz band, and a doubled HF energy due to reflection. Finally, a high maximum sound level of 105dBA was attained in the listening room.

Sound quality

Though moderate changes in the sound quality could be made by experimenting with the enclosures in terms of location and symmetry control (these mainly relating to frequency balance and apparent stereo separation), certain other dominant characteristics remained unaltered, and I feel the latter were largely responsible for the *601*'s rather poor showing on both listening tests.

While the bass power handling was adequate, the floor/wall location tended to excite more room coloration than did the

stand mounted models, and in consequence, the low frequencies were described as rather boomy. While the balance was considered rather thick and dull (these comments related to 'boxy' coloration effects), the upper registers were described by many listeners as 'fizzy' and lacking in extreme treble.

The speaker did not compare favourably with the live instruments and on the stereo sessions, the quality of the stereo image itself was considered to be poorly focussed; interesting for multi-miked recordings, but lacking precision in the case of classic 'crossed pair' microphone program.

T.F. Comments

From my position in the listening room I could find little enthusiasm for this system. Stereo imaging at HF and extreme HF was highly unstable, with a 'boxy' 'boomy' bass and generally uneven response.

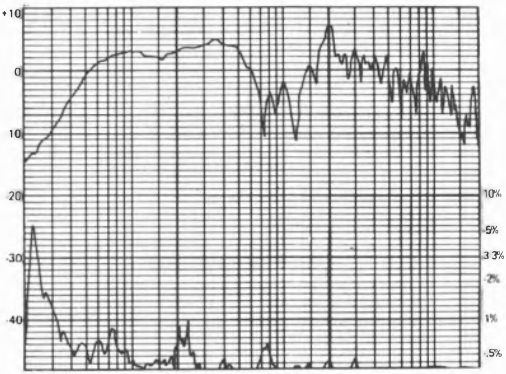
Summary

It is possible that some listeners will like the *601*, but it found little favour with the *'Choice'* panel, the high level of coloration making it difficult to relate its performance to the quality standard set by so many other models in the group.

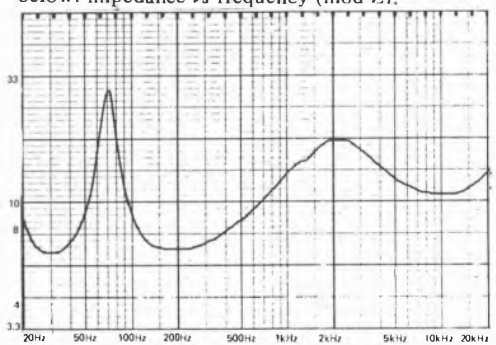
Size	64.7(25.5) H; 38(15) W; 33(13) D; cm(inches)
Weight	16.4(36) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	floor near wall
Frequency response within ±3dB (2m)	NA*
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	91dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	good
Forward response uniformity	good*
Typical price per pair inc. VAT	£400

*See text.

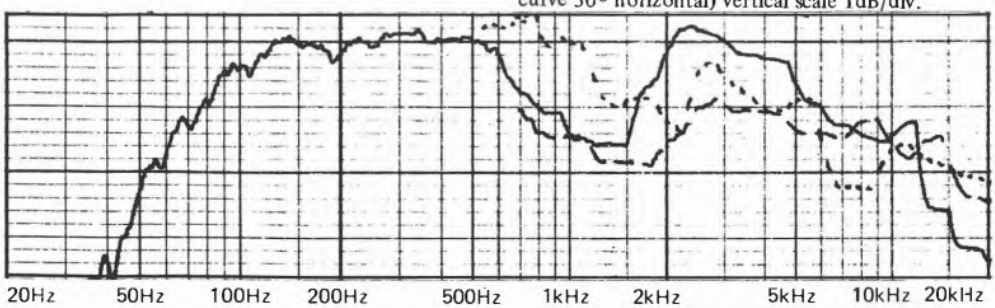
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Castle Richmond II

Castle Acoustics Ltd., Shortbank Road, Skipton, N. Yorks. (0756) 5333/4.

Produced by a relatively young British company, the Castle range is designed using the manufacturer's own range of enclosures and drivers. The *Richmond II* is said to employ the latest reflex design techniques, and as such should offer an attractive combination of a compact package possessing a good low frequency response plus high sensitivity. The instructions state that either shelf or stand mounting is permissible.

Technical details

A 130mm treated pulp-cone bass-midrange driver is employed, together with a 30mm plastic cone treble unit. The high quality crossover comes in at 3.5kHz, with a ducted port of adequate diameter completing the driver panel array.

Lab results

The pair matching was very good, with the responses aligning within 1dB throughout. The sensitivity was high at 90dB and was unaffected by the impedance characteristic, the latter recording an average of 8 ohms, with no area below 5 ohms. As such the Castle acquired an 'average' ranking for amplifier loading. At 48Hz, the —6dB low frequency point was good for the speaker's size and efficiency.

In general, distortion results were likewise commendable, and allowing for a moderate 0.8% third harmonic area from 1.5kHz to 3kHz, very low figures were demonstrated from 100Hz right up to the measurement limit at 12kHz. Apart from an isolated bump of 1.5% at 90Hz, distortion levels also remained good at low frequencies, and did not exceed 3% until below 50Hz.

At 1 metre the sine wave response illustrated a near perfect low frequency range, together with a slightly (+1.5dB) prominent upper mid, 500Hz-1.5kHz. A rise at high frequencies to +4dB at 15kHz-20KHz was also apparent, but nonetheless, ±2.5dB limits were sufficient to encompass the entire range.

At 2 metres the curve was essentially the same, although the mid prominence had increased somewhat to +4dB. The off-axis curves also demonstrated very good integration and uniformity; clearly this is a carefully designed system. Shelf mounting would help to restore the low frequency range relative to the mid, and would also probably give the best subjective results.

Sound quality

The *Richmond* gained 'average' and 'above average' ratings respectively, for the live and the stereo tests, both results commendable for the price level.

It could be driven to high sound levels, namely 104dBA, and did not require much power to do this, as the minimum recommended amplifier rating of 10W per channel bears out. The low frequency power handling showed some restriction at 8W average of electric bass guitar, but the speaker's high efficiency meant that even with this input there was sufficient accoustic power

Stereo imaging was considered to be above average, but the panel consistently felt the speaker to be a trifle on the thin and bright

RECOMMENDED

side of an ideal balance. In fact the majority of criticisms related to this effect, and serve to reinforce the shelf mounting recommendation, which should provide some compensation. In addition, some 'boxy' and 'hard' effects were noted although moderate in degree. The low frequency range was free of boom, but the extreme treble emphasis did not pass unnoticed, and at least one panellist felt it could prove a little fatiguing.

T.F. Comments

At its price, this speaker performed well and with good efficiency. I found the treble rather hard and 'spikey' and a rather thin overall balance, however.

Summary

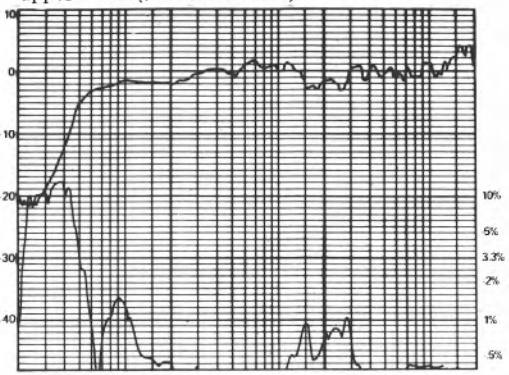
This compact loudspeaker offers an essentially smooth and well integrated response with low distortion and above average sound quality. Its efficiency is a further bonus, and it can also attain high sound levels. Taking into consideration its price, the *Richmond* certainly deserves recommendation.

Note

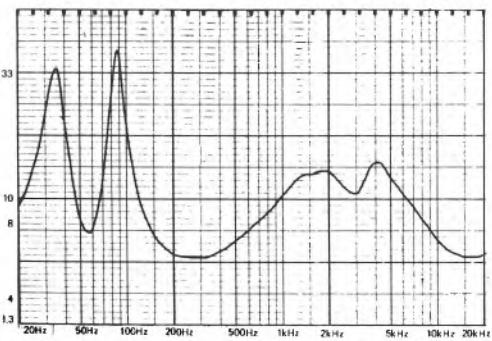
Castle have informed us of a minor production change to the bass-mid unit which slightly improves the upper midrange quality. However specifications and curves will remain substantially unaltered.

Size	41.5(16.5) H; 23(9) W; 25(10) D; cm(inches)
Weight	8.5(18.8) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	stand or open shelf
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	90dB at 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£90

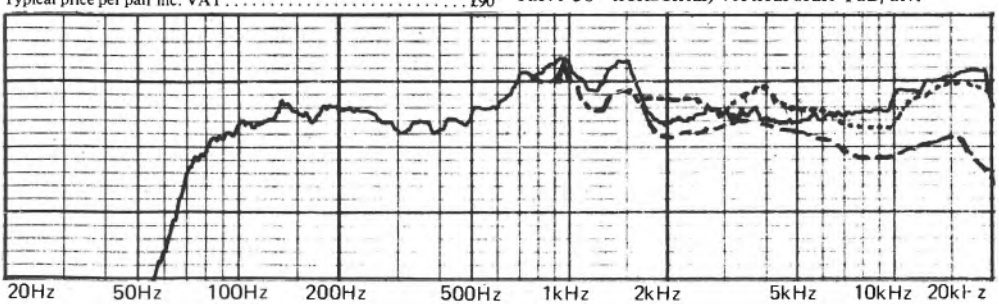
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Celestion Ditton 22

Rola Celestion Ltd., Ditton Works, Foxhall Road, Ipswich IP3 8JP. (0473) 73131.

A compact and inexpensive three way loudspeaker, the *Celestion 22* belongs to the Ditton range, and as such, offers a higher sensitivity than the plastic coned 'UL' series manufactured by the same company. Shelf or stand mounting is permissible, and even sideways positioning is suggested, although this must impair the stereo quality owing to the speaker's vertical-in-line configuration of drive units.

Technical details

A sealed box enclosure, the low and mid frequencies are handled by two pulp-cone units, the former 200mm and the latter 100mm in diameter. The treble is handled by a 25mm fabric dome. All the drive units are Celestion's own manufacture, with the relatively simple crossover operating at 500Hz and 3.0kHz.

Lab results

With less than 1dB of L/R imbalance up to 15kHz, and only a small 2dB error above this, the pair matching was undoubtedly very good. The —6dB low frequency point was recorded at 50Hz, with a usefully high sensitivity of 89dB. This however was offset to some extent by the relatively 'difficult to drive' impedance characteristic; the latter measured as low as 3.5 ohms at 3.2kHz, and was typically of the order of 4-5 ohms. The distortion levels were generally very low, but were slightly let down by 0.9% third harmonic readings from 1.3-3kHz, and an early rise in the lower frequencies at 180Hz, where 1% was recorded; the 3rd harmonic of this 180Hz fundamental appears at 540Hz, which is an aurally sensitive range. However considering the high 96dB test level, distortion values at the lower frequencies were really very good.

On the 1 metre sine reference curve, the response was almost ruler flat from 80Hz to 1.5kHz, above which the output was a little erratic, with a suckout in the 4-8kHz range. Measured at 2 metres, with $\frac{1}{3}$ octave signal averaging, the same trends remained, and a reasonably well integrated group of responses was obtained. The 30° off-axis curve possessed some problems in the 7-12kHz range, which I suspect are caused by interference effects due to the grille baffle producing a cavity around the treble driver. The 10° vertical response revealed a 5dB suckout at 5kHz, which indicates that the listener should be close to the main axis for the best results.

Sound quality

While the live sound results suggested an 'average' rating, the speaker did produce a well above average maximum sound level at 105dBA, and withstood the full output of the 500W amplifier on short term peaks. 8-10 watts of electric bass guitar did excite some buzzes, but the low frequencies were judged to be quite even and uncoloured. Some coloration was however apparent in the mid and treble ranges, this including hollowness, some hardness and nasality, and an uneven treble which emphasised sibilants and gave a trace of 'fizz' high up. The balance sounded dulled and lacking a degree of presence.

The *22* faired quite well on the stereo tests,

RECOMMENDED

possessing fair image depth and precision. The uneven treble range was noted by the panel, and on occasion they felt it gave an edgy quality to the sound.

T.F. Comments

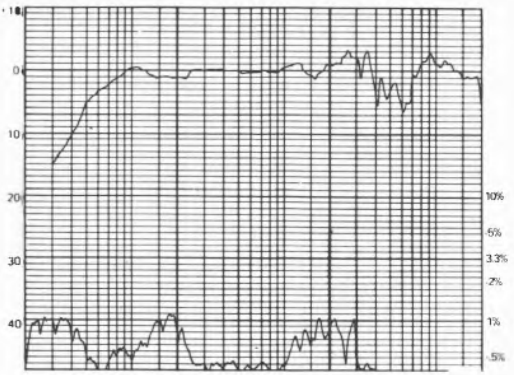
I found this speaker on or above average in all respects, and it was also capable of producing high volumes comfortably. The HF had a 'nasal' quality which made percussion sound a little 'wiry'.

Summary

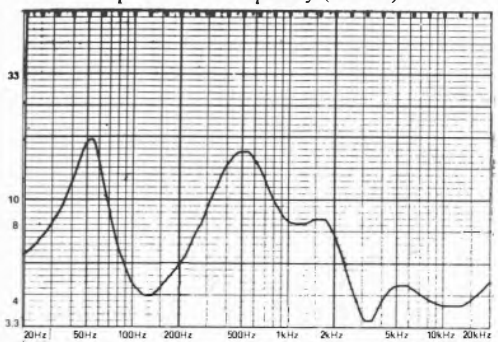
Taking into account its moderate price, the *Ditton 22* has some strong points, notably a high maximum level, fairly good low frequency range, good sensitivity and a pretty fair sound quality. On the minus side, the amp loading could be a problem, implying that an amp suitable for 4 ohm drive should be used. While it clearly does not break any performance standards, the *22* is still well worth considering.

Size	51(20) H; 33(13) W; 27(10.5) D; cm(inches)
Weight	12.4(27. 3) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	to W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	poor
Forward response uniformity	good
Typical price per pair inc. VAT	£130

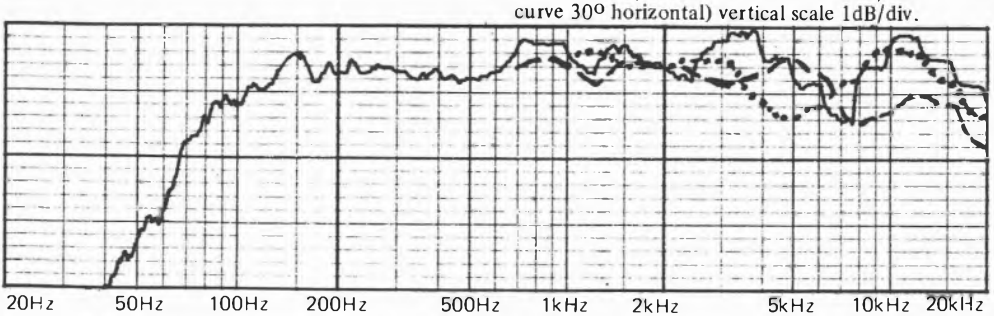
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Celestion Ditton 15XR

Rola Celestion Ltd., Ditton Works, Foxhall Road, Ipswich IP3 8JP. (0473) 73131.

The *15XR* is a new version of a famous and long established design, the *Ditton 15,* the latter having enjoyed a 10 year production run. A slim and compact enclosure, the *15XR* can be described as a reflex two-way, as in addition to bass-mid & treble drivers, it uses a 200mm passive low frequency radiator.

Technical details

Bass and midrange coverage is supplied by a new Celestion 200mm pulp cone driver with applied surface damping, while above 2.5kHz a 25mm fabric dome tweeter (again manufactured by Celestion) takes over. A simple 3-element crossover provides the power division between the three units and, in common with its predecessor, the speaker is loaded by an ABR.

Lab results

A level difference of 1.5dB was measured between the two enclosures, but having taken this into account, the remaining irregularities held within 1dB throughout. In practice, a minor adjustment of the amplifier balance control would provide compensation. An average 88 dB sensitivity was recorded, together with a —6dB point at 48Hz. In contrast to the Ditton 22, the 15XR is easy to drive with an impedance of no less than 7 ohms and with a typical value of 10 ohms, containing low reactive effects.

A 'very good' classification applies to the distortion results at 96dBA, which is loud for a small box, and it was only the spike at 1.5kHz and the 0.8% rise at 100Hz which precluded a rating of 'excellent'. Predictably, the distortion rose rapidly below 50Hz, reaching 30% at 30Hz, so a low filter at 40Hz may be an advantage if this model is to be driven hard.

While an encouragingly even frequency response was recorded up to 1.4kHz, this was followed by a 3dB suckout and a +4dB peak at 3kHz, together with a generally uneven response thereafter. At 2 metres the characteristic response suggested a mild mid-prominence, a dulling in the low presence band, and a forward 3-4kHz area followed by another suckout. The off-axis curves do not exhibit close uniformity with the axial trend, and the integration was thus considered to be less than satisfactory. This means that not only will certain changes in sound quality be apparent with different listener positions, but the stereo precision is also likely to be impaired. As with the *22,* the grille is suspected of inciting certain of the upper range irregularities, something from which the older *Ditton 15* did not suffer.

Sound quality

The *15XR* scored 'below average' on the live sound comparisons and 'average' on the stereo programme sessions. Despite the frequency response anomalies, however, the benefits of the narrow cabinet when vertically positioned could be perceived in terms of good stereo imaging properties despite the noted integration problem.

The *15XR* could be driven as hard as the larger *22,* resulting in a loud 105dBA maximum level. The low frequency range could produce satisfying power on electric

bass, and withstood 15W average without rattles or buzzes.

On the live tests coloration was however fairly noticeable, with frequent comments of 'boxy', 'chesty' and 'hard' effects, and a distant 'shut-in' quality. These were less obvious on the stereo programme, but moderate degrees of hardness, nasality, hollowness and a forward midrange were described.

T.F. Comments

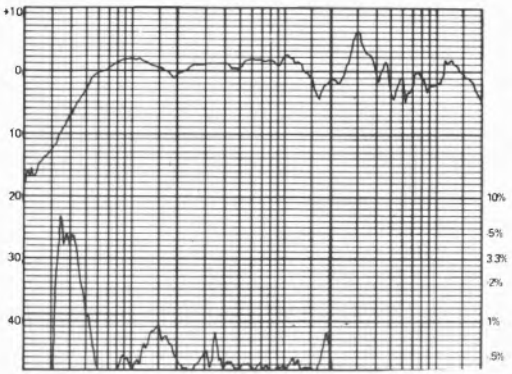
I found the sound quality marginally below average throughout, with a rather chesty bass and hard prominent top; this model is capable nevertheless of quite high volumes for the price.

Summary

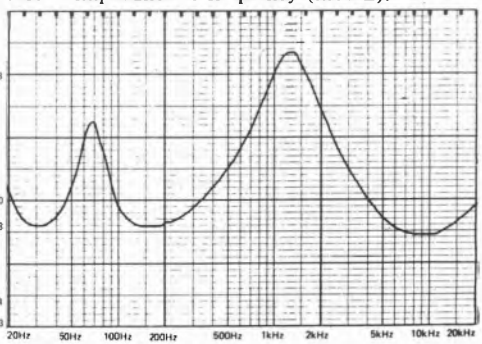
This loudspeaker possesses no serious faults, can be driven hard and is inexpensive. It does not however compare too well on sound quality grounds with those price range competitors that have received recommendations in this report.

Size	56(22) H; 25(9.8) W; 24(9.5) D; cm(inches)
Weight	8.2(18) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£95

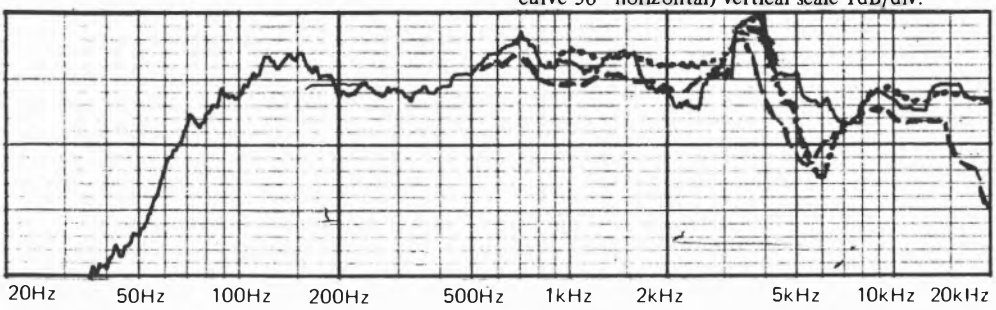
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Chartwell PM450E

Chartwell Electro Acoustics Ltd., 2 Commonside East, Mitcham, Surrey CR4 1HX. 01-648 4494 & 01-640 7426.

The 'E' suffix for this model refers to the inbuilt electronic crossover. This is accompanied by adapted *Quad 405* power amplifiers, with a total of 400 watts of available power to drive each speaker pair. (A version of the speaker with similar drive units but incorporating a conventional passive crossover is also available). This speaker is one of the largest of the 60 models here reviewed, and is designed for stand mounting in approximately free space conditions. Not primarily intended for domestic use, it is a little out of context in this report, as its main application is that of a medium-high level studio and broadcast monitor.

Technical details

A wide range 305mm heavy duty driver with a polypropylene cone is used to cover the bass-midrange up 1.8kHz (this material is an exclusive to Chartwell and Harbeth for drive unit construction.) A 25mm Son Audax fabric dome unit (overload protected) covers the range up to 20kHz and beyond, fine degrees of equalisation being incorporated in the electronic crossover filters.

Lab results

An excellent pair match was shown; within 0.5dB throughout, with the —6dB cutoff point occurring at a usefully low 35Hz. The distortion readings were also excellent; above 80Hz they remained at or below the measurement threshold, while at lower frequencies some rise was apparent to a moderate 2.5% at 50Hz, and a maximum of 10% at 30Hz.

The 1 metre sine wave response showed moderate irregularities — a 220Hz ç3dB hump; a 850Hz —4dB dip; a somewhat prominent 2kHz region followed by a recessed treble band, and an early rolloff in the high treble eg —4dB at 20kHz. Moving to the more realistic 2 metre measuring distance, the 250Hz hump still remained, with the corresponding depression centred on 1kHz. Nevertheless, the axial and off-axis curves were pretty uniform, with the dispersion being particulary good for a such a large bass-midrange unit.

Sound quality

The results from the two listening sessions were in marked contrast, with a 'good' rating established on the live sound comparisons, but a 'below average' ranking attained on the domestic stereo programmes.

The latter showed that the *450E* possessed a noticeable deficiency in stereo imaging, by comparison with the average performance of the test group. The panel also noted mild coloration which included 'tubby', 'boxy' and 'wiry' effects, together with comments of an emphasis in the upper bass, a slightly hard and forward low treble, and a marginally dull balance. Although these effects were less marked on the live sound comparisons, such comments were again repeated.

The *450E* certainly proved capable of high levels of bass power, but did not sound very even as the harmonic relationship of the electric guitar notes was described as 'altered'. The maximum subjective loudness was established at an impressive 108dBA for two

metres, and by the group standards, the sound output possessed above average balance and uniformity.

T.F. Comments

I found this speaker was above average on the live tests, but a grumbling bass character impaired speech reproduction. In stereo I found the image both confused and confusing.

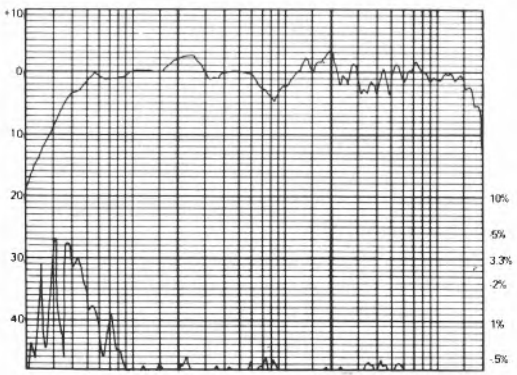
Summary

This is undoubtedly a fairly good loudspeaker and one whose purchase price includes a pair of power amplifiers. The cost is however high, and as such the *PM450E* is rather out of its depth in this survey. The panel did find problems on stereo imagery which might however improve with a listener-to-speaker distance in excess of the 2.5-3.0m used for our tests.

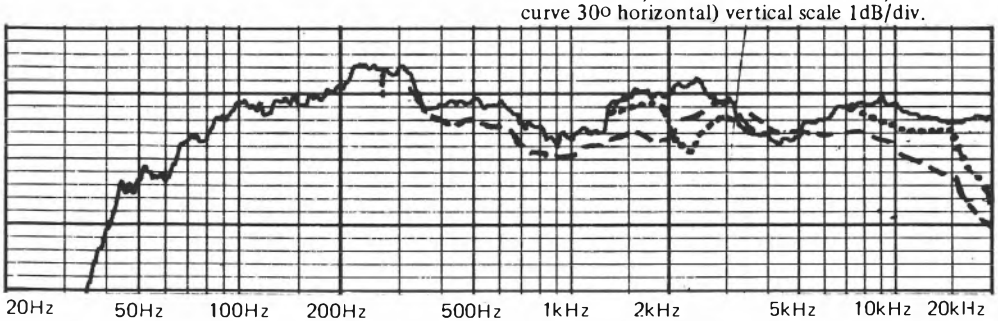
Chartwell have informed us of a continuing research programme for this model; for example, they claim that the moderate mid-range coloration we noted is already under control, by means of an improved equalisation stage, and likewise, the stereo image properties are also being investigated. However both *'Hi Fi Choice'* and Chartwell concede that, while the *PM450E* makes an interesting and valuable addition to the review group, it has been assessed out of its proper 'studio' context, and this should be borne in mind when reading the report.

Size	76(30) H; 46(18) W; 41.2(16.2) D; cm(inches)
Weight	32(70.4) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	NA
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	35Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	NA
Approximate maximum sound level (pair at 2 metres)	108dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	NA
Forward response uniformity	v. good
Typical price per pair inc. VAT	£1400

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Chartwell PM210

Chartwell Electro Acoustics Ltd., 2 Commonside East, Mitcham, Surrey CR4 1HX. 01-648 4494 & 01-640 7426.

Chartwell PM210

The *PM210* is a brand new design, which, in common with the *MP450E* also uses a cone made of polypropylene. The manufacturers have aimed at a higher than usual sensitivity, which can be augmented further by means of a switch that exchanges some of the response equalisation for increased output. The enclosure is intended for stand mounting, and while the review commenced with a pair of prototype speakers, these were soon replaced by pre-production models.

Technical details

A bass reflex design, the 200mm bass-midrange unit operates to approximately 2kHz, above which a 34mm Son Audax soft fabric dome unit takes over. The precision crossover employs air-core inductors and film capacitors.

Lab results

Judged by the curves of the second pair, the pair match should be fine for this system. A sensitivity of 88dB was recorded which puts the *PM210* into the 'average' category, which is some 2-3dB louder than other similar low coloration designs. The —6dB LF point was a quite typical 45Hz.

The sine wave response at 1 metre showed a slight emphasis in the 150-700Hz region, with a mild droop to 2kHz followed by some prominence around 3kHz. The treble could be seen to roll off gently above 15kHz.

On the characteristic response, the lateral dispersion at 30° was of a high order, and although the correct trace could not be printed in time, the vertical 10° uniformity has been improved on the second pair.

Except at 1.5kHz, the third harmonic distortion values were very good, holding at the threshold level, and distortion remained fine at low frequencies, still measuring about 1% at 50Hz.

There were some reservations concerning the impedance of the prototype models, which showed a 4 ohm dip at 1.3kHz, but this had been improved by the second samples, with a mean value of 10 ohms and a minimum of 6; thus the system can be classed as relatively easy to drive.

Sound quality

With initial testing already underway on the first pair, careful comparisons were made with the production models when they arrived, to establish the differences and update the results. Testing then proceeded with this second pair, the following comments relating to these production speakers.

On both live and domestic stereo sessions the *PM210* gained an 'above average' rating. The stereo image quality was praised as was a particular aspect of its midrange quality. Most plastic cone drivers appear to have some degree of — for want of a better word — 'quack' in the upper mid voice band, although this does vary in intensity (whilst it can be severe with some units, in others it may be barely noticeable). However with both this model and the Harbeth (which also uses a polypropylene driver) there was no subjective evidence of such an effect, and this may be due to the new cone material.

RECOMMENDED

Other colorations were present in small degrees and included some hardness, a slight lack of eveness in the treble band with upper treble rolloff, and a slightly bright balance. However, low frequencies were free of boom, and showed good power and eveness on electric bass guitar. A fairly high 101dBA maximum level was attained.

T.F. Comments

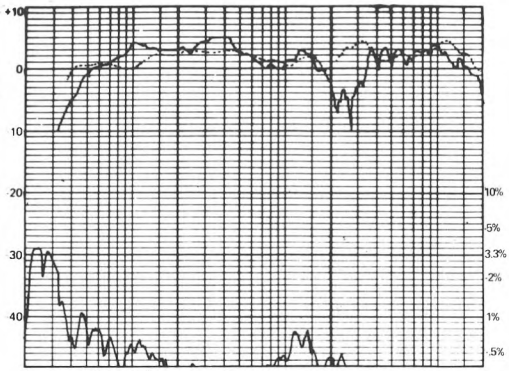
I found the *210* above average in all respects; it performed especially well on stereo image. The balance was rather 'toppy' and tended to exaggerate the pops and crackes on a worn record.

Summary

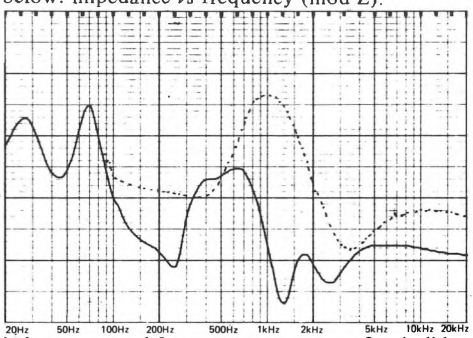
Assuming that this model continues to follow the format established by the early production samples reviewed here, the *PM210* can certainly be described as an interesting version of the classic two way, stand mounted, reflex design. It performed well on many counts, being both easy to drive and possessing a usefully high sensitivity. Coloration levels were low, the response even, and in view of the price, it can certainly be recommended.

Size	66(26) H; 34.3(13.5) W; 28.6(11.3) D; cm(inches)
Weight	17(37.4) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB at (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA*
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£250

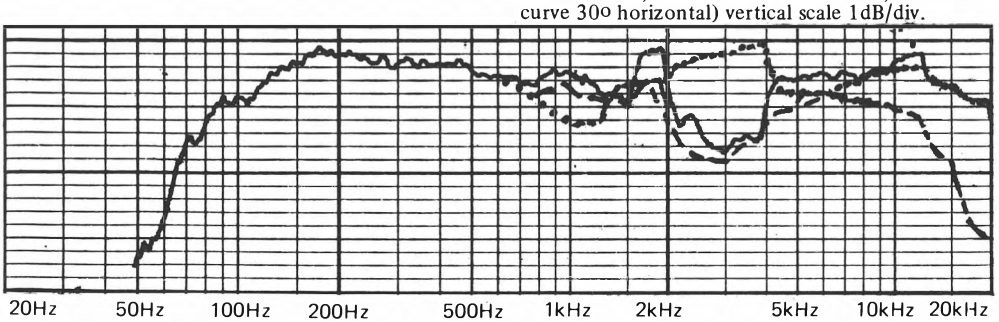
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB). (dotted curve second sample).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Dahlquist DQ10

Hayden Laboratories Ltd., Hayden House, Churchfield Road, Chalfont St. Peter SL9 9EW. (02813) 88447.

An unusual American loudspeaker with more than a passing external resemblance to a black Quad Electrostatic, the *DQ10* in fact employs an array of five drivers, four moving-coil and one piezo-electric. As requested, the review samples were supplied as mirror-image pairs, and rather than using the stubby feet supplied by the manufacturers we found the best results were obtained with the speaker positioned on a pillar stand, taking the care to establish optimum angling.

Technical details

The lower section of the enclosure comprises a sealed box LF assembly powered by a 250mm pulp-cone driver. On the top deck (so to speak) is arranged a group of staggered open-baffle drivers, comprising a pulp-cone mid unit (Philips), a fabric-dome upper mid (Isophon), a plastic-dome treble driver (again Isophon), and a horn-loaded piezo unit

Lab results

Up to 10kHz a very good pair match was measured, but irregularities set in at the higher frequencies, no doubt in some degree attributable to the irregular polar pattern in this range. One enclosure peaked up to +5dB at 15kHz, then fell quickly to —10dB at 20kHz, while the other peaked at 17kHz. This suggests that perhaps the horn tweeters are poorly matched. The sensitivity was fairly low at 85dB, and this is not helped by the just 'acceptable' impedance characteristic, which dipped to 4.5 ohms at 100Hz. The low frequency range was quite extended with a —6dB point at 40Hz, and excellent distortion results were obtained at 96dB spl.

One metre is too close for an accurate measurement of this speaker's overall response but it provides representative information about low and mid frequencies. A small narrow resonance notch can be seen at 150Hz while the 200Hz-2kHz range is mildly elevated against the remaining level.

While the overall trends are acceptable, even at 2 metres the midrange is clearly prominent and the presence band depressed, while both the 10 above and 30 lateral responses show comparatively poor uniformity and integration. The marked asymmetry between the right and left off axis directed responses shows the importance of the mirror-imaged driver arrangement, and the correct left/right room orientation.

Sound quality

Apart from the extreme HF, which many considered to be too directional with an accompanying 'edgy' effect, the overall impression was that of muted airiness and smoothness, which rarely sounded 'loud' in the unpleasant sense. A high 103dBA could be produced, at which point 500W peak and close to 250W average was feeding each loudspeaker (accordingly the fuses had to be uprated to achieve this). The low frequencies were reproduced with fair power and clarity.

Compared with live sound, the *DQ10* scored 'average' which is not too good for a speaker in its price range. While certain areas of the frequency range found favour, for example, voice was surprisingly good, a general 'thick', 'rich' and 'dull' impression was given, with clear presence loss and an occasional 'fizz' in

the high treble.

A 'below average' score was analysed from the stereo test sheets with relatively weak imaging, considering that the mirror arrangement was in operation. Multi-miked recordings sounded pleasantly spacious, but locations were hazy on coherent cross-pair program. The high treble was found to emphasise distortion, and several colorations were described, including 'boomy' 'sibilant' and 'dull', these often recorded by panellists who were sitting somewhat off-axis.

T.F. Comments

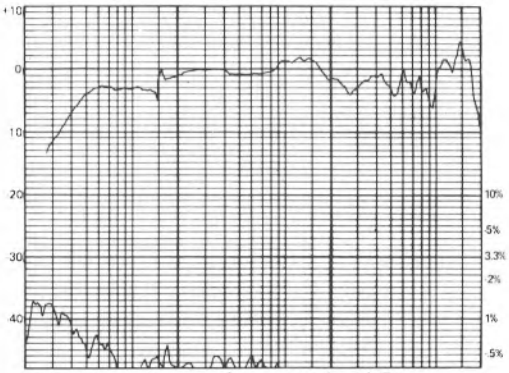
Sitting in the best possible listening position, I was apparently the only panel member to appreciate a good stereo image; in this optimum position I found the extreme HF rather uncomfortable. In the mono tests my previously favourable position was less pleasant, and there were indications of uneven response and cancellations.

Summary

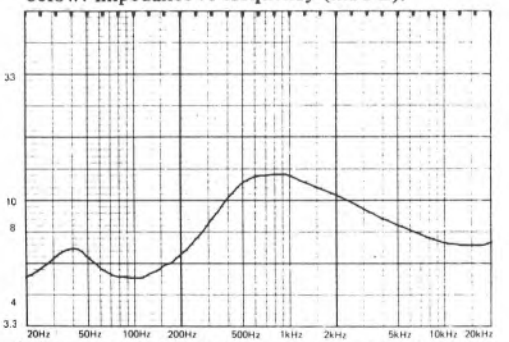
While areas of this loudspeaker can sound very promising, and could well find favour with some, taken on balance the overall results do not appear to justify the price. It is critical of listener position and it is thus essential to set them up carefully. A large amplifier is also necessary to drive them adequately.

Size	80(31.5) H; 77.5(30.5) W; 22.9(9) D; cm(inches)
Weight	27.3(60) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	50 to 250W
Recommended placement	Special stand
Frequency response within ±3dB at (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£640

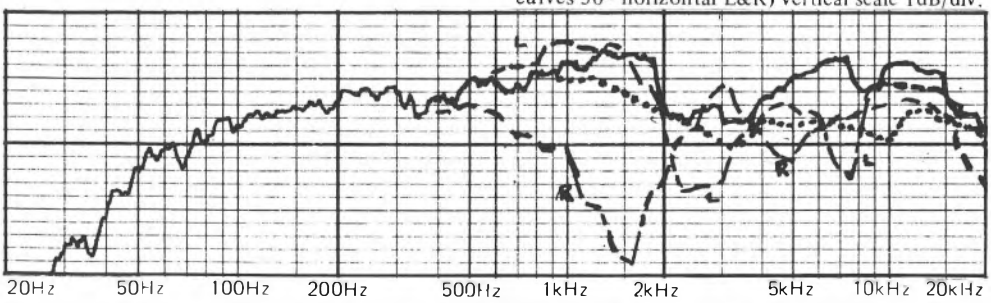
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



Eagle L6600

Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU.
01-902 8832.

A UK designed and built loudspeaker, this three-way model offers a usefully high sensitivity. Specified for free field measurement, it is presumably intended for stand mounting (the manufacturer's instructions were not available in time for this review.) The particle board enclosure was well finished in American Walnut veneer. Despite the fact that pre-production samples were supplied to us, general distribution is expected to begin some time in March.

Technical details

With a vertical-in-line driver array, this reflexed enclosure utilises three Peerless drivers, with a 250mm pulp bass cone operating up to 600Hz, a 100mm pulp cone mid unit with an integral rear chamber, and finally, for frequencies above 3kHz, a 25mm fabric dome tweeter.

Lab results

An absolute sensitivity difference of the order of 1.5dB was noted, and with this taken into consideration, the pair matching held to within 1.5dB up to 8kHz, beyond which a 2-3dB difference was measured. It is to be hoped that this aspect will be improved in production. The sensitivity measured 89dB which is fairly high, and was not compromised by the impedance characteristic, the latter measuring 5.5 ohms at 150Hz, with a typical value of 10 ohms. The speaker thus rates an 'average' rating for amplifier loading.

Very good third harmonic distortion figures resulted at the normal 96dB level, the readings remaining below 0.6% throughout the frequency range above 50Hz where a fine 2.5% was recorded. Clearly a carefully tuned system, the *L6600* demonstrated an extended —6dB low frequency point at 40Hz.

At 1 metre the sine wave response revealed some anomalies, notably a suckout at around 1.5kHz-2.5kHz, with some irregularity at 3.6kHz, the treble then rising to a maximum at 14kHz before falling off to —5dB at 20kHz. (A rear panel switch allows suppression of the 14kHz prominence in two steps.) $\frac{1}{3}$ octave averaging at 2 metres altered the position marginally, the upper bass showing some emphasis with the output still not particularly good near to the upper 3kHz crossover. Essentially, however, the responses were quite even and showed good integration off-axis.

Sound quality

On commencing listening tests the speakers were found to rattle on the organ track. Investigation by the designer revealed that these pre-production models had not been fitted with the sealing gaskets, and with this corrected no further problems of this kind were encountered.

On the live sound comparisons the speaker scored 'above average'. Good low frequency power handling was demonstrated with up to 50W average of electric bass guitar accepted without distress. The LF register was fairly good in terms of depth, but did alter the harmonic timbre of the bass guitar.

Driven to high levels a form of saturation set in the midrange rapidly hardened, thus limiting the maximum level to 98dBA, this corresponding to a 60 watt average input.

STOP PRESS: As we go to press we are informed that the L6600 will be marketed at the L7800. Please read L7800 for L6600 throughout.

Coloration was noticed in the form of 'fizzy' hard effects, together with some 'hollowness'.

On the stereo tests the speaker did not fare so well and scored 'below average'. Imaging was not considered particularly precise although this might well be improved in future as the production standards settle down. The panel found that the speaker's balance sounded less even than the response suggested, and they noted 'gritty' effects together with nasality, hardness and emphasised distortion, with a 'plummy' quality that was reinforced by the depressed low presence range. Some felt it to be potentially a little fatiguing.

T.F. Comments

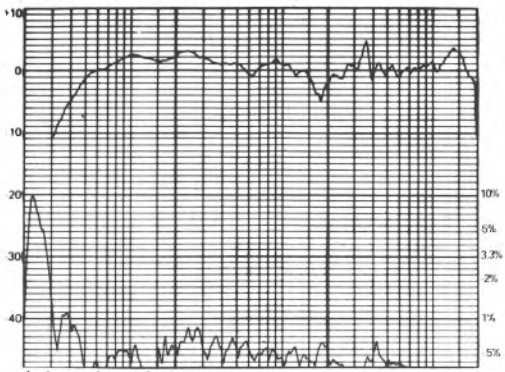
I found this speaker below average on stereo due to a phasey image and apparent uneveness in extreme HF plus a 'boxiness' evident on orchestral excerpts. In mono better comments were recorded, but still treble reservations.

Summary

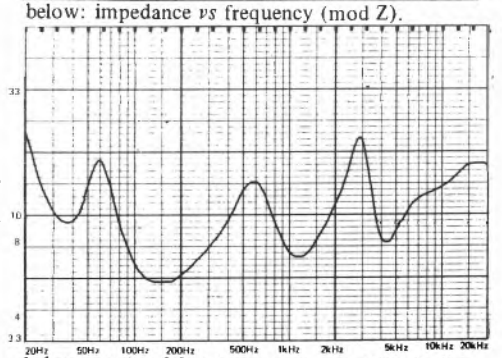
While the overall frequency response, sensitivity, distortion and impedance characteristics are all quite favourable for this loudspeaker, the panel did not greatly favour its subjective quality. This is not to say that the *L6600* is a poor loudspeaker by any means, just that it did not compare well enough with its competitors under the listening conditions employed to justify a recommendation.

Size	62(24.4) H; 33(13) W; 30.5(12) D; cm(inches)
Weight	NA
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£200

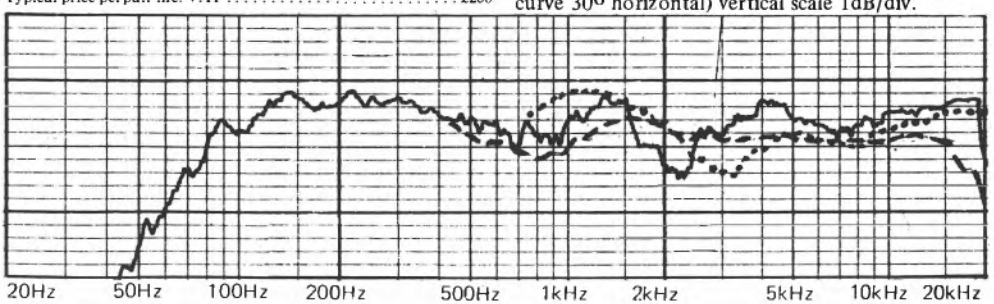
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Exposure 1

Exposure Electronics, Richardson Road, Hove, Sussex BN3 5RB. (0273) 777912.

A product from a small dealer/specialised manufacturer, Exposure Electronics of Hove, this medium sized enclosure is intended for open stand mounting. Finished in a glossy teak veneer, the grille is of dark brown, open cell foam.

Technical details

A small transmission line design, the system employs two drivers, one a bextrene cone 200mm unit (originating from Richard Allan), and the other a 19mm plastic dome (KEF).

The Exposure 2 is a similar design except that an additional mid/treble unit is incorporated. A relatively small 0.8 amp fuse is fitted on the rear terminal panel, and the drivers are mounted vertically-in-line with the bass unit uppermost.

Lab results

The reference sine wave response suggests a 1dB overall imbalance between examples. Inside this difference, 1dB deviations were noted to 10kHz, worsening to 2-3dB above. This aspect could well be improved by the manufacturers to the speaker's advantage.

The sensitivity is undoubtedly low at 83dB, and for realistic sound levels the speaker will need a large amplifier of minimum 40 watts per channel. On the plus side the Exposure was very easy to drive, with an impedance measuring typically 12 ohms, and never falling below 9, and reactive effects were also well controlled. Third harmonic distortion was generally very low, let down only by a marginal 1% peak at 2kHz near to the crossover point. At low frequencies the 3% value at 50Hz was fine, particularly in view of the high power input necessary to generate the 96dB test level, but despite the 'transmission line' construction the —6dB point at 45Hz was not particularly low.

Examining the reference sine curve one can see evidence of a pronounced suckout in the upper mid/presence range, followed by a spike thereafter. This was largely due to mike position, as indicated by the 10° above response on the characteristic curve, and is caused by the inverted driver arrangement. However, the output is correctly optimised by the designer for a nominal listening axis. The characteristic responses also showed the upper bass suckout so prevalent with transmission line designs, together with a tendency for a midrange recessiveness. Taking into account the mike axis as somewhat incompatible with a normal listening position, both the uniformity and the off-axis response integration of this speaker were quite good.

Sound quality

Overall the Exposure 1 gained an 'average' rating which is fair at the price. The maximum level was limited by the low sensitivity to 98dBA, the quality holding well at this level. Minor buzzes could be detected on the live bass guitar test but no gross distortion occurred in the bass until above 25W average power input.

Looking at the panel data in more detail, the speaker was rated as 'average' for the domestic stereo tests, with reasonable imaging and fair location, but not much depth. It sounded a trifle 'small' with 'boxy' and 'nasal' effects in evidence, a slight emphasis of

distortion and a little 'fizz' and sibilant emphasis.

Compared with the live sounds, it scored a 'below average' position, and while the coloration was not severe, the dull balance and distant midrange clearly affected the marks. Never unpleasant, on the other hand it lacked liveliness.

T.F. Comments

Slightly above average overall, this speaker sounded slightly dull, with an uneven quality to the extreme HF, and also some 'tubey' coloration.

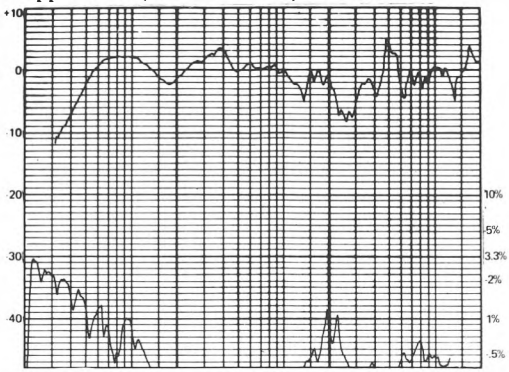
Summary

Requiring a large amplifier (and a higher rated fuse!) the Exposure could understandably win favour, particularly if partnered with a bright and forward pickup cartridge. It sounds smooth and easy, but in consequence it lacks punch and exposition of detail, the dull balance tending to make it sound more coloured than it really is. Although the price is quite reasonable, no clear benefit can be seen to derive from the transmission line construction, and better quality control of pair matching would be desirable.

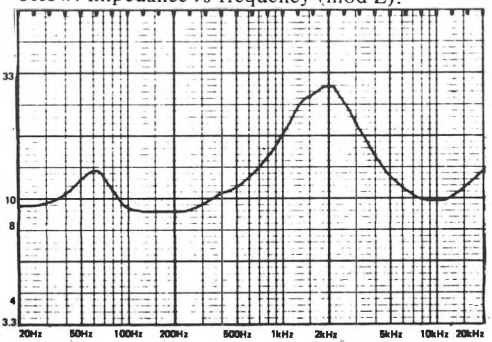
Size	61(24) H; 30.5(12) W; 30.5(12) D; cm(inches)
Weight	14(31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	40 to 150W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	83dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA*
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£175

*See text.

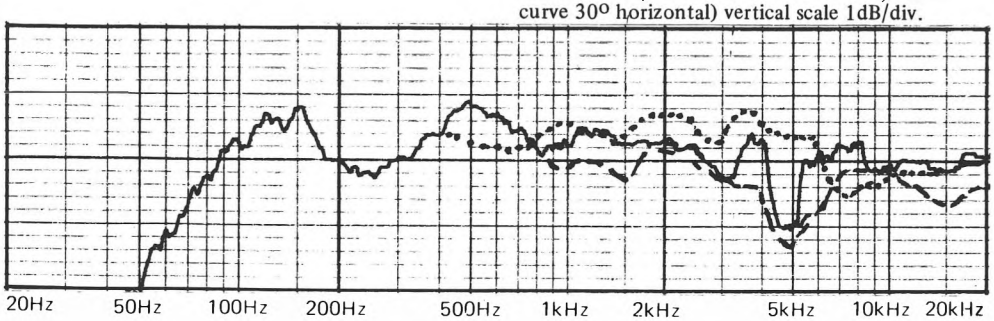
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Goodmans RB35

Goodmans Loudspeakers Ltd., Downley Road, Havant, Hants.

The Goodmans RB series is intended to complement their low coloration Achromat range, by offering greater sensitivity and value for money in a more popular package. The company offers a 3 year guarantee on these speakers. The *RB35* is one of four models which share a common instruction book which includes no information on positioning, although the general advice on room acoustics is helpful. Stands were used for auditioning.

Technical details

A medium sized sealed-box enclosure, the low-mid frequencies up to 1kHz are handled by a 250mm treated pulp cone unit. The 1-6kHz range is allotted to a 86mm pulp-cone sealed-back driver, and above 6kHz a hard dome tweeter continues the output to 20kHz. A relatively simple 7-element crossover (simple that is for a 3-way system) divides the power spectrum between these units, and vertical-in-line mounting is followed.

Lab results

Very good 1dB pair matching was maintained overall, except for a small 2dB difference around 500Hz. A high sensitivity was recorded, but this is partly due to the below average impedance, which dips to 4 ohms at 120Hz, and has a typical value of 6 ohms; having a low reactive content, however, this speaker should be fairly easy to drive. For this enclosure size the LF resonance was rather high at 55Hz, due presumably to the light bass cone, but the corresponding —6dB cutoff point was at a reasonable 48Hz

The third harmonic content was quite good, generally well under 0.8% even at the lower frequencies; the high sensitivity meant that very little power input was needed to achieve the 96dB test level.

At 1 metre on axis, the response showed a marginally early treble rolloff at 17kHz, a slightly uneven treble register, and a moderately lumpy mid range. With an averaging response at 2 metres, the 10° vertical trace was quite different to that on axis, indicating that the listener must be close to the geometric axis of the speaker in order to perceive a good frequency balance. The lateral 30° off-axis characteristic was weak, with noticeable irregularities around 5kHz. Overall this speaker cannot be said to be well integrated in the forward plane, and in consequence the sound will vary significantly with listener position.

Sound quality

This loudspeaker was not rated very highly on subjective grounds, never gaining more than an 'acceptable' or 'below average' ranking. Against this must be set its price which is much less than the average for the group, and is comparatively low for a three-way system.

Despite the high sensitivity, the sound character mitigated against very high levels, with 101dBA set as the maximum tolerable from a stereo pair at 2 metres. The low frequency power handling was a disappointment, with obvious degradation on electric bass guitar at power levels in excess of 5 watts average.

On the live tests the panel found the RB35 to be quite hard and aggressive with some

'boxy' and 'fizzy' effects, together with 'tunnelly' and 'hollow' sounds. On the stereo programme, similar 'hard' 'honky' and 'edgy' colorations were observed, with an element of fatigue inducing effects. In contrast to the sound quality, the stereo imaging was considered to be quite good.

T.F. Comments

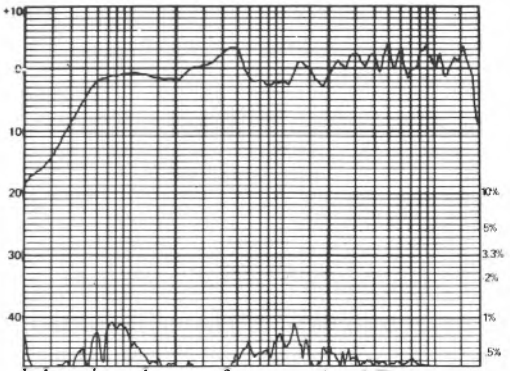
With overall scores 'below average', I thought this speaker sounded hard and forward with a 'nasal' quality.

Summary

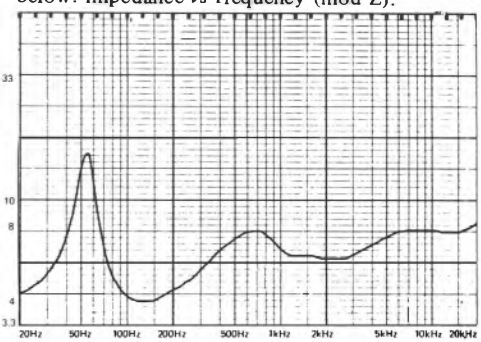
The results must speak for themselves with this loudspeaker. The price/efficiency ratio is good, and because of its 'attack', the *RB35* might suit a loud sounding, low cost rock-oriented system, but its overall sound quality just did not come up to the higher standard set by the recommended models in the survey.

Size	62(24.4) H; 32(12.6) W; 25(9.8) D; cm(inches)
Weight	12.5(27.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 18kHz
Low frequency rolloff (—6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	92dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	average
Typical price per pair inc. VAT	£105

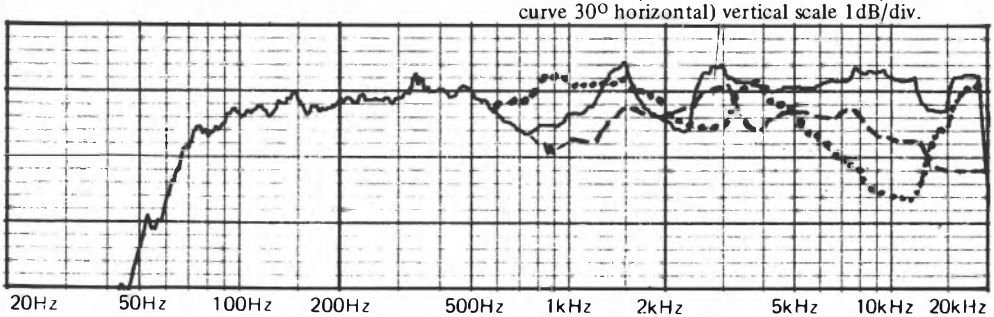
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



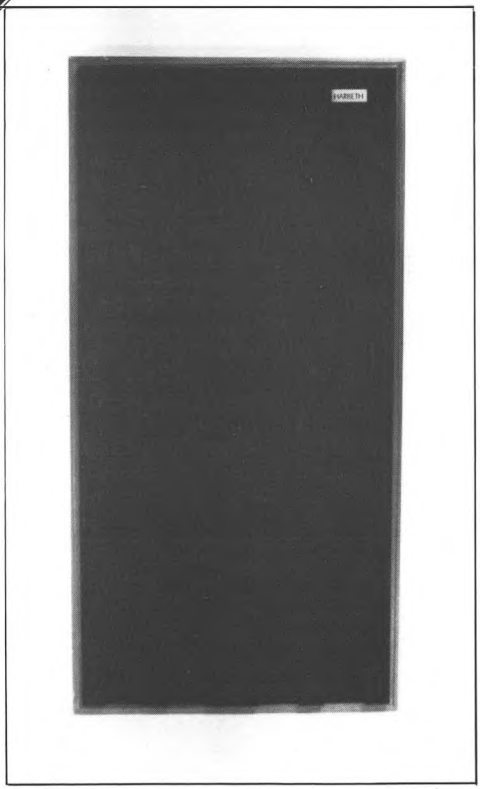
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Harbeth HL

Harbeth, 2a Nova Road, W. Croydon CR0 2TL. 01-681 7676.



Hi-Fi Choice were loaned a pair of *HL*s on which all tests were conducted, only one or two points being important enough to be raised with the manufacturers. A further production pair was supplied. They were better in many respects, and where possible the following report includes these new results.

Technical details

A two way bass reflex design with a ducted vent, the main unit is exclusive to Harbeth, being a 200mm polypropylene cone bass-mid driver. The treble range is handled by the ubiquitous 25mm fabric dome Son Audax. A 'classic' BBC style cabinet is employed, made of relatively thin plywood with a double layer of bituminous damping felt for absorption of panel resonances. The crossover on the second pair was rather better constructed than the first, even though the soldering techniques still leave a little to be desired.

Lab results

The first pair matching was pretty good except for an area around 700Hz — 1.5kHz, where a 7.5dB difference was noted; this anomaly also apparent with the second samples. Sensitivity was 87dB with the first pair and a slightly above average 88dB with the second (due to a small crossover change); referenced to this was a —6dB point at 45Hz, which is quite typical for this size of enclosure. Third harmonic distortion was excellent at the high 96dB test level, typically at or below threshold, except of course at the lowest frequencies, where moderate 1.5%, 50Hz and 12%, 30Hz were measured. The latter suggests that a 40Hz amplifier filter would extend the power handling.

At 1 metre the first samples showed an elevated low frequency range and a strong mid trough, followed by a gently rising treble, reaching a maximum at 15kHz. Reference checking with the second pair showed this mid trough to be now under control, although a moderate 2dB suckout here is apparently a deliberate design intention.

At 2 metres on pink noise, the curve is that for the first pair. The bass shows a 2-3dB prominence, in a broad, even band, while comparison of the axial 30° and 10° curves shows that the *HL* has very good dispersion and driver integration up to 12kHz, above which some falloff is apparent.

Sound quality

Despite their measured deficiency, the first pair were nonetheless good enough to score quite high marks on the listening tests, attaining an 'average' rating on the stereo sessions, and 'above average' on the live sounds. Improvements were however noted in several areas with the second pair. For example, the maximum level was increased from a weak 94 to a fair 97dBA, mainly due to a bass tuning improvement. Bass power handling similarly improved from 15 watts to 25 watts average of electric bass guitar, while pair 2 were also 1 or 2dB louder.

The listening panel clearly recognised the mid suckout and in consequence commented on related balance changes, including 'fizz,' 'recessed,' 'slight box,' 'sibilant,' 'plummy' and 'chesty' effects. In general, however,

RECOMMENDED

coloration in the accepted sense was quite low.

The second pair were transformed by comparison, having a much better mid balance. The treble and upper bass ranges no longer sounded obvious and exposed, and began to integrate naturally with the midrange.

T.F. Comments

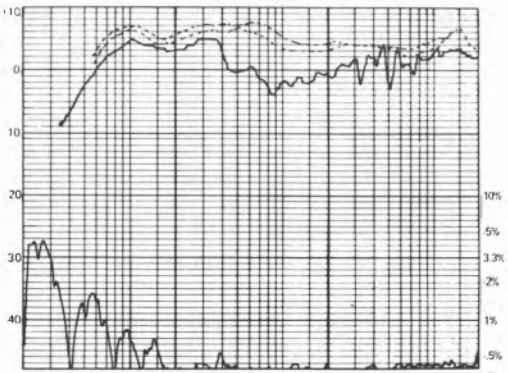
The confused stereo image of the first samples placed the Harbeth slightly below average in my estimation. I was aware of a suckout in the response which gave a thin sound quality, with the treble and bass rather detached from each other. On auditioning the second samples the suckout was 'filled-in' considerably, but the stereo was still rather muddled.

Summary

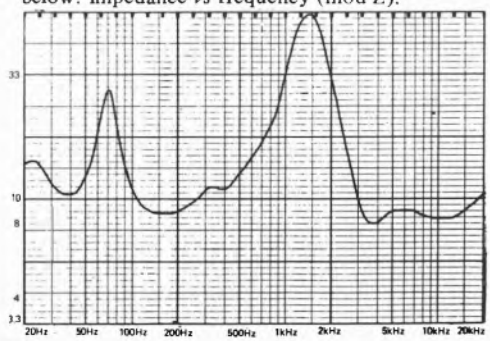
Left wishing I had started the review with a proper production pair in the first place, the second samples at least sorted out some of the problems we had encounted. The power handling remains somewhat restricted, although conversely the sensitivity is a little higher than average; the bass quality is fairly good, and the mid exceptional in detail and transparency. Presuming that the pair match can be improved on future production, the *HL* now deserves to be included amongst our recommended systems.

Size	64(25.5) H; 32.5(12.8) W; 30(11.8) D; cm(inches)
Weight	13.5(30) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 75W
Recommended placement	stand
Frequency response within ±3dB (2m)	300Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	97dBA*
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£250

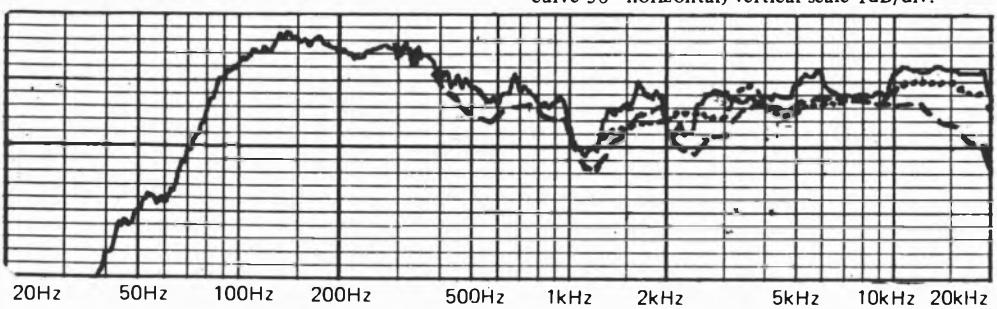
below: upper curves 1m sine wave reference; (dotted curves show pair matching, sensitivity, and frequency response of second samples). lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



IMF TLS80 II

IMF Electronics Ltd., Westbourne Street, High Wycombe, Bucks. (0494) 35576.

The Mark I version of this speaker was included in the previous *Hi-Fi Choice Loudspeakers*, the *TLS80* being a large, free-standing enclosure of imposing dimensions. A purpose built steel stand with an inbuilt angle of tilt is supplied with the speakers, which come in left/right mirror pairs and are provided with a switched HF control allowing nominal degrees of lift or cut to suit room acoustics and position.

Technical details

A KEF 30cm x 21cm wedge diaphragm bass unit operates up to 350Hz and is loaded by the large transmission line enclosure. From this point up to 3kHz a 110mm KEF bextrene-cone midrange unit comes into operation, its diaphragm especially treated. A Celestion 38mm hard-dome driver continues up to 13kHz, above which a Celestion 19mm plastic-dome tweeter takes over. The ducting is lined with a special grade of anechoic foam with surface contouring.

Lab results

Both left and right enclosures matched very closely, their curves overlaying within 1dB throughout. At 85.6dB the sensitivity was low, but not outrageously so, and while a minimum amplifier rating of 30 watts per channel is indicated to get them moving, the maximum power handling is potentially very great.

Assessed against the sensitivity, the maximum level attained was high at 105dBA, indicating compatibility with up to 250W per channel amps. The benefit of the large enclosure is evidenced by the —6dB LF point at a truly low 25Hz.

The low impedance values recorded (near 4 and with an average of 5 ohms) suggest that the speaker is not too easy to drive. It measured below 4 ohms near 20kHz, the value still decreasing thereafter, although the musical power should be falling away rapidly at this point. Bar a narrow region near 1.6kHz, the 3rd hasrmonic distortion results were remarkably good, as they were generally below the measuring threshold, and only recorded 1% at 30Hz with an extraordinarily low 2.5% at 20Hz, where the output was still considerable.

The reference sine wave trace illustrates the exceptional LF extension of this model, and reveals a generally even response, with a mild 130Hz suckout and a just detectable upper-mid droop. On $\frac{1}{3}$ octave averaging, the left/right 30° off axis assymetry was clearly evident, the correct 'handed' direction being much superior. Generally a very even trend was shown with good vertical plane integration, the only notable feature being a slight lift around 600Hz.

Sound quality

In general the basic rating for the *TLS80 II* was 'above average' on sound quality. On the live tests, the low frequency power handling was considerable, and up to 150W of mean electric bass power was accepted before breakup. The low frequency range was admirably extended, even a trifle excessively. A much larger listening room than the one used for *Choice* could well assist here. No new standards for mid and treble accuracy were

set, and coloration could be heard on occasion. Some loss of airiness and presence was observed, together with a rather 'small' voice sound and a degree of 'shallowness'. Two of the panellists remarked that this was a 'nice' speaker, clearly reflecting its generally smooth character.

More coloration was observed on the stereo tests, and at times the image itself was a little hazy. Piano reproduction possessed some 'honk' with parts of the frequency range reproduced rather better than others. The organ track, not surprisingly, was presented with great depth, space and scale.

T.F. Comments

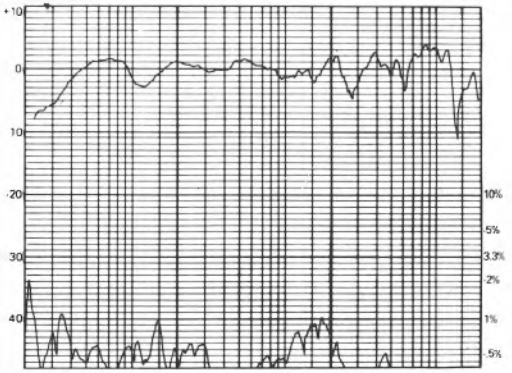
Above average overall, this speaker was warm and I am sure, easy to live with, if not strictly accurate; stereo imaging was just below average.

Summary

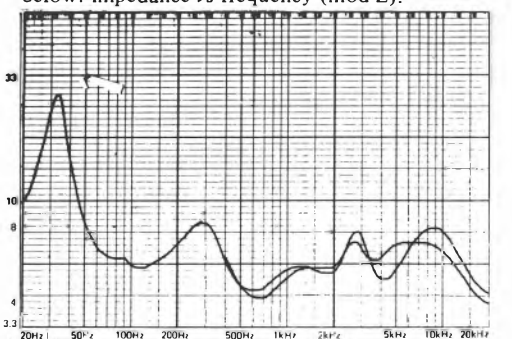
This unusual and large speaker offers a fairly good standard of sound quality, possessing an exceptional low frequency range together with great power handling and loudness potential, despite its lowish efficiency. It will however give of its best in large listening rooms.

Size	98(38.5) H; 46(18) W; 41(16) D; cm(inches)
Weight	37(81) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	stand supplied
Frequency response within ±3dB (2m)	55Hz to 20kHz
Low frequency rolloff(—6dB)at (1m)	25Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	105dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	good
Typical price per pair inc. VAT	£550

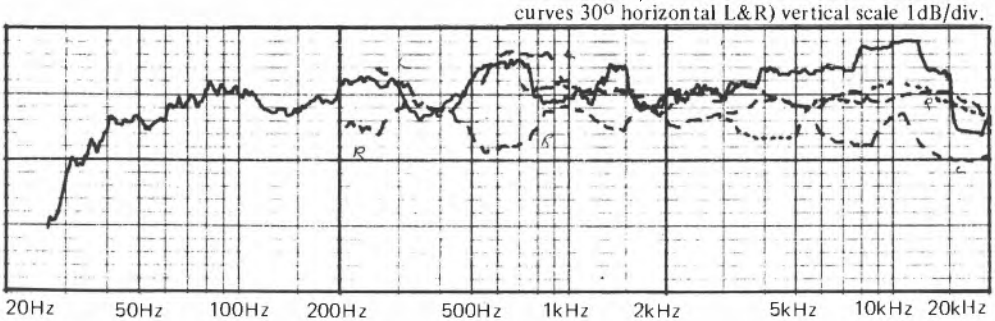
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



Isophon HI100

Hayden Laboratories Ltd., Hayden House, Churchfield Road, Chalfont St. Peter SL9 9EW. (02813) 88447.

Early models of this UK design using Isophon drivers were supplied to *Hi Fi Choice* and fully tested, but towards the end of the project manufacturers Hayden Laboratories decided the design was inadequate, and they developed a new version for sale, using the same drive units. We felt bound to reassess the new speaker and as such report on both models, with the emphasis on the second version. It was not possible however to reconvene the full listening panel, so the sound quality descriptions are in consequence more cautious in their judgments, and they cannot be directly compared with those for the other speakers that underwent the full group assessment.

Technical details

A three-way sealed-box design, the system incorporates an Isophon 200mm bass unit with large coil, massive chassis and flared pulp cone. The upper mid is handled by a fabric dome unit of about 35mm diam, and finally a 25mm dome tweeter covers the treble range. (In the first pair this HF Unit was hard white plastic, and in the second pair it used a doped fabric, thus explaining the significant change in upper treble response shown on the graphs.)

Lab results

The first samples demonstrated a poor pair matching in the mid range with up to 4dB difference over the 300Hz-1.5kHz band, and a further mismatch also evident around 8kHz. The second pair showed a much improved balance.

Both pairs of speakers possessed a similarly low sensitivity of 83dB with —6dB LF point at about 45Hz, this corresponding to a system resonance at 40-45Hz. The impedance curve showed the second pair to be easier to drive, with a minimum value of not less than 7 ohms.

On sine wave it was clear that the second speakers showed a considerable improvement over the first, although a slight mid-prominence was still evident, coupled with a broadly depressed presence range. The upper treble rose to a hump at 10kHz before falling gently away — a contrast to the spike on the earlier samples.

The 2 metre responses are taken from the first pair, and while the overall shape does not conform with that of the second samples, the basic grouping of off-axis responses will not be greatly different. In general quite good integration and dispersion was shown in the forward plane.

Third harmonic distortion was very good on this model, except at low frequencies. At 60Hz a rise to 0.8% was noted increasing to 3% at 50Hz and 7% at 40Hz, although these values are quite typical of smaller systems such as the *HI 100,* and the high level 96dB test level must also be taken into consideration.

Sound quality

The maximum sound level of 99dBA holds true for both pairs, this requiring 500W peak from the test amplifier and demonstrating good power handling. However 5-10 watts average of electric bass guitar was sufficient to incite rattles on the driver panel, this secured with woodscrews rather than the usual tensioned bolts.

The low bass was deficient on both pairs, with the thin, edgy and uneven balance of the

first examples replace by a rather thick, muddy and rich balance on the second. The latter effect appeared to accentuate the inherent boxiness of the system while the dulled presence is clearly indicated on the graph. While the depression was shallow, it extended over a wide enough range to be significant.

T.F. Comments

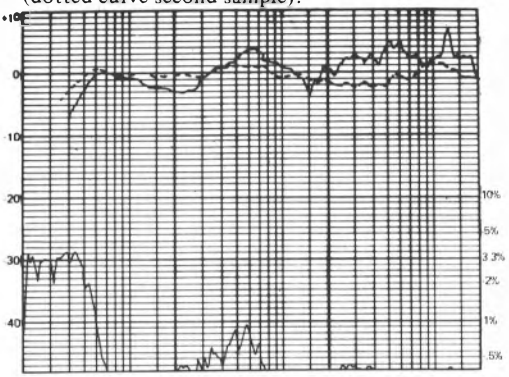
Below average, the first samples of this speaker sounded thin and rather coloured, with an 'ong' sound, some power-handling problems, and mechanical rattles. The second pair sounded different but still not altogether satisfactory.

Summary

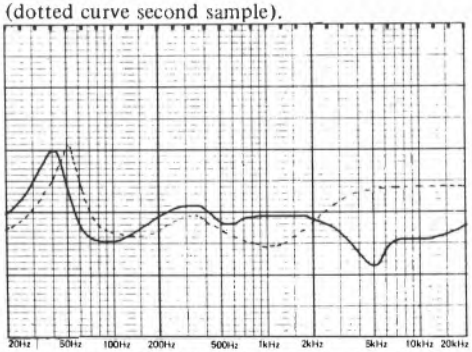
At this stage we would still regard the *HI 1000* as incomplete, and in truth, the speakers should not have been submitted for review at this stage in their development. It must be regarded as an act of commercial bravery on the part of Hayden in that they agreed to supply us with samples at this early stage, and that they were prepared to let the results stand. The second pair possesses certain undoubted advantages over the first, but they still require some finishing touches; these, we hope, will be complete and the speaker into production by the time this report is published.

Size	53.3(21) H; 33(13) W; 25.4(10) D; cm(inches)
Weight	NA
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	shelf
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	83dB at 1m
Approximate maximum sound level (pair at 2 metres)	99dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£150

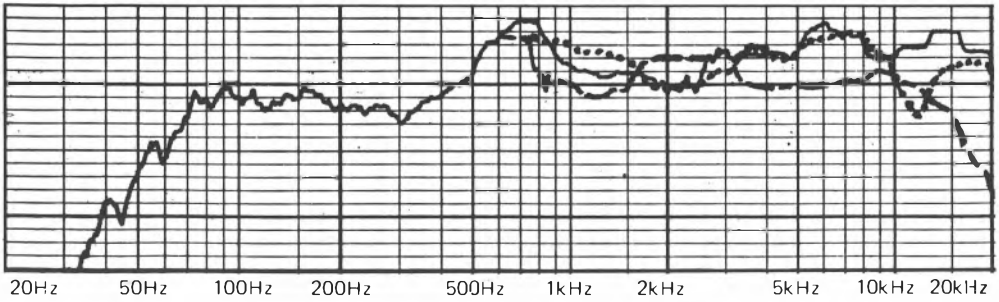
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB). (dotted curve second sample).



below: impedance *vs* frequency (mod Z). (dotted curve second sample).

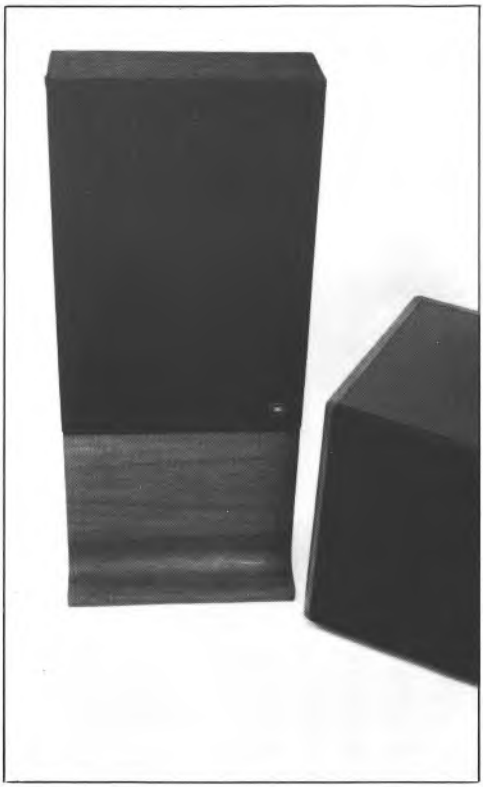


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



JBL L212

Harman (Audio) U.K. Ltd., St. John's Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049-481 5221.



One of the most intrinsically interesting models in the review, the *L212* also turned out to be one of the most frustrating. A three-box system, it comprises two satellite units in the form of slim and tall enclosures, free standing on a built-in pedestal, while the third box comprises a 'common' sub-woofer. The latter incorporates an electronic low pass filter at 70Hz and a 50 watt amplifier with equalisation for the woofer responses, while the satellites possess a natural, sealed-box 12dB/octave rolloff at 70Hz to match. JBL recommend an 'open' position for the satellites, presumably well away from room corners.

Technical details

The satellites comprises a bass driver (200mm) with a massive 75mm motor coil and a rigid pulp cone. A 100mm pulp-cone unit operates from 800Hz to 3kHz, the range above alloted to a 25mm hard fabric dome tweeter with an aluminium film coating. The sub-woofer box is also sealed, and contains a 305mm bass unit with a 100mm motor coil. Level controls are provided for HF, presence and bass.

Lab report

An excellent pair match was demonstrated by the satellites, to within 1dB overall. However the uneven response made it awkward to specify a mean sensitivity although 91dB would appear to be a fairly representative figure. The —6dB LF point was also difficult, since it depends on the bass gain setting, but with an overall smooth response set (7) an astonishingly low 20Hz was indicated. The satellites were very easy to drive.

Above 150Hz excellent distortion readings were taken. Below, a fine 1% 50Hz was measured, climbing to 30% at 30Hz. This latter figure was unfairly exaggerated by comparison with the other speakers, as so few produced any significant output at 30Hz.

Our first series of sine wave 1 metre responses were taken with the satellite controls on '5', which we assumed represented the level position. The odd results obtained, however, led us to contact JBL: who suggested position '8' was 'flat', the responses in this mode being indicated by the dotted line on the reference trace. The manufacturers also suggested that we should take the grille off for measurement purposes, but in practice, this made very little difference. Finally they submitted a new satellite for checking, and this gave almost identical results — good manufacturing consistency is apparent here, at least.

At both 1 and 2 metres, response anomalies were clearly in evidence. The level setting to '8' ameliorated the situation but did not effect a cure. We were told that the satellites do measure flat when flush mounted in a baffle of 10m sides, but clearly this neither relates to our own measurements nor to typical conditions of use. The characteristic response showed a mid-dominant plateau centred on 500Hz, some 4-6dB above the rest of the response. The treble range was uneven with a broad suckout in the 8kHz region, which exposed the extreme treble peak at 18-20kHz all the more (this being some +8dB relative to the preceding curve level on the sine wave traces).

Sound quality

While this model was tried in various adjustments and special repeat tests were run to achieve these variations, the panel did not find the overall quality very accurate. It attained a very loud and clean 111dBA, and produced high sound levels on electric bass guitar with great accuracy, depth and eveness. These factors helped to pull it forward to an 'above average' rating on the live comparisons, but on the stereo tests it was considered to be 'poor' with 'boxy' and 'Middy' colorations together with a depressed presence band, while a 'ringing' 'scratchy' treble was commented upon by many panellists. Despite the subjectively poor balance, its essential clarity and rendition of detail was good.

T.F. Comments

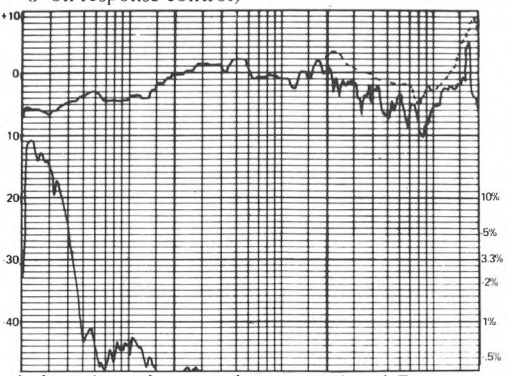
This unusual loudspeaker was capable of producing very high volumes but was far from flattering to most classical music. There was evidence of extended bass, but there was some spikiness at extreme HF and a clearly audible suckout which suppressed considerable detail.

Summary

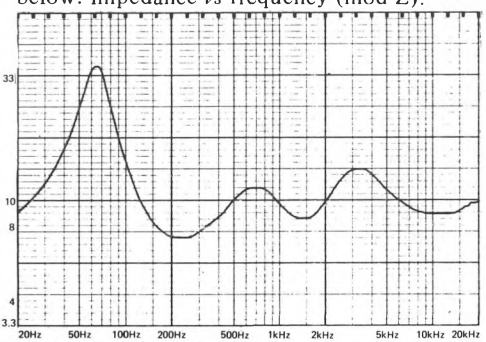
While the *L212* can sound extended, excitingly impressive and detailed, by the standards of this report it cannot be called accurate.

Size	98. 1(38. 5) H; 43.2(17) W; 33(13) D; cm(inches)
Weight	45(100) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 250W
Recommended placement	floor
Frequency response within ±3dB (2m)	40Hz to 6kHz
Low frequency rolloff (—6dB) at (1m)	20Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	91dB at 1m
Approximate maximum sound level (pair at 2 metres)	111dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	good
Forward response uniformity	average
Typical price perpair inc. VAT	£1462

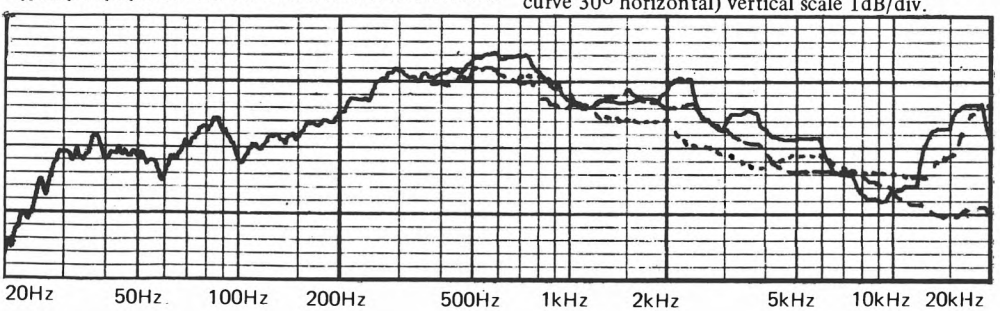
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).
(solid curve at position '5', dotted curve position '8' on response control)



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



JBL L19

Harman (Audio) U.K. Ltd., St. John's Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049-481 5221.

A new compact system from JBL, the *L19* comes in an oiled walnut finish of excellent quality. It is in fact the domestic equivalent of an existing small studio monitor, the *4301*, and as it possesses a usefully high sensitivity (in JBL tradition) it should be capable of high sound levels.

Technical data

A bass reflex enclosure with a narrow ducted port, the low/mid spectrum is handled by a highly rigid 200mm pulp cone driver. This top class unit incorporates an excellent die cast frame together with a large 50mm motor coil. Crossing over at 2.5kHz, a 36mm pulp-cone tweeter continues the range, with a level control allowing adjustment of the HF output. The crossover comprises a 6-element 12dB/octave design network, this count including the level attenuator.

Lab results

Our sensitivity data placed the *L19* at 89dB, which is higher than specified, although an absolute 1.5dB level mismatch was recorded between the two speakers. Allowing for this discrepancy, the matching then held to within 1dB up to 8kHz, but deteriorated thereafter due to the erratic nature of the high frequency range. (The sharp edged grille baffle may be partly responsible for this.) The —6dB LF point was placed at 60Hz. Very good third harmonic distortion values were recorded above 150Hz, where the speakers measured close on the threshold value, only rising at lower frequencies to 1% at 100Hz and 3% at 60Hz. No further increase was noted thereafter until below 30Hz. With a 5.5 ohm minimum impedance at 5.5kHz and well-controlled reactances, the speakers were classed as presenting an average amplifier loading.

The 1 metre sine curve showed a rising trend with frequency, suggesting shelf mounting for optimum balance. A dominant feature was the fierce +8dB spike at 10kHz. At 2 metres the averaged characteristic response moderated the spike but it was still obvious. Other features included the upper-mid prominence of +3dB and the acceptable lateral dispersion. The off-axis curves showed plainly the lack of high frequency energy above 12kHz, the response measuring —10dB or more at 20kHz.

Sound quality

The L19 scored typically 'average' sound quality ratings, which is fair enough at the price. It could be driven to very high levels — 106dBA maximum — and tolerated 500W peaks on transients without damage.

Quite high subjective levels were also produced in the electric bass guitar test, although inputs over 10-15 watts average did induce mild buzzing which was thought to come from the rear panel.

On comparison with live sounds the *L19* appeared somewhat 'edgy' and 'hard' with 'thinned' and 'boxy' effects commented on with male voice. The loss in extreme treble was noticed and the overall balance was considered to be quite thin and bright. These characteristics were largely confirmed on stereo programme, which also gave rise to comments of sibilance and distortion

emphasis, 'fizz' (undoubtedly the 10kHz peak), and some metallic edginess. On the plus side the speaker was very clear and produced considerable detail. Shelf mounting and some treble cut would help to rebalance this system to advantage, but cannot of course cure the 10kHz peak in the treble range or the falloff thereafter.

T.F. Comments

I found this system very clear, although with some excess of treble which tended to exaggerate any tape hiss. Although capable of high volumes, I found the treble became oppressively hard when played very loud.

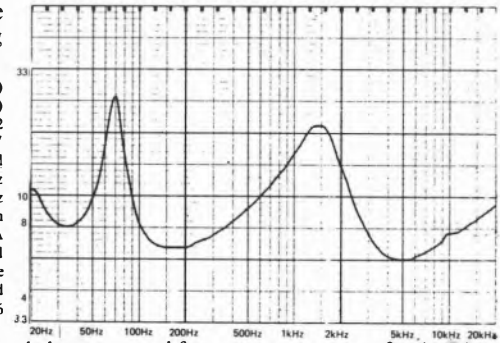
Summary

Clearly the *L19* contains some good ingredients and can be seen to have potential. Easy to drive and capable of high sound levels, the general feeling from the test data was that the treble unit let the side down, and thus prevented the system from attaining a 'good value' standard. Unless a really bright, punchy sound is desired (and the treble quality is not over important) the *L19* cannot really be recommended at its price; pair matching should also be improved.

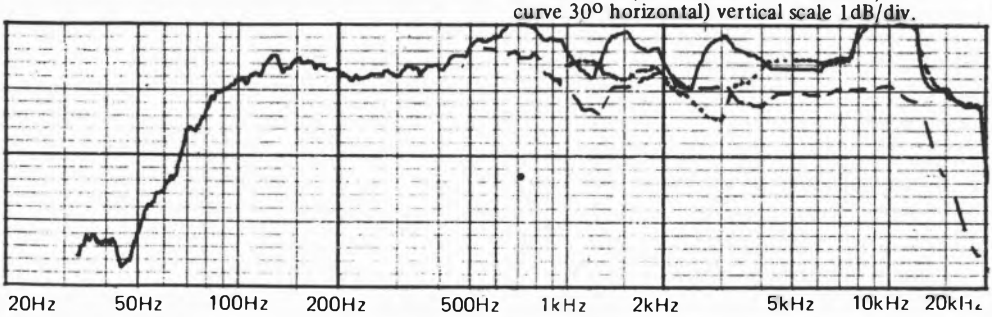
Size	58.3(21) H; 33(13) W; 25.4(10) D; cm(inches)
Weight	13(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	shelf or stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB at 1m
Approximate maximum sound level (pair at 2 metres)	106dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£236

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

JR 149

Tape Music Loudspeakers Ltd., 114 Ashley Road, St. Albans, Herts. AL1 5JR. (0727) 64337.

A frequently reviewed loudspeaker the cylindrical *149* was examined in an early form in the last edition of *Loudspeakers*. Minor manufacturing improvements have since been put into effect, together with the introduction of an optional accessory, namely a sub or 'super' woofer. This, in the manufacturer's own words is intended to realise 'an accurate extension of bass response (30Hz to 120Hz) while the main system, relieved of the stress of extreme bass reproduction, gains in terms of distortion and power handling'. This was unfortunately not confirmed on test, and the tables thus refer to the small *149* alone, the 'woofer' proving to be somewhat of a disappointment.

Technical details

Formed from heavy gauge aluminium sheet, this rigid sealed enclosure uses thick particle board end caps with tensioning. The driver line up is similar to that used in the LS3/5A, using a KEF 110mm bextrene cone bass-mid and a 19mm plastic-dome treble unit. The crossover is also related to the 3/5a, although with a lower 3kHz changeover frequency. The cylindrical profile almost guarantees an excellent lateral dispersion.

Lab results

While matching was very good at within 1dB up to 11kHz, a 2dB discrepancy was noted above this frequency. Sensitivity was very low at 83dB, necessitating a decent minimum amplifier rating of at least 25-30 watts for a satisfactory sound level. The low frequency range was quite extended at —6dB, 45Hz, and the rolloff was quite slow. The *149* was also easy to drive with a minimum impedance of 7 ohms, although with the 'woofer' attached, a rather low 3 ohms was recorded (control 'max').

At an understandably modest 90dBspl the 149 gave very good third harmonic levels — at or below 0.5% distortion above 70Hz and a moderate 2.5% at 50Hz. An attempt at 96dB with the sub-woofer was frustrated by gross overload in the latter, and with the woofer at 90dB, the distortion actually increased to 8% at 50Hz. The sine wave reference curves show that the woofer adds virtually no bass extension to the *149*s and unfortunately provides an excess at 80Hz, plus a minor cancellation at 125Hz (the alternative phase connection cancels nearly all the LF output). On its own the *149* demonstrated an even, well balanced response.

At 2 metres the average characteristic curves show a similarly good result. At 10° above axis a 5dB suckout appears at 5kHz, suggesting that the speakers should be at ear level or angled to direct axially. A superb 30° off axis response was also apparent.

Sound quality

Initial tests showed the sub-woofer added some extra weight but also significant coloration, and it was therefore omitted from the following subjective reports.

On its own the 149 achieved an 'above average' sound rating — a fine result considering its quite modest price. An acceptably loud 98dBA maximum sound level was achieved, and though loud electric bass guitar was not within its capability, moderate

RECOMMENDED

levels of 10-15 watts average were tolerated.

The stereo image quality was of a high standard with good depth and spatial location. On the stereo programme tests the speaker fared well, with only mild degrees of coloration observed; notably tubby voice, and sibilance, together with 'tubey' and 'nasal' effects. The balance was felt to be a trifle hard and yet somewhat dulled.

On the live sound comparisons it did not score as well (this result in contrast to a similar test in HFP some 18 months ago). Reinforcing the slightly dulled impression gained on the live tests, the comments ranged from 'muffled' to 'hollow', with again a slightly 'tubby' voice.

T.F. Comments

Personally, I did not find this speaker particularly exceptional. I was aware of the lack of deep bass and uneven HF, and found it rather enclosed and 'small-sounding'.

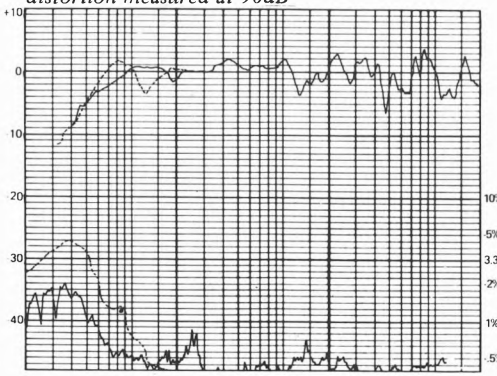
Summary

Despite a low sensitivity and low power handling capability, the *149* continues to score an impressive line of ratings (sub-woofer system excepted).

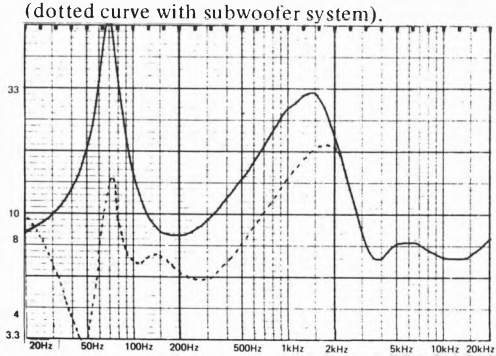
Size	37(14.5) H; 23(9) W; 23(9) D; cm(inches)
Weight	5.5(12) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	83dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	v. good*
Impedance characteristic (ease of drive)	good*
Forward response uniformity	v. good
Typical price per pair inc. VAT	£125

*See text.

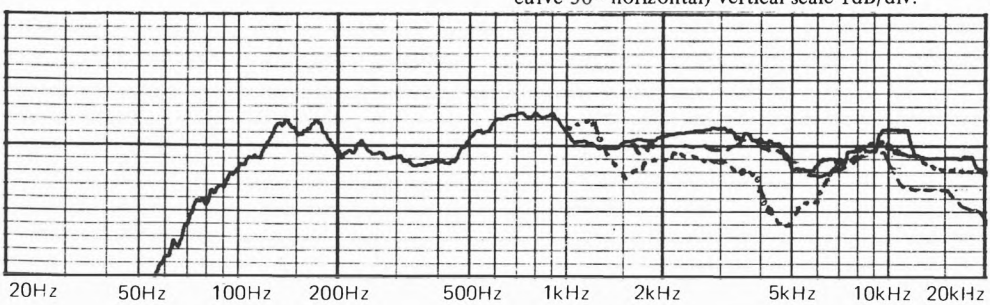
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB). (dotted curve with subwoofer system). *distortion measured at 90dB*



below: impedance *vs* frequency (mod Z). (dotted curve with subwoofer system).

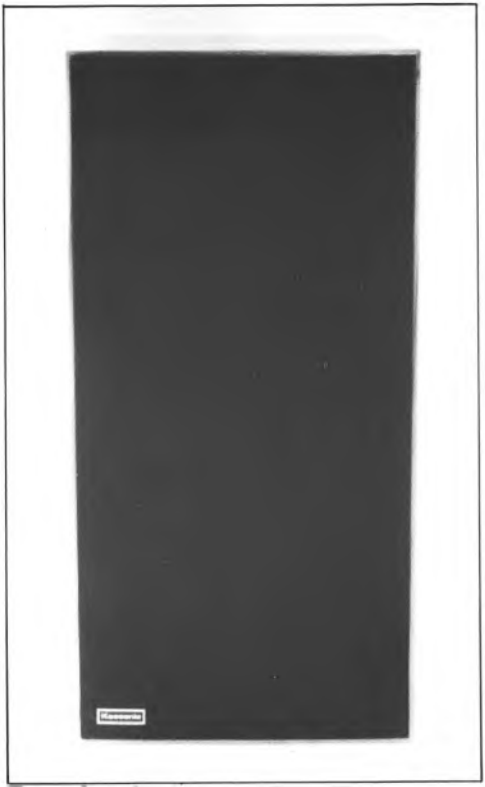


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Keesonic Skout

Keesonic Audio Developments Ltd., Halldore Hill, Cookham, Maidenhead, Berks. (06285) 22726.



Keesonic is a small UK company manufacturing a range of speakers which includes the successful and inexpensive Kub. The Skout is a rather larger system intended for stand mounting, although, set against the size average for the group, it can still be regarded as a compact. It has only just been released and quite early samples were supplied to us for review.

Technical details

A bass reflex enclosure, the LF/MF range up to 3kHz is provided by a 200mm pulp paper-cone unit (Peerless), with a 25mm fabric-dome tweeter (again Peerless) operating above. The latter unit is mounted in a recess or cavity in the front panel, to bring the two drivers into approximate alignment and hence impart some measure of phase linearity to the design. A 6-element crossover is incorporated, this (as with the IMF) is glued securely to a block of foam plastic within the enclosure.

Lab results

An excellent pair match was demonstrated, within 0.5dB overall. A fairly high 89dB sensitivity was recorded together with a typical —6dB low frequency rolloff at 50Hz. On the whole, third harmonic distortion readings were good, with 0.9% as average, 1-2kHz, and a moderate rise to 5% at 50Hz.

Some strong reactive effects were noted in the impedance characteristic, which fortunately did not coincide with low modulus values. While the typical value was 7 ohms, a dip to 3.6 occurred at 7.5kHZ, where considerable programme energy is present. As such, the Skout presents a difficult amplifier load.

On sine wave at 1 metre the curve up to 600Hz was commendably even, but above this it became rather erratic with evident reflection and interference effects. At 2 metres with $\frac{1}{3}$-octave averaging, the characteristic curves still showed these irregularities, and illustrated a mild prominence at 700Hz, together with a 2.5dB hump at 120Hz. The 10° vertical angle response was fair, but the relatively mild 30° off-axis curve showed a strong 10dB suckout down to 2kHz. The response was also 5dB down at 15kHz on this axis.

Sound quality

Disappointing results were achieved on the listening tests with an overall rating of 'acceptable'. Fairly poor on the live sound comparisons, the *Skout* was considered to have a 'wooden', 'dull' quality with 'edgy', 'nasal' effects and a noticeably uneven and directional treble range. A form of breakup in the sound limited the maximum level to 99dBA, at which point detail and clarity noticeably suffered. A veiled effect was described in connection with the low frequency range, although a decent 25 watts average of electric bass guitar was accepted without complaint.

Placed marginally higher on the stereo listening sessions, a number of weaknesses were nonetheless apparent. The stereo itself was unconvincing; 'grating' and 'sibilant' effects were noted, with a distortion emphasis on disc programme, and midrange coloration

was evident.

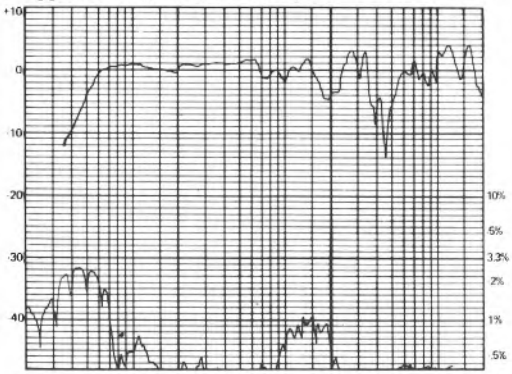
T.F. Comments

I found this speaker rather poor, with an apparent suckout in the response and 'boxy' coloration giving a 'hollow' overall quality and a hazy stereo image.

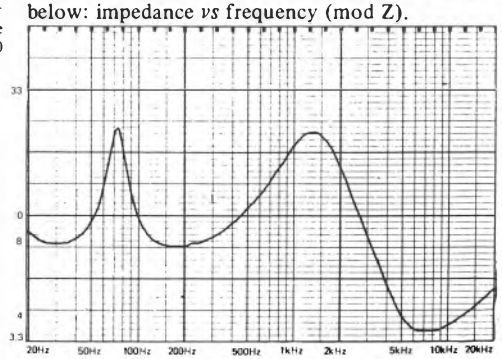
The Skout is rather a disappointing speaker as judged by the standards of this report. While its sensitivity is attractive, it is not easy to drive, and response anomalies are apparent on the measured curves which correlate with adverse listener judgements. Coloration levels are also rather high, when viewed in the light of the competition.

Size	56.4(22.2) H; 28.5(11.2) W; 31(12.25) D; cm(inches)
Weight	10(22) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	89dB at 1m
Approximate maximum sound level (pair at 2 metres)	99dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	poor
Forward response uniformity	average
Typical price per pair inc. VAT	£160

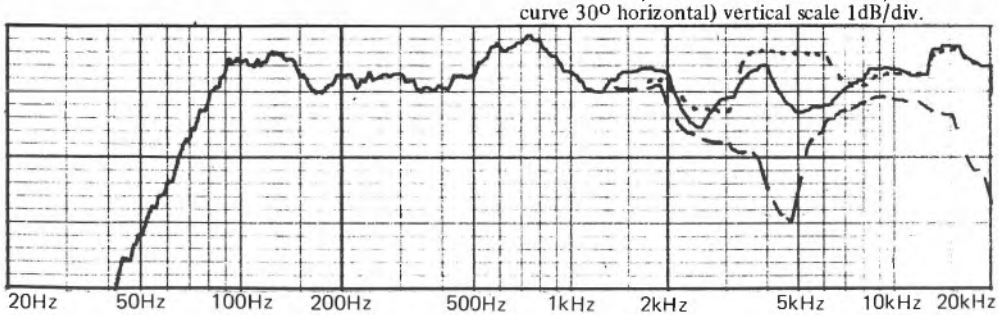
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



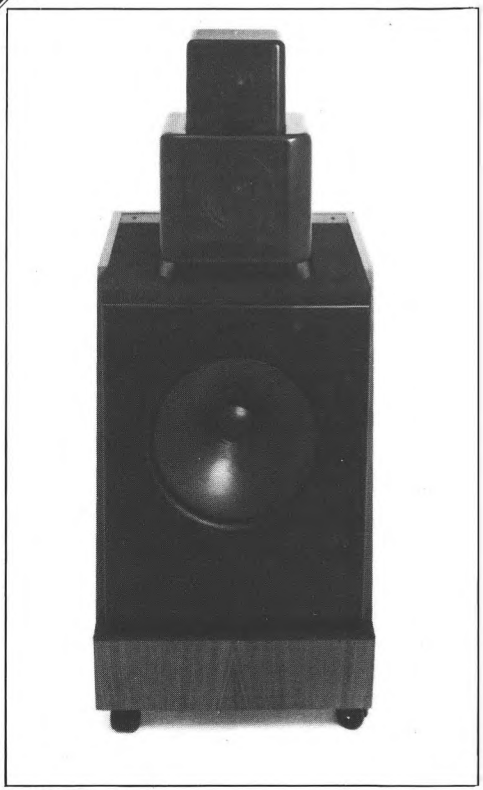
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

KEF R105

KEF Electronics Ltd., Tovil, Maidstone ME15 6QB. (0622) 672261.



KEF 105

The *R 105* is KEF Electronics' latest and largest design, incorporating such a high content of innovative thought and engineering practice that a review is almost mandatory. Our samples were from an early batch, and while they adhered fully to the correct acoustic standards, they lacked certain minor details of final production finish, as well as an instruction booklet.

Technical details

Briefly the system as reviewed is three-way, employing a 305mm Bextrene LF unit with cast alloy frame, mounted in the sealed lower enclosure. A third-order low frequency response is achieved via an additional reactive component in the precision 20-element crossover. A variable geometry midrange enclosure located above the bass enclosure contains a 110mm Bextrene-cone midrange unit working from 400Hz-2.5kHz, and a third contoured box carries the 38mm hard-dome tweeter; all the drivers are approximately equidistant from the listener.

Lab results

Excellent pair matching was demonstrated, within 0.5dB throughout the range up to 16kHz, with a minor deviation thereafter. Sensitivity was below average at 86dB, although the low frequency response was clearly well extended, with a —6dB point at a nominal 35Hz.

At low frequencies the third harmonic distortion was excellent giving 1% at 40Hz, and only rising to 2.5%, at 30Hz. The figures remained good even at the higher frequencies, although possibly the midrange levels could be improved: 0.8% at 600Hz-2kHz, and 0.6%, 6-9kHz. With an impedance minimum at 6.5 and a mean value of 8 ohms, together with a well-controlled reactive content, the *R105* rates as a easy amplifier load.

Great uniformity is apparent from the frequency curves, the 2 metre characteristic demonstrating excellent integration of the 30° lateral and 10° vertical responses. Note that with this model the 10° curve shows more output at the higher frequencies, which simply means that the 10° response was closer to the designed true measurement axis. Above 10kHz the 30° lateral response shows an accelerating rolloff: —6dB at 15kHz and —10dB at 20kHz. But in actual use, adjustment of the head assembly enables the optimum listening position to be easily achieved.

Sound quality

Very few reservations were expressed about this system's sound quality; by the standards of the whole group it achieved an 'excellent' rating, with its truth-to-life quality assessed as 'very good' and its stereo programme performance even better.

It accepted the full output of our 500 watt amplifier on peaks without distress, a pair generating a loud 103dBA at two meters. Astonishing levels of electric bass guitar were tolerated — up to 100W average — with the corresponding sound quality described as neutral, even and deep.

Those criticisms which *were* made were mild enough for the program quality sometimes to

RECOMMENDED

be more suspect than the loudspeakers. A slightly disembodied effect was occasionally heard betwen the bass and midrange — sometimes noted on voice, which was lightened in balance and apparently elevated. Slight boxiness was present in the midrange together with a hardening at higher volumes. But the overall impression was one of airiness, but with a mildly dulled effect. The stereo imaging was outstanding in its ambience, clarity, depth, and locational accuracy. The panel noted the good low frequency power and extension, albeit with a mild extreme-LF overhang (possibly due to interaction with listening room). A slight mid and presence emphasis was also noted by some listeners, balanced by excellent rendition of musical detail and an accurate treble range free of distortion or sibilant exaggeration.

T.F. Comments

One of the very best in both live and stereo tests. Extended bass response was clearly audible, as was some slight 'horniness' in the top.

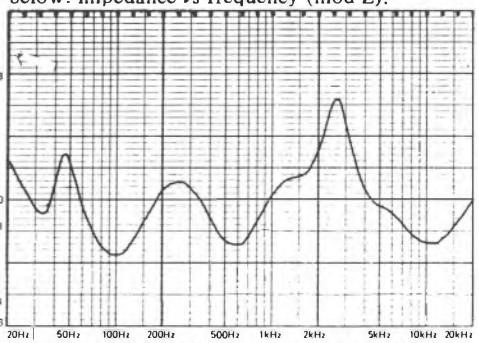
Summary

Easy to drive and capable of extended bass, possessing a high output, accurate stereo imaging, and outstanding overall quality, the *R105* must be rated as a notable success.

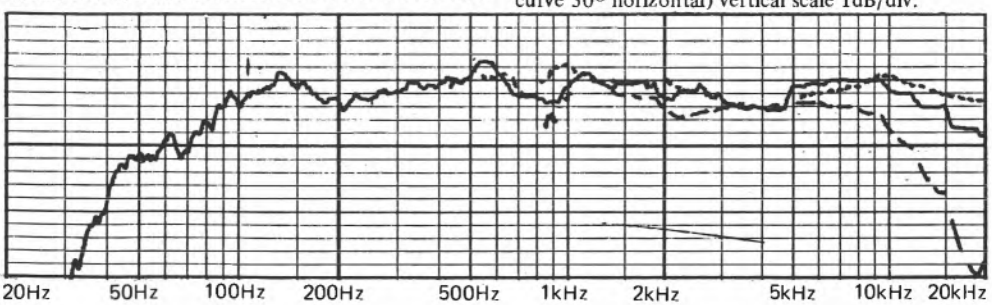
Size	96.5(38) H; 41.5(16.3) W; 45.5(17.9) D; cm(inches)
Weight	38(84) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 200W
Recommended placement	floor
Frequency response within ±3dB (2m)	45Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	35Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	excellent
Typical price per pair inc. VAT	£785

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



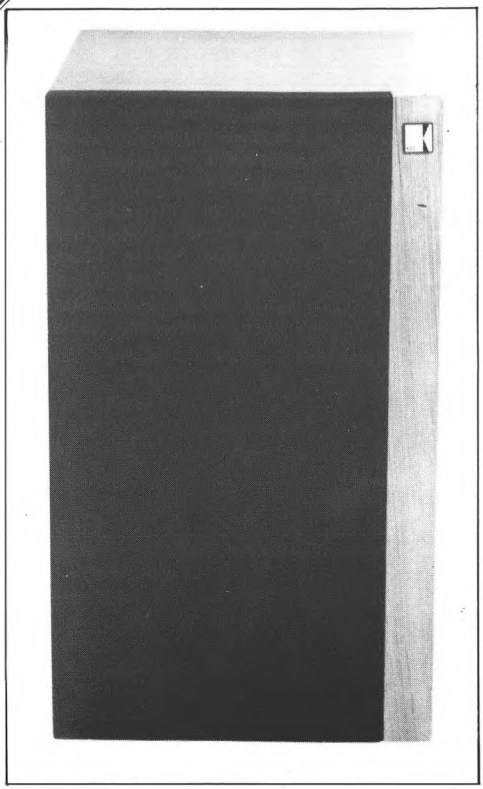
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

KEF Corelli

KEF Electronics Ltd., Tovil, Maidstone ME15 6QB. (0622) 672261.



A compact and attractively styled loudspeaker of slim proportions, the *Corelli* is supplied in mirror pairs and could be placed on an open shelf, but worked well on test when stand mounted. A recent design, it employs the latest 'Acoustic Butterworth' crossover for the treble driver, and as it is a relatively inefficient model, the manufacturers recommend the use of up to 50 watt amplifiers.

Technical details

A sealed box design, all the drive units are of KEF's own manufacture, as with the *R105*. A bextrene 200mm bass-midrange unit of new design with a high power 25mm motor coil is employed, the complex crossover transferring power at c.3.5kHz to a 19mm hard dome tweeter. The terminal panel is of the universal 4mm socket and DIN type.

Lab results

The nominal sensitivity worked out at 85dB, and although this is only 1dB less than the *R105,* it is nonetheless fairly inefficient. The —6dB LF point at 50Hz was typical for the size of enclosure, with the system resonance recorded exactly on specification at 58Hz.

Typically at the 8 ohm level, the impedance did dip fractionally below 6 ohms at 10kHz, and the speaker is classified as presenting an 'average' amplifier loading. Third harmonic distortion levels were very low, bar a small rise at around 7kHz. Distortion remained at under 1% even at 50Hz and did not exceed 10% at 30Hz — remarkable for a relatively small enclosure driven to the full 96dB test level.

The sine response illustrated an even, well balanced characteristic. A mild 2dB hump around 500Hz was evident together with a mild upper-mid suckout. Pair matching was very good and held within 1dB throughout the range.

At two metres, a mild mid-prominent trend appeared on the characteristic response, together with a dimming in the presence range. Inspection of the 30° lateral and 10° vertical off axis responses showed this loudspeaker to be very well integrated and it should offer a predictably consistent sound balance over a usefully wide listening area.

Sound quality

The Corelli established an 'average' rating on sound quality overall — a good result considering its price level.

Some weaknesses were shown on the live sound comparisons, where the quality was judged marginally 'below average'. Cymbal reproduction was a trifle brittle, voice somewhat 'boxy' with slight nasality and hardness, and the balance a little on the 'dead' side. Driven hard, compression saturation set in in the midrange, limiting the maximum sound level to a fair 98dBA. On the plus side the low frequency range was judged clean and deep, with good power delivery. Up to 50W average of electric bass could be sustained before overload, though some mild buzzing was apparent from the rear terminal panel at lower powers.

Rated as 'above average' on the stereo sessions, the *Corelli* generally sounded

RECOMMENDED

smooth, clear and even, with fine rendition of detail, and provides good stereo depth and locational information. On occasion it appeared a little 'edgy' with dulled presence and a rather 'small' middy character, but as with the live tests, the low frequencies were praised.

T.F. Comments

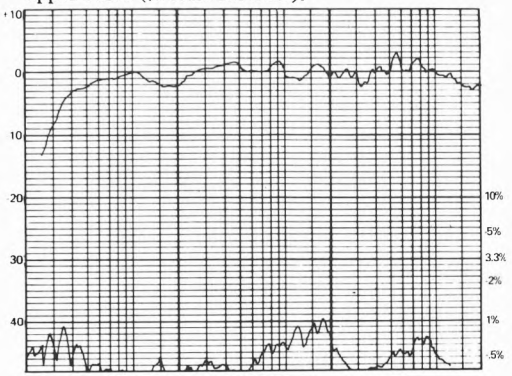
This speaker had a dull rather than bright balance, with clean bass but slightly ragged top. It performed well on the stereo tests, and about average on the live comparisons.

Summary

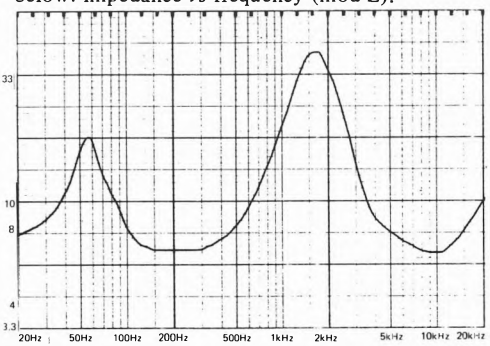
Exhibiting only mild coloration, an essentially even frequency balance, with very good off-axis uniformity, the *Corelli* offers fair power handling with a fine low frequency range, all contained in a compact package. It is well engineered, easy to drive and low in distortion, and its 'above average' rating on stereo sound quality indicates a clear recommendation in view of its price.

Size	47(18.5) H; 28(11) W; 22(8.7) D; cm(inches)
Weight	9(20) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£125

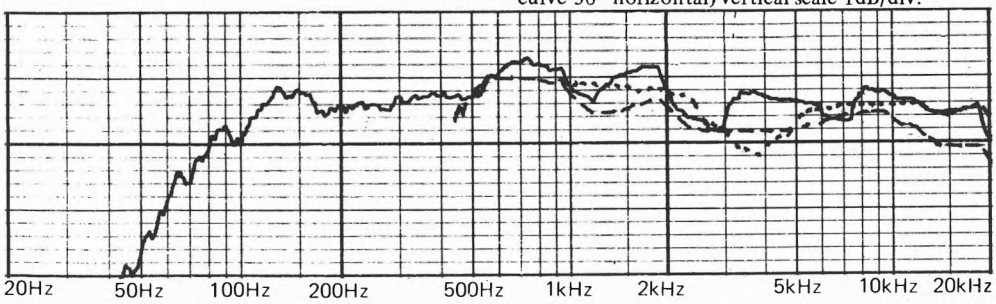
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).

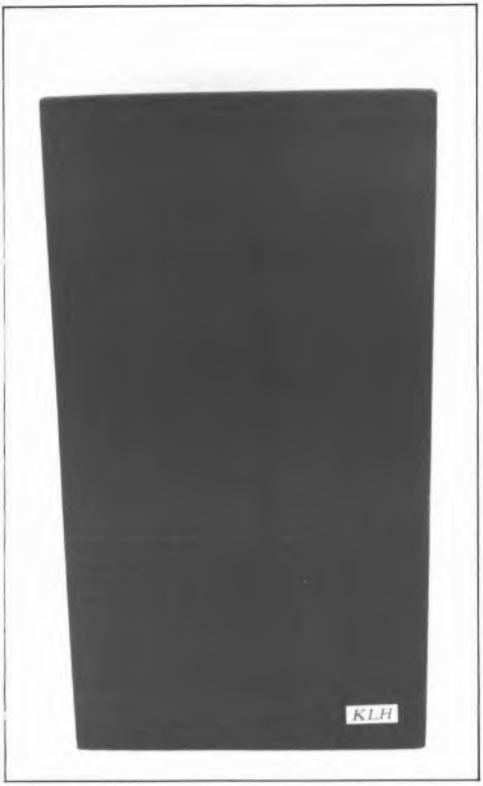


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



KLH 363

Webland International Ltd., PO Box 70, Unit 7, 129 Waltham Green Court, Moore Park Road, London SW6. 01-385 9478.



Although the American company of KLH is now linked to the Peerless speaker firm based in Denmark, the *363* uses KLH drivers built in the USA. Of moderate dimensions, this speaker would appear to suit stand mounting, and in common with many other American manufacturers, KLH offer a 5 year warranty period.

Technical details

A 305mm pulp cone woofer loads into the sealed box enclosure, while the midrange is handled by a 130mm pulp cone driver with integral rear chamber. An inexpensive 50mm pulp cone tweeter completes the lineup. The crossover is very simple, comprising two capacitors and one inductor, plus some attenuating resistors. With our samples the LF unit to enclosure baffle seal was very poor, the driver only secured by woodscrews and lacking any form of gasket.

Lab results

Matching of the left and right systems was satisfactory to 500Hz, the difference increasing to 1.5dB at 4kHz and subsequently to 3dB over the treble range. A fair 88dB sensitivity was recorded together with an average —6dB LF point at 45Hz, the system resonance being rather high at 60Hz.

Rated as easy to drive, the impedance modulus never fell below 6.8 ohms, and the reactive content was very low. Third harmonic distortion levels were fine at typically 0.7% throughout the range, and remained satisfactory even at the lower frequencies; for example, 1.5% at 50Hz.

At 1 metre mike spacing the response appeared uniform up to a 'corner' at 600Hz, above which an 8dB trough extended to 1.2kHz. Beyond this frequency the output was fairly ragged, with the deep square edged grille frame possibly contributing to this effect. The 2 metre characteristic averaged response showed the outputs to be poorly integrated over the forward radiating angle — hardly surprising in view of the minimal crossover. The 3-6kHz range was particularly erratic off-axis, with evident lateral asymetry. At 10° above the nominal axis, further suckouts appeared, so the moral is clearly that for a reasonable frequency balance, the listener should stay right on axis.

Sound quality

While the *363* did not appear too promising judging by some of the lab curves, it nevertheless achieved an 'average' rating for overall sound quality, this consistent with its price. Stereo imaging was just about average, and the clarity reasonable. The panel felt that the sound was somewhat harsh and uneven, with moderate 'brittle', 'sibilant', 'boxy', 'hard' and 'nasal' effects.

Such colorations were more readily exposed on the live music comparisons, where a 'below average' score resulted. Expressions such as 'shut-in', 'metallic', 'fizzy', Hard', 'aggressive' and 'rough' were all used. A powerful low frequency range was however demonstrated though buzzes were apparent from quite a low level, and the base register was none too clean on the guitar's harmonic timbre. However the *363* did tolerate 250W of amplifier power, and attained 103dBA, the sound being relatively clear at this level.

T.F. Comments

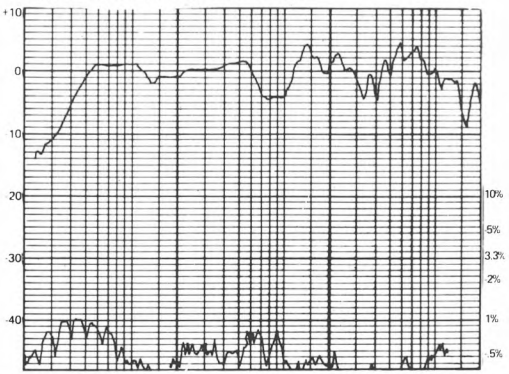
Apart from the stereo image, this speaker performed quite well in the stereo tests, albeit with some brittleness and hardness. In mono the uneveness was more obtrusive, and the sound varied as I moved my head.

Summary

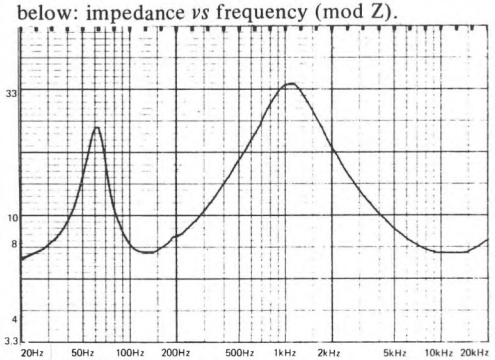
Engineering weaknesses were evident with the review samples, namely poor LF driver fixing and sealing, a possibly inadequate crossover and a poor treble match (at this price level it might well be worth the company's time to improve on the drive units currently used for production). While aspects of its sound found disfavour, the *363* nevertheless achieved a reasonable rating overall, although nowhere near that of the recommended models.

Size	61(24) H; 33(13) W; 31.8(12.5) D; cm(inches)
Weight	19(42) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	60Hz to 16kHz
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£245

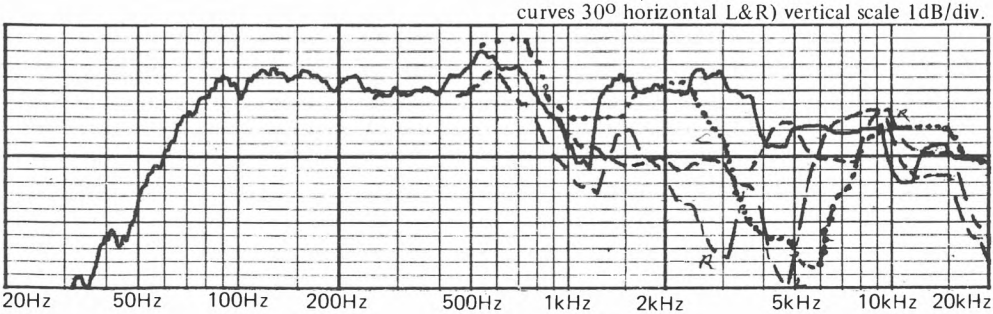
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



Leak 3030

Rank Hi-Fi, PO Box 70, Great West Road, Brentford, Middx. TW8 9HR. 01-568 9222.

One of the Leak 3000 series of time delay compensated speakers, the *3030* is a small enclosure of similar volume to the KEF *Corelli*. The driver panel is made from a high density, expanded polyurethane structural foam, which allows the speaker to be used with the deep front grille removed. Nominally a free space specified design, probably either open shelf or stand mounting will be satisfactory.

Technical details

Two 130mm bextrene cone drivers work in parallel over the bass-mid range up to 4kHz, loading into the sealed box enclosure. A precision 11-element crossover with 18dB/octave slopes transfers signal above this point to a 19mm plastic dome tweeter. Both drivers are Leak's own manufacture.

Lab results

Pair matching was excellent at typically 0.5dB throughout. A moderately low sensitivity of 86dB was recorded with the referred —6dB LF point at 55Hz, this corresponding to the high enclosure resonance at 70Hz. This model is certainly easy to drive, since the impedance never falls below 7 and was typically of the order of 8 ohms; low reactive effects were also in evidence. Measuring greater than the average for the test group, the third harmonic distortion was on the high side; a 2.8% spike appeared at 8kHz, with the 150-600Hz range remaining at around 1.3%. The distortion quickly rose at lower frequencies to 2.5% at 100Hz, 10% at 70Hz and 30% at 50Hz. These results suggest that, despite the use of two bass drivers in parallel, the 96dB standard test level was rather too high for this model.

On sine wave the curve was excellent to 2kHz, above which it was rather irregular, with a mean HF response rising to +4dB at 15kHz, before finally decaying. At 2m there was evidence that the frequency balance was bass light, suggesting shelf mounting for the best subjective results. The 10° vertical response was again not very uniform, and no real improvement in integration occurred at this increased microphone spacing. The 30° lateral off-axis trend was well controlled, so on this plane at least the speaker should not be overcritical of listener position.

Sound quality

The 3030 was rather weak on several aspects, scoring imaging 'below average' overall, although the stereo quality did at least merit a 'good' ranking for its.

Confirming the poor measured distortion, as little as 5W of average bass guitar input produced problems, and the LF sound was hard and 'harmonic', thus restricting the maximum sound level to a nonetheless acceptable 97dBA. On the live sound comparisons the balance was light with 'hollow', 'brittle', 'sibilant', 'aggressive', 'boxy' and 'steely' effects all apparent.

On the stereo programme test, the LF register was judged to be deficient. disc distortion showed emphasis, and the overall balance was rather middy. Similar characterisations to those used during the live tests again appeared on the panellists' sheets.

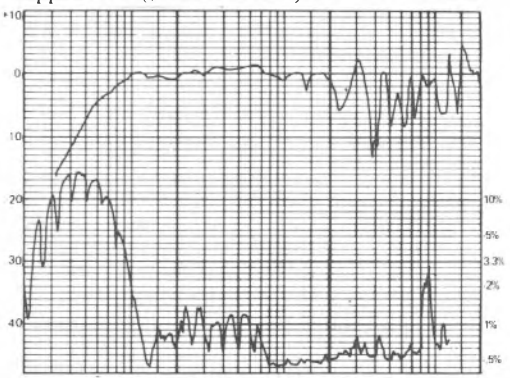
T.F. Comments

Roughly average or just below on marks, this speaker sounded slightly small and coloured, although the stereo image was satisfactory. In the live comparisons, the top sounded ragged with odd 'squeaking' sounds on program containing tape hiss.

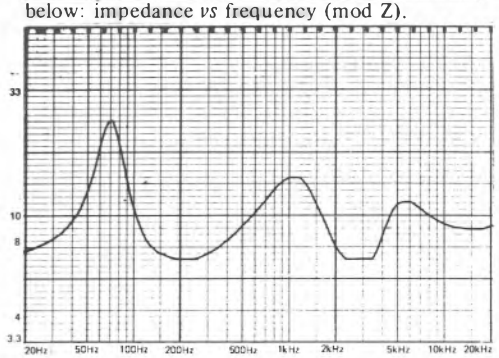
At its price level the *3030* is just not competitive on grounds of sound quality, power handling or distortion. Unfortunately, no specific advantage could be attributed to the time delay compensation aspect of this design in terms of an enhanced stereo image; hearing is believing, they say, and the panel was remarkably consistent in what they said about this speaker.

Size	52(20.5) H; 25(9.5) W; 25.5(10) D; cm(inches)
Weight	14.4(31.8) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25 to 40W
Recommended placement	shelf?
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	97dBA
Third harmonic distortion (96dB at 1 metre)	acceptable
Impedance characteristic (ease of drive)	good
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£140

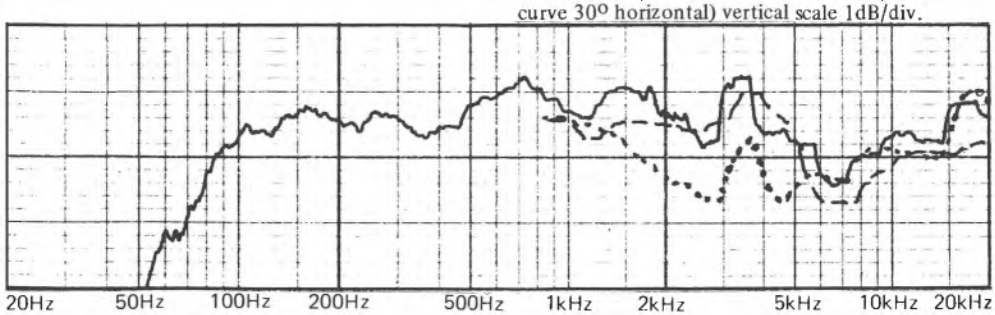
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



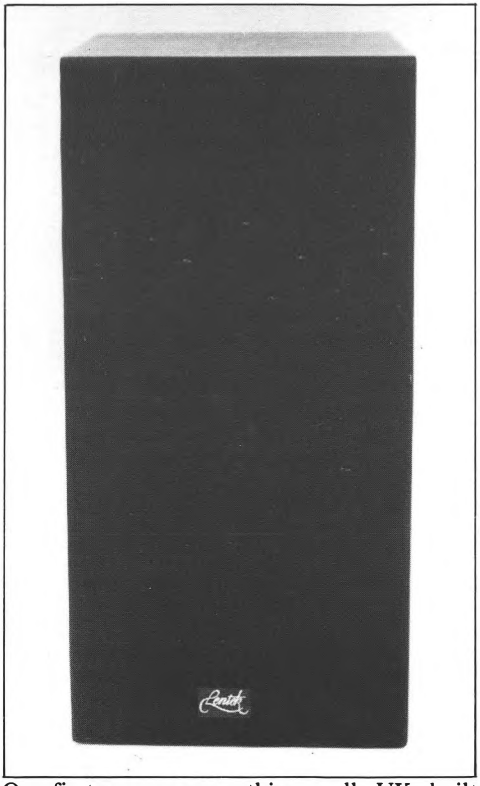
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Lentek S4

Lentek Audio Ltd., Edison Road Industrial Estate, St. Ives, Huntingdon, Cambs. PE17 4LE. (0480) 62225.



On first appearance this small UK built loudspeaker may seem rather expensive, but a closer look indicates that more than usual care is taken in its manufacture, and this is naturally reflected in the price. Specialist stands are available to position the speakers at the optimum height, and a useful instruction book is also provided. The superb finish is in American walnut, and the Company offers a 3 year guarantee.

Technical details

The *S4* is a two-way sealed box, again using drive units from Son Audax. A 200mm bextrene cone bass-mid range unit (specially modified) operates up to 2.5kHz, with a selected 25mm fabric-dome tweeter continuing the range to 20kHz. A complex 10-element close-tolerance crossover divides the signal spectrum with 18dB/octave slopes. The enclosure is rigidly constructed and carries damping panels.

Lab results

An excellent pair match was demonstrated, within 0.5dB throughout. Sensitivity was comparitively low at 84.5dB, with a —6dB, 47Hz LF cut off, the latter corresponding with the fairly high 65Hz system resonance. Driven to the full 96dB test level, and despite the high power input this required, the third harmonic distortion remained at the 'excellent' level over the whole range above 80Hz. More usual figures were recorded at lower frequencies; for example, 3% at 50Hz.

With an impedance value of typically 9 ohms, which never fell below 7, the *S4* is classified as easy to drive. At 1 metre, under sine wave drive, it demonstrated a very even response, which met +1, —3dB limits, 50Hz-20kHz.

At 2 metres a small hump at 700-800Hz was evident, but apart from this, the forward dispersion characteristic was commendably uniform, with excellent integration demonstrated over the 30° lateral and 10° vertical off-axis curves. The output rolled off a little above 13kHz; for example, at 30° off-axis the 20kHz point was 8dB down. The LF characteristic was very even and reasonably extended for this size of enclosure.

Sound quality

This model's basic neutrality and lack of distinctive character (in the most positive sense), made it a logical choice for one of the control checks used for frequent repetition in the test sequence. Throughout, it consistently ranked 'above average' overall.

Its stongest performance was during the stereo tests where imaging was highly rated both for its depth and for its precision. Its mild failings were classed as 'sibilance', a degree of 'hardness', 'wiry' and 'reedy' effects, plus a mild mid-prominence and a lightish balance.

On live comparisons the colorations seemed to be slightly accentuated, and some mild buzzes could be heard on moderate levels of electric bass guitar. However, the S4 withstood the full peak output of the 500 watt stereo amplifier without breakup, reaching a fair 99dBA, although the mid frequency

RECOMMENDED

sounds were rather hard at this volume. Generally speaking, in comparison with live sound, it was a trifle bright.

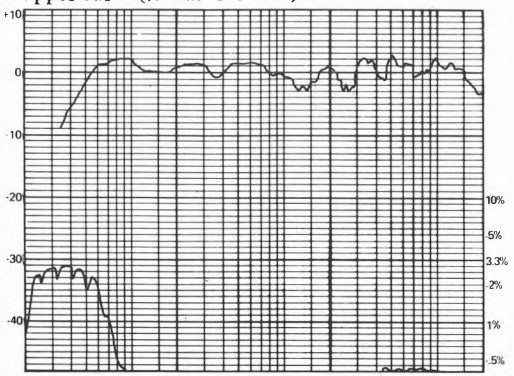
T.F. Comments

I found this speaker consistently above average, with mellow qualities and good overall clarity. Extreme HF seemed slightly lacking, and another HF problem affected string quality and emphasised sibilants; no strong criticisms, however.

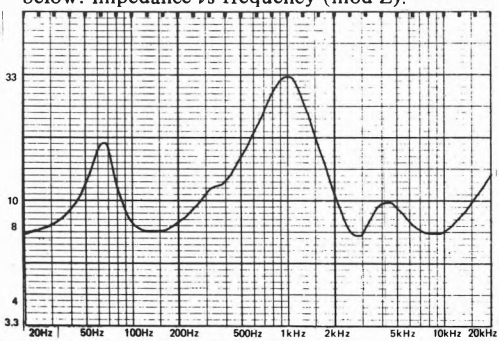
This design packs an attractive performance into a small box. The clean and consistent lab results and above average structural quality indicate skilful production engineering,m and while it is incapable of very high sound levels, at volumes within its compass a clean, wide-range sound is produced. It clearly gains a recommendation, albeit at a price.

Size	49.5(19.5) H; 25(9.75) W; 25.5(10) D; cm(inches)
Weight	11.7(25.7) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	47Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	99dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£205

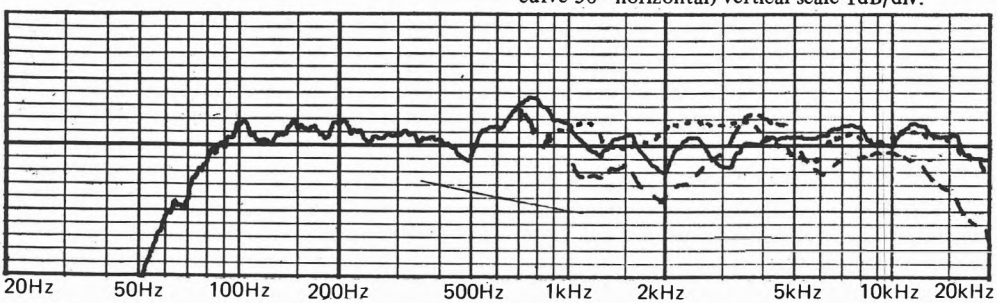
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



LNB LAB8

LNB Audio Ltd., Duke Street, Loughborough, Leics. (0509) 61229.

LNB are a long established UK company who specialise in small labyrinth designs, and who also produce cabinets for other loudspeaker manufacturers. The *Lab 8* is intended as a less expensive companion to the *Lab 20 II*, and the instructions state that the best bass response will be obtained 'with the loudspeaker in a corner of the room'. This is somewhat at variance with current thinking on the subject of speakers and room coloration, which suggests that a corner is perhaps the worst place to site a normal enclosure.

Technical details

This small labyrinth or line enclosure employs two drivers from Son Audax; a 200mm bextene cone bass-mid unit plus a 25mm fabric dome tweeter. The crossover was a fragile assembly on stripboard that was secured by two woodscrews and stressed over foam strips. One had in fact disintegrated during transit, and required repair before testing could commence.

Lab results

The review samples demonstrated a very good pair match to within 1dB. A low 86dB sensitivity was recorded with the —6dB LF rolloff at a reasonable 55Hz. The system rates as an average amplifier load, due to a mild impedance dip to 6 ohms at 10kHz, although the typical value was nearer to 9 ohms.

The third harmonic distortion values were acceptable, with typical readings of 1% - poor 10% at 7kHz, and 4% at 50Hz.

The 1 metre sine reference curve illustrated a rising response trend, some +4dB over the 80Hz-1.5kHz region. The output beyond was erratic but basically balanced. Moving out to 2 metres on $\frac{1}{3}$-octave averaging, the rising trend was confirmed, suggesting that the manufacturer's recommendation to use these speakers backed against a wall is substantially correct. The response was quite even at low frequencies, if not very extended, while the off-axis curves were in fairly close agreement with the slightly uneven axial response. The +3dB hump at 12kHz on axis was the most significant irregularity.

Sound quality

This loudspeaker performed well in achieving an 'average' sound quality rating overall, since its price is only about half that of the group average.

On the live sound comparisons, however, a 'below average' rating was established. A problem was apparent on the electric bass guitar test, whereby so much output in the form of chuffs and buzzes emmanated from and around the poorly sealed LF driver as well as the edges of the baffle itself, that the guitar character was greatly altered. Little low bass energy was evident, although a fairly loud 101dBA was achieved on the high level test, with up to 250W peak output, but the output was none too clean at this volume. The panel recorded significant colorations, these including 'hollow', 'metallic', 'boxy', 'brittle' and 'reedy' effects.

Faring better on the stereo tests, the image location was fairly precise. However the system was still regarded as hard, slightly

sibilant, 'middy', presence dull, and light in balance, with some 'box' sounds.

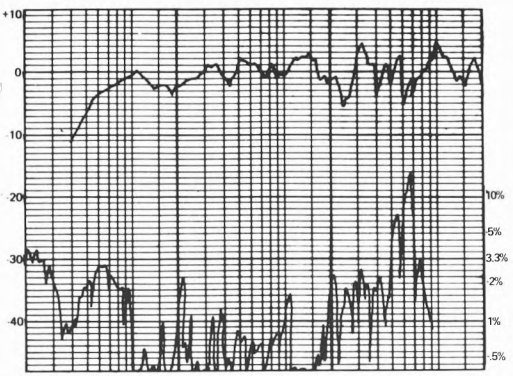
T.F. Comments

Marginally below average, this model sounded rather small and a little 'shireky' giving a 'horny' quality to some tracks. The bass rattle was also rather disconcerting, but hopefully this will be cured on future production.

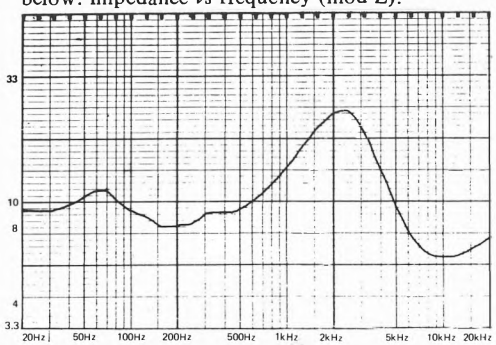
Summary

This speaker has some attributes which win through despite the poor assembly exhibited by the review samples. The lack of baffle or driver clamping and sealing indicates that tighter quality control is required, while the crossover will need to be reconsidered and affixed in a more secure fashion. As such it cannot be recommended, but it does not represent bad value, considering its relatively modest price.

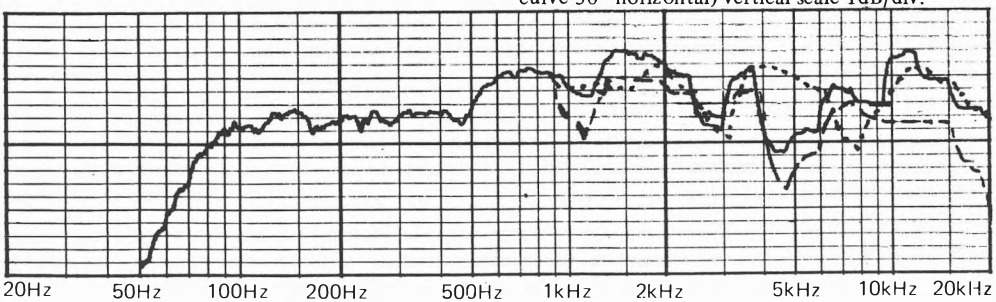
Size	59.7(23.5) H; 28(11) W; 28.5(11.2) D; cm(inches)
Weight	11.8(26) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 50W
Recommended placement	stand (shelf possible)
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	NA
Impedance characteristic (ease of drive)	average
Forward response uniformity	average
Typical price per pair inc. VAT	£125



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Marantz HD66

Marantz (U.K.) Ltd., 203 London Road, Staines, Middx. (0784) 50132.

This Marantz loudspeaker is built in Belgium, and in addition to its unusual sculpted foam front, it offers further interesting features. Three response controls are provided for treble, mid and bass registers. The latter consists of a thick foam plug with an attached handle, that can be used to block the large ducted reflex port and thus convert the speaker into a sealed-box enclosure, with more extended bass at a reduced level.

Technical data

A three-way system, the *HD66* uses a 250mm pulp paper cone driver to cover the bass-mid output up to 1kHz. The 1-4kHz band is handled by a 155mm cone driver, with the range above allocated to a 37mm low profile plastic dome tweeter. With the exception of the level attenuator controls, the simple crossover consists of two inductors plus two capacitors.

Lab results

A very good pair match was demonstrated with the left/right alignment within 1dB throughout the range. The sensitivity was quite high at 90dB and fortunately this figure was not seriously compromised by its 'average' impedance characteristic. A minimum of 5 ohms was recorded, although the typical values were of course higher than this. In sealed-box form, the system resonance clocked in at 58Hz, and since the bass output under these conditions was more than adequate, most tests, including all the listening sessions, were done with the speaker in this mode. Interestingly enough, the —6dB LF cutoff was the same under both ported and sealed conditions.

A slightly prominent midrange was shown on the 1 metre reference response, but generally the output looked quite even and well balanced. At 2 metres the picture was similar with the LF range commendably flat. The vertical 10° response axis was pretty fair, but the 30° lateral traces were weak and also asymetrical (mirror pairs are not available). The right directed response showed a 16dB deep crevasse, and at the highest frequencies the same rolloff was also apparent at the 30° axes; for example, —10dB at 15kHz.

Third harmonic distortion readings were fair, measuring 1% at 700Hz and 0.8% at 200Hz but remained good at the lower frequencies; for example, 1.5% at 50Hz.

Sound quality

A reasonable performance rating was achieved for overall sound quality, which is perhaps just as well considering the price. Just 'average' on the live sounds, the *HD66* was considered to be slightly harsh, with a touch of 'fizz', 'box' and 'tunnel' effetcs. Some buzzes were apparent in the bass, but these aside, the system went on to accept up to 100W average of electric bass guitar before overload set in, with the bass quality considered to be both even and powerful. A pretty loud 103dBA could be attained, although obvious deterioration had set in at this point.

Third harmonic distortion readings were fair, measuring 1% at 700Hz and 0.8% at 200Hz but remained good at the lower frequencies; for example, 1.5% at 50Hz.

'Above average' was analysed from the

stereo testing, but the image quality was considered to be only 'average'.

It seems likely that the downgrading on this result was due in part to the poor measured lateral dispersion and asymmetry. Coloration was felt to be less obvious under these conditions and slight 'muffled', 'metallic', 'boxy', 'strident' 'wiry' and 'sibilant' effects were noted. The overall impression however was one of acceptable smoothness.

T.F. Comments

Around average, this model had a somewhat brittle-sounding top, and a rather below average stereo imaging capability; in other respects it was satisfactory.

Summary

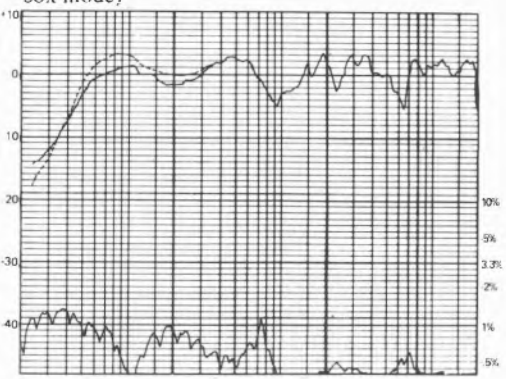
This loudspeaker has some suprisingly good points and offers very flexible acoustic balance adjustments, should these be required. Its axial response is relatively uniform, its sensitivity quite high, and the typical sound quality above average. At its price it is a worthy contender and misses a recommendation by only a small margin.

Size	61(24) H; 32(14.6) W; 28(11) D; cm(inches)
Weight	kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	90dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	average
Impedance characteristic (ease of drive)	average
Forward response uniformity	poor*
Typical price per pair inc. VAT	£280

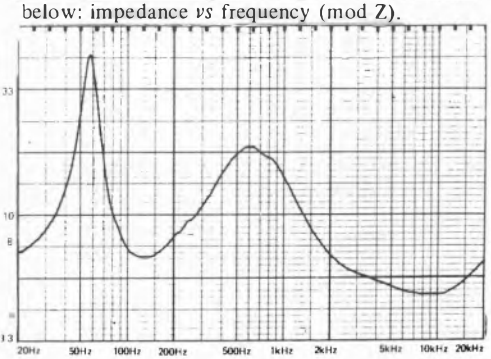
*See text.

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

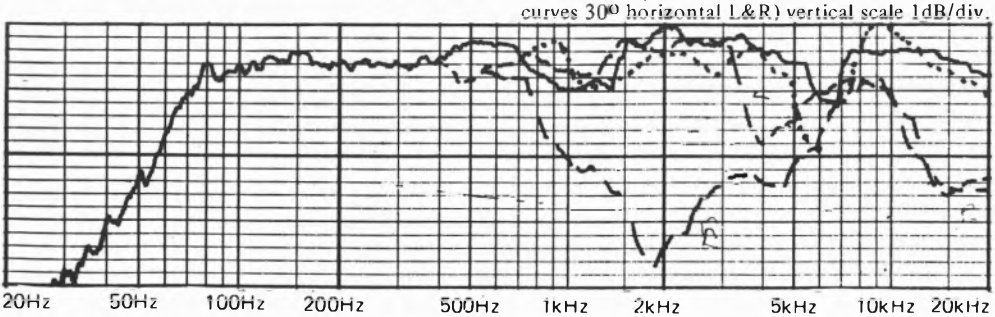
(dotted curve in reflex mode, solid curve in sealed box mode)



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



RECOMMENDED

Monitor Audio MA4 II

Monitor Audio Ltd., 347 Cherry Hinton Road, Cambridge CB1 4DJ. (0223) 42898/46344.

The *MA4* was assessed in the previous issue of *HI FI Choice Loudspeakers* and now appears in a *Series II* form. The crossover has undergone revision, and in addition the original Isophon treble driver has been replaced by one from Son Audax. The enclosure and bass-mid unit remains essentially the same. This relatively compact system is intended for stand mounting, and is provided with a two year warranty.

Technical details

A two-way bass reflex design, the low to mid frequencies are handled by a KEF 200mm bextrene-cone driver with a lightweight 33mm motor coil of high power rating. A 25mm fabric-dome treble unit operates above 3kHz, the transfer effected by a close tolerance 18dB/octave network. The braced enclosure incorporates panel damping.

Lab results

A close pair match was recorded within 1dB up to 15kHz, above which a moderate 1.5dB difference occurred. An average —6dB LF point was indicated at 44Hz, with the corresponding reference sensitivity at a fairly low 86dB. Having a minimum value of 7.5 ohms, and with the reactive content restricted to areas of higher impedance modulus, the impedance characteristic suggests that the *MA4* is easy to drive.

Excellent third harmonic values were plotted at the full 96dB test level. Down to 70Hz the readings were at the measurement threshold, below which a moderate rise occurred to 3% at 50Hz, with even the 30Hz figure measuring a fair 5%.

The 1 metre sine wave trace showed a mildly elevated upper mid, followed by a dip to —6dB at 1.6Hz, with the HF range slightly erratic thereafter. The frequency balance was good, although another dip was apparent at 8kHz.

At 2 metres the lifted mid character was confirmed, the dip beyond settling into a —3dB trough over the lower presence band 1.5-4kHz, while the treble range still showed some irregularity. Assessing the 10° above and 30° lateral off-axis traces, the output could be seen to be very well integrated and dispersed up to 12kHz, with a gentle rolloff above this on the 30° axis not exceeding 5dB at 20kHz.

Sound quality

Good power handling is claimed by the manufacturer, and this was confirmed on test. The full 500W peak output was tolerated on program without breakup, and despite the lowish efficiency, a good 103dBA sound level was attained. However on bass guitar the power rating was poorer, with more than 10 watts average resulting in a 'grumbly' distortion.

While an 'above average' score was achieved for the overall sound quality, the *MA4 II* was less impressive when compared with live sounds, and actually scored 'below average' on the tests. A smooth character was noted with some colorations of a moderate nature; comments of 'tubby', 'middy', 'hollow', 'presence suckout' and slightly 'gritty' effects on cymbal were all recorded.

RECOMMENDED

Ranked two divisions higher on the stereo program sessions, the *MA4* was found to have good imaging with fair depth. Comments on coloration were not severe and included 'plummy', 'boxy', 'fizz', mild distortion emphasis and 'boomy' effects. The bass was judged to be slightly excessive, and the presence region somewhat dull, this being in agreement with the measurements.

T.F. Comments

Above or around average, I felt this speaker has a somewhat somer chestiness muddy bass, and a gritty top which emphasised disc surface noise. A general 'veiled' character indicated some response uneveness.

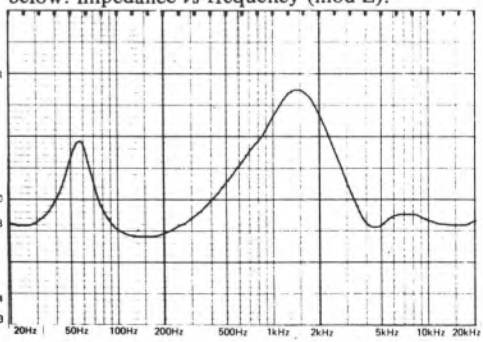
Summary

While this loudspeaker would not appear as a top ranked model, it notched up sufficient plus points to justify a recommendation at its price level. It proved easy to drive, withstood high power inputs, and could produce quite good sound levels. Coloration was moderate and the stereo properties good, with a generally even character free of aggressive tendencies.

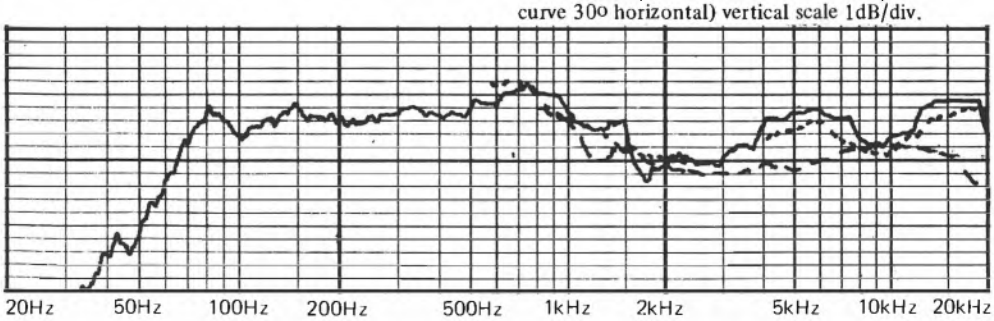
Size	59.6(23.5) H; 31.6(12.5) W; 28(11) D; cm(inches)
Weight	16(36) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 150W
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	44Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£190

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



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Monitor Audio MA8

Monitor Audio Ltd., 347 Cherry Hinton Road, Cambridge CB1 4DJ. (0223) 42898/46344.

The *MA8* is a recent introduction to the Monitor Audio range, being a small shelf-type system of the same dimensions as the established *MA7*. An accessory pillar stand is available, although the test results indicate that shelf mounting would produce the most acceptable sound balance.

Technical details

Both drivers in this sealed enclosure are made by Son Audax. A 165mm bextrene-cone unit covers bass-mid range up to 3.5kHz, above which the unibuitous 25mm fabric-dome HF unit takes over. A complex 18dB/octave crossover is fitted, and the enclosure panels are resonance damped by 12mm thick bituminous slabs.

Lab results

As with several other small enclosures in the group, the third harmonic distortion test level was reduced to 90dB at 1 metre. Against this the figures were very low at frequencies above 90Hz — typically in the 0.4% range. However at 60Hz 8% was recorded, continuing to rise to 10% at 50Hz and 15% at 40Hz. This suggests that the use of a low frequency 50Hz filter on the matching amplifier might be an advantage.

A very low 82dB sensitivity was recorded (about 2dB below spec), with a —6dB cut off at 58Hz (good for size), the latter corresponding to a system resonance at 65Hz. The impedance loading was considered to be 'good' with a minimum value of not less than 6.4 ohms and well-controlled reactive components.

Moving onto the reference sine wave curve, a mild emphasis present in the upper bass was following by a relative mid depression, and subsequently a marked treble lift. The whole 3-8kHz band showed a 2.5dB shelf boost, increasing to +5dB at 16kHz and rolling off thereafter. The speaker is clearly on the bright side.

At two metres this imbalance was more obvious with clear treble lift, and also a +3dB hump at 150Hz in the upper bass. On the plus side, the 30° and 10° off-axis curves showed fine uniformity and dispersion, and hence the speaker will not be over critical of listener position.

Sound quality

The overall sound quality was given an 'acceptable' rating, which although approximately in line with the price is inferior to that attained by other similar models in the report. The overbright balance would appear to be largely to blame.

The stereo image was quite good, despite the treble forwardness which subjectively exaggerated detail and 'presence' but which detracted from depth and ambience. The following colorations and frequency balance effects were all frequently described by the panel on stereo programme, namely 'nasal', 'hard', 'edgy', 'sibilant', 'gritty', 'thin', 'tubby' and slightly 'boomy' effects.

On the live sound comparisons the speaker fared less well with both mid and LF coloration apparent in addition to the expected treble effects. The upper bass prominence was described in terms of 'boom', 'hollow' and 'tunnel' comments, and voice

reproduction was very sibilant. Average powers above 5 watts for the electric bass guitar resulted in overload, and a hard, compressed effect was present when the speaker was subjected to the high level test, thus limiting the maximum output to a modest 90dBA.

T.F. Comments

I should find this speaker rather difficult to live with because of the over-bright balance, which imparted 'sqeaks' to much of the program and disrupted the stereo image at HF.

Summary

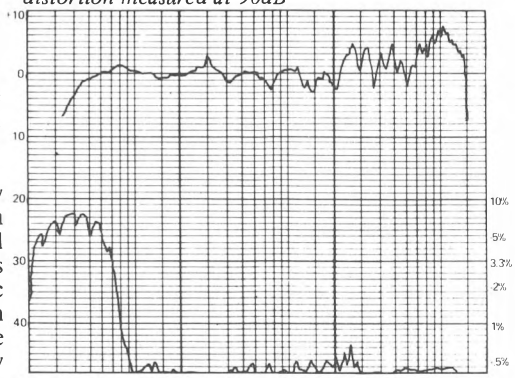
The manufacturer was informed of the review findings concerning the overbright balance, in case the samples were faulty. He explained that the review pair were to spec, and that this model was very successfully meeting specific export requirements. In its present form however the *MA8* does not align with the overall standards of neutrality and frequency balance achieved by the better systems in this report, and hence cannot be recommended in the context of this review.

Size	40.5(16) H; 22.8(9) W; 20.3(8) D; cm(inches)
Weight	8(17.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	stand*
Frequency response within ±3dB (2m)	90Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	48Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	82dB at 1m
Approximate maximum sound level (pair at 2 metres)	90dBA
Third harmonic distortion (96dB at 1 metre)	poor*
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£115

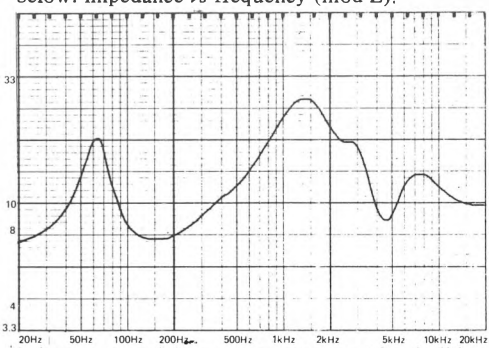
*See text.

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

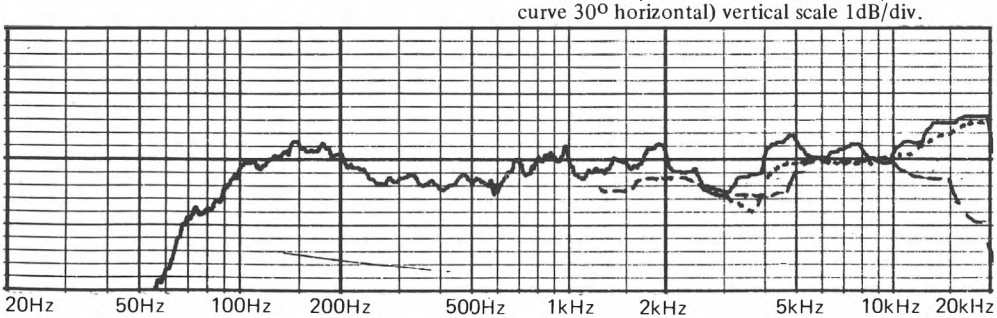
distortion measured at 90dB



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Mordaunt-Short Pageant 2

Mordaunt-Short Ltd., Durford Mill, Petersfield, Hants. GU31 5AZ. (073 080) 721.

Another model which was assessed in the previous edition of *Loudspeakers*, the *Pageant* has since undergone slight revision, with the Isophon tweeter now altered to remove a previous rise in harmonic distortion at 10kHz. A slim, compact design, stand mounting is recommended, but an open shelf is also permissible. Mid and HF attenuation are both provided, giving 2dB of shelf cut.

Technical details

Mordaunt-Short's own 200mm bass-mid unit is incorporated, this having a flared pulp-cone diaphragm treated with a doping compound and operating throughout the bass and mid-range. An Isphon 25mm plastic-dome unit continues the response above 3.5kHz, and reflex loading is provided via a small ducted vent. The precision crossover uses 12 and 18dB/octave rolloff slopes.

Lab results

Generally very good pair matching was noted, with a narrow area from 1-2.5kHz where a moderate 1.5dB difference was apparent. The sensitivity was above average at 88dB (and this is also higher than for many similar enclosures) with the —6dB LF point placed at 50Hz.

Performing well on the distortion tests, the low frequency third harmonic content was commendable at 1%. 50Hz and 5%, 30Hz, although minor spikes of about 1.5% were also present at 200Hz and 2kHz. The good LF power handling indicated that bass lift could be applied without trouble if this appeared necessary. With a minimum impedance of 6 ohms and averaging 9, good amplifier loading is indicated, and the reactive elements were also well controlled

The 1 metre sine wave curve showed a +4dB lower-mid hump centred on 400Hz. Some irregularity was apparent in the treble band, with a rapid falloff above 16kHz; for example, to —7dB at 20kHz. Out at the 2 metre mike spacing, the mid was still prominent, with a well controlled low frequency rolloff below. Essentially the trend was even and well balanced. The 30° and 10° off-axis curves showed close conformity with the axial master response, and the forward output was very well integrated and dispersed. Above 12kHz the 30° off-axis rolloff was significant — a not uncommon result.

Sound quality

Taken overall the Pageant scored an average placing, which is good in relation to its price. It did its best in the stereo session, where it was reckoned to offer clean, precise imaging with with excellent rendition of musical detail. Not too much stereo depth was apparent, this attributable to the presence of certain colorations, described by the panel as moderate 'middy', 'boxy', 'hard' and slight 'fizz' effects.

Compared with the live sounds these colorations seemed to be more obvious, with clear indications of 'hollow', 'boxy', 'hard', 'brittle' and 'brash' effects in moderate quantity. The speakers did not like being driven too hard, with saturation effects limiting the maximum level to a nonetheless fair 98dBA. Buzzes and chuffs were clearly

heard above 10 watts average of bass guitar.

T.F. Comments

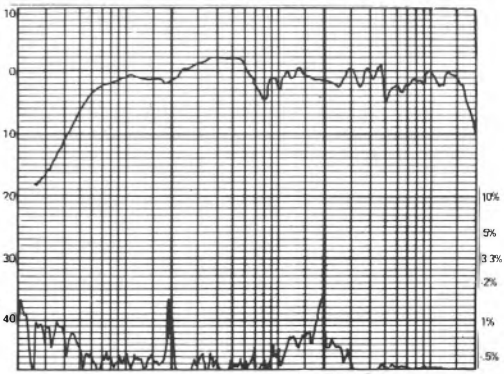
Just below average, I noted a slight bass boom, some hollowness, and also some treble brashness.

Summary

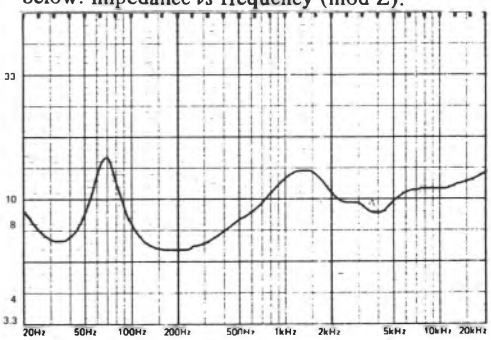
Still quite good value for money, the Pageant offers slightly above average sensitivity and is easy to drive. It is fitted with response controls, is well engineered and is also capable of precise stereo. Since last assessed, the competition in its price bracket is rather fiercer, particularly in terms of coloration levels, and it is this aspect more than anything which prevented it gaining a recommendation.

Size	53.3(21) H; 33(13) W; 23(9) D; cm(inches)
Weight	9.6(21) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 50W
Recommended placement	stand (shelf?)
Frequency response within ±3dB (2m)	90Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£160

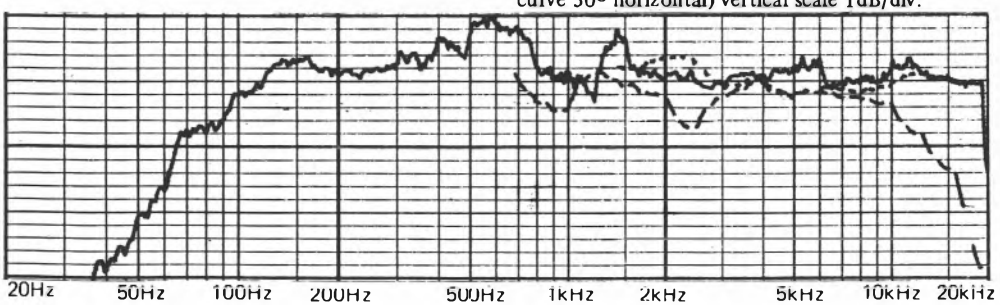
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Nightingale NM1

Nightingale Acoustics, 60a Green Street, Eastbourne, Sussex. (0323) 30405.

A product of one of the small dealer/manufacturers (John Jeffries), the *Nightingale NM1* owes something to the *Dahlquist DQ10* in terms of its design, as a similar lateral arrangement of small open baffles is used above the main bass enclosure. These and the crossover are all concealed beneath the thick open cell foam 'hat' which fits on top of the system.

Technical details

A KEF B139 bass driver is loaded by a sort of labyrinth, terminated in a horizontal slot near the top of the enclosure; a cross between a 'reflex' and a 'transmission line'. Midrange is handled by the popular 100mm Peerless unit with its integral sealed rear chamber. An Isophon 19mm tweeter completes the driver array. A degree of time delay compensation is effected by the staggered location of the small driver baffles, and the whole is well finished and engineered.

Lab results

(It was pointed out to us that these speakers were not measured during design, and that while the lab results might be interesting the manufacturer did not consider them particularly relevant.)

The sensitivity was typically low at 86dB, with a corresponding —6dB LF cutoff point at 46Hz — fairly high for this size of enclosure. Pair matching was excellent overall, but with a moderate 1.5dB discrepancy between 2 and 5kHz — probably near to a crossover point. Third harmonic distortion levels were very low over most of the range bar a small rise to 0.7% at 2kHz. A fine 1% at 50Hz was recorded together with an equally good 3.5% at 30Hz.

The manufacturers note in their brochure that the *NM1* requires a a powerful amplifier, the impedance dip to a low 4 ohms at 2.5kHz probably having something to do with this.

At 1 metre the reference sine wave curve was quite even from 60Hz to 1kHz. A broad hump 2dB high appeared around 3kHz, followed by a trough in the upper presence/low treble. At higher frequencies the response evened out.

The 2 metre averaged characteristic showed some off-axis dispersion anomalies as low as 400Hz, with a marked L/R 30° asymmetry, thus confirming the designer's provision for mirror pairing. The axial response was somewhat uneven, having a tilt in the midrange with the upper mid dominant.

Sound quality

A maximum level of 100dBA could be produced with reasonable quality before blowing the fuse, and up to 25W of bass guitar input was possible without spurious buzzing, this being quite a respectable level. The bass quality did not attract much comment so must be considered as reasonably neutral. The panel were however aware of the unevenness in the response, and commented accurately on the forward upper-mid and on the presence suckout. They also heard coloration as 'tunnel', 'tube', 'hard', 'brittle', 'cupped' and 'muffled' effects.

On the stereo tests, the image quality was fair but with some obscurity resulting from the coloration. The piano and acoustic guitar had a plummy quality and percussion was muted, with a hard and uneven balance

overlaying many sounds. The panel were consistent in their criticisms.

T.F. Comments

Under our listening conditions, the *Nightingale* did not give enough results on stereo program to justify the premium price. In addition to coloration, the response seemed to consist of many 'hills and dales' which I found disrupted musical balance.

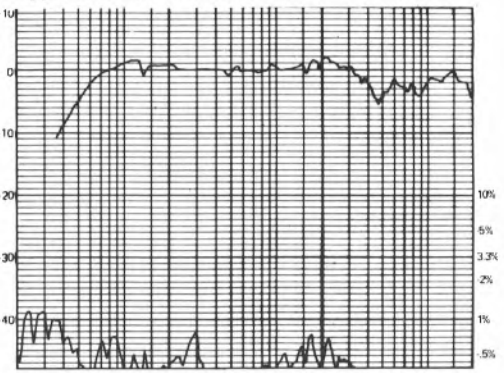
Summary

The manufacturers have also pointed out to us that the *NM1* is not intended to be 'accurate' in the accepted sense; rather it has been subjectively tailored to suit a specific disc playing system (tuner and tape not included). That system essentially comprises a Linn Sondek turntable, Grace arm and Supex cartridge, with a Naim amplifier (a Nytech XD being given as a lower cost alternative).

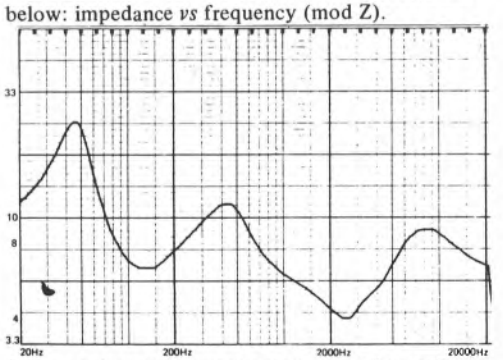
In view of the disappointing performance of the *NM1*s within the framework of this review, I can only suggest that interested purchasers do their own research in respect of the manufacturer's recommendations; it is just not possible for 'Choice' to review entire systems 60 at a time, although interestingly enough, we *did* use a Naim amplifier to drive the NM1s on the stereo tests, albeit from master tape sources predominately.

Size	86(34) H; 40.6(76) W; 28.6(11.25) D; cm(inches)
Weight	24.5(54) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	floor
Frequency response within ±3dB (2m)	65Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	46Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	100dBA
Third harmonic distortion	(9od
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	average
Typical price per pair inc. VAT	£385

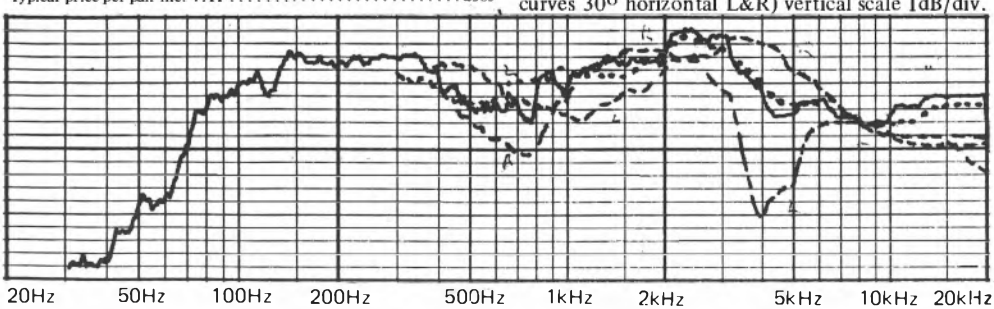
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



RECOMMENDED

Philips AH487

Philips Electrical Ltd., City House, 420/430 London Road, Croydon CR9 3QR. 01-689 2166.

The two Philips speakers included in this report have only recently become available. In contrast to the electronic 'active' models assessed in the previous issue, these are conventional systems with passive crossovers. Of slim proportions, the 487 is styled in the usual Philips tradition with a dark veneered exterior and a fine chrome trim around the grille edge. A DIN plug is fitted to the permanently connected and generously long speaker cable.

Technical details

This system is quite complex, comprising 3 units plus an additional 200mm passive bass radiator; these consist of a 200mm pulp-cone low frequency unit; a 50mm soft fabric-dome midrange and a 25mm fabric-dome tweeter, with the crossover dividing the signal at 900Hz and 3kHz. A good power-handling capability is claimed by the manufacturers.

Lab results

Excellent pair matching was demonstrated, the worst area being at 2.5kHz where the difference was still as small as 1dB. The sensitivity was high at 93dB, and was not offset by the impedance characteristic, despite Philips spec of 4 ohms. In fact, with low reactive content, the typical value was 6.5 ohms, with a minimum of 5, and an 'average' amp loading was thus denoted. A pretty average 50Hz frequency was also measured for the —6dB rolloff point.

Above 300Hz the third harmonic distortion content was excellent, bar a moderate rise to 0.8% at 100Hz, and it was also very low at bass frequencies. Clearly bass lift, if required, would not stress this model.

The sine wave reference trace suggested an even, slightly rising trend to 1kHz, with moderate irregularity beyond, followed by a flat region and finally a +3dB hump at 16kHz before final rolloff. At a more realistic 2 metres microphone spacing, it was clear that the 10° above axis response was probably the best. This suggests that the speaker should be open shelf mounted at a little below ear level. The off-axis integration was not very promising in the lateral 30° plane, with poor symmetry and up to 10dB suckouts, the latter undoubtedly due to the relatively simple crossover and the consequent interaction of the three drivers in the mid-range area. Visually summing up the characteristic curves, the basic trends were quite uniform and well balanced, with a smooth LF range.

Sound quality

This model achieved a well above average overall score on sound quality; excellent in view of its relatively low price. A few panellists had mixed feelings about it, but most strongly approved.

During the live comparisons, the speakers accepted over 150W peak without damage, achieving a loud 103dBA sound level, at which point the quality was a little hard and aggressive. Power handling at low frequencies was fine, the speaker taking up to 50W average of electric bass guitar with an even, clean output. Some coloration was noted, generally moderate in degree and mainly relating to its bright balance. Off-axis listeners also commented on some mid unevenness.

Scoring highly in the stereo tests, the overall

RECOMMENDED

impression was favourable, probably due to its great clarity and clean sound, but the positional information was often rather hazy. Slight 'box' and 'reedy' effects were also described, with moderate hardness and sibilance. Disc distortion was slightly emphasised, and a loss of extreme treble was occasionally observed by the younger panellists.

T.F. Comments

This speaker was considered to be very pleasant, with both warmth and clarity. Speech was slightly 'plummy', but overall it was a fine loudspeaker with good sensitivity.

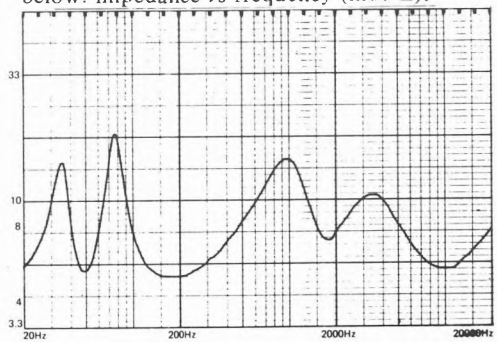
Summary

A fine sounding loudspeaker, the 487 is fairly easy to drive, has low distortion and is very sensitive, working well on as little as 10 watts per channel. Showing a good frequency balance, its only real failing relates to its somewhat hazy stereo imaging, and this is believed to result from the erratic off-axis responses. In context this latter problem is secondary, the speaker remains very good value, and is thus recommended with enthusiasm.

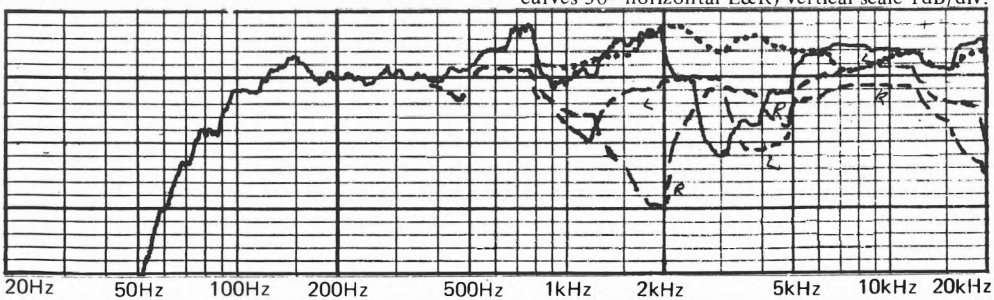
Size	57(22.4) H; 39(15.4) W; 22.5(8.9) D; cm(inches)
Weight	12.5(28) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	low stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	93dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£140

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



Philips AH486

Philips Electrical Ltd., City House, 420/430 London Road, Croydon CR9 3QR. 01-689 2166.

Closely related to the AH487, apart from the smaller enclosure the only external difference between the two speakers is the omission from this model of the extra reflex bass radiator. It was therefore surprising to find that the two systems sounded rather different, notably in their degree of treble output, which was accentuated in the case of the *486,* and which suggests that shelf mounting with the speaker backed against a wall is likely to provide the best subjective balance in this case.

Technical details

A three-way system with sealed box loading, the lineup comprises a 200m pulp-cone bass driver, a 50mm fabric-dome mid unit with an enlarged rear chamber, and finally a 25mm fabric dome tweeter, the 7-element crossover being relatively simple for a three-way design. The driver layout is approximately vertical-in-line, offset on the panel to reduce diffraction effects. A 50 watt power handling is claimed, which was confirmed on test.

Lab results

With a moderate reactive content, the 486 rates as an average amplifier load, and its impedance characteristic does not in fact fall below 5.6 ohms. The —6dB LF point was a little high at 60Hz, corresponding to a system resonance at Hz. However the uneven response meant that the reference sensitivity was somewhat arbitrary, with a high 93dB being fairly representative.

Fine pair matching was shown; within 1dB overall and typically within 0.5dB. Distortion values at the high 96dB test level were excellent, holding virtually at the threshold level down to 100Hz, with a well controlled rise below; for example to 2% at 50Hz.

It may come as a surprise to find that this model reached a loud 106dBA on the high level test; in fact, 3dB more than the larger Philips' enclosure! This was mainly due to the *486's* bright balance which better matches the subjective 'A' weighting adopted for this measurement.

At 1 metre, the sine wave reference curve showed a clear +3dB shelf boost in the high frequencies. Elsewhere the curve was smooth, although with a fairly early LF rolloff. At 2 metres the characteristic response showed some increase in upper mid prominence, as well as the accentuated treble band. The lateral 30° curve was fairly well controlled bar a 6dB suckout at 3kHz. The 10° vertical response was fine.

Sound quality

Even taking into account its lower price, the 486 was not considered to be as impressive as thje 487, this largely reflecting the panel's preference for a more neutral balance as produced by the larger system. A rating of 'poor' was recorded on the stereo listening sessions, its 'above average' score on the live sessions bringing the overall rating up to 'acceptable'.

It has already been noted that a loud 106dBA was measured for the maximum level, although the sound was rather hard and edgy at this point. On the electric bass guitar the *486* proved inferior to its larger brother, as an average power of between 5 and 10 watts

proved to be its limit, even if the bass quality was quite good up to this point, although rather restricted in depth.

On the live music comparisons the general clarity and rendition of detail was excellent, and while the treble lift and light balance was obvious, they did not attract great censure, as the general quality was so good. On the stereo programme, however, this bright balance proved to be less of an attraction; violins appeared 'wiry' with some 'boxy' coloration and the sound also seemed 'hard', 'sibilant', and 'gritty', as well as emphasising distortion effects.

T.F. Comment

I found this speaker rather disappointing, with fairly vague stereo imaging and uneven response; voice was reproduced with some boxiness and a 'nasal' quality. The *486* is bettered by the *487* in all respects.

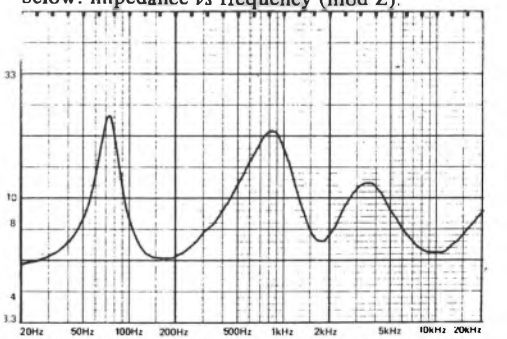
Summary

Exhibiting some good points, this loudspeaker is clearly optimised for wall or bookshelf locations, it might suit a purchaser who would appreciate the clarity and would use it in a heavily furnished room. It offers very low distortion and a high sensitivity, but despite its virtues, the poor frequency balance precludes recommendation.

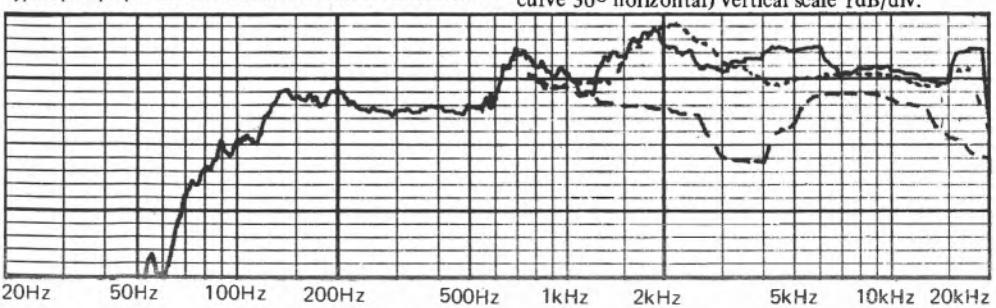
Size	48(18.9) H; 32(12.6) W; 22.5(8.9) D; cm(inches)
Weight	10.5(22) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	shelf
Frequency response within ±3dB (2m)	100Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	60Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	93dB at 1m
Approximate maximum sound level (pair at 2 metres)	106dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£110

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Pioneer HPM100

Shriro (U.K.) Ltd., Shriro House, The Ridgeway, Iver, Bucks, SLO 9JL. 0753 652222/7.

This substantial system features the unusual High Polymer (HP) upper treble unit developed by Pioneer, in the form of a cylindrical section of piezo-electric film, covered by a fine metal grille. The use of a carbon fibre blend for the bass driver is also described in the brochure. Classified as a 'bookshelf' model by the manufacturers, its large size suggests stand mounting, the latter successfully adopted on test.

Technical details

A four-way design, the enclosure is reflex loaded by a long pipe. The massive framed 305mm LF driver employs a ribbed pulp cone, and operates up to a surprisingly high 1.2kHz point. A 100mm cone driver takes over at frequencies between 1.2 and 4kHz, followed by a 45mm lower treble unit working from 4-12kHz. Above this range the tweeter finally takes over with less than half an octave of useable audible bandwidth remaining. The crossover is relatively primitive for such an array, although the components are of good quality.

Lab results

The correspondance between the reference curves was not particularly good with these samples. A pair mismatch of the order of 5dB existed between 2 and 8kHz, no doubt partly due to the poor integration. Outside of this range the matching was much better. The measured sensitivity was high at 92dB. The usefully low 6dB cutoff point was at 38Hz, and while only small phase shifts were present in the impedance, a dip to 4 ohms was present at 10kHz, placing the amp loading in the 'acceptable' category.

Very good third harmonic distortion levels were recorded, with moderate maxima of 0.6% at 7kHz; even the 50Hz reading was still fine at 0.8% with only 3% at 30Hz.

At 1 metre the sine wave reference curve showed rather severe phase and driver integration anomalies, paticularly above 2kHz. A +3dB, 500Hz mid-prominence was apparent, with an additional emphasis in the treble range. The mid emphasis was confirmed on the 2 metre characteristic response. An early rolloff was shown on all measurement axes, suggesting that the super tweeter output was inadequate. The off-axis response did not exhibit good integration of driver outputs, but indicated that the optimum listening postion for this model was about 20° lateral and 10° above the main axis; for example when used with the loudspeaker axes crossed in front of the listener.

Sound quality

The perceived frequency balance and quality was found to be position dependant, thus confirming the curves. Despite this problem, an 'above average' sound quality was assessed from the panel scoring. Under the circumstances, the 'acceptable' stereo image rating is understandable.

On stereo programme, clarity was good with a fine low frequency extension, but some panellists felt the strings were poor, with a lack of extreme high frequencies. 'Boxy', 'middy' and 'hard' colorations were all

present to a degree.

An 'average' truth-to-life rating was assessed, with the maximum power input limited to a 125W peak. Due to the onset of aggressive effects, the corresponding maximum loudness level was set at a fair 101dBA, but the bass power handling was excellent, the speaker sustaining up to 200 watts average of electric guitar with only the slightest suspicion of a rattle. The speaker was, however, considered to be moderately coloured by comparison with live sounds, with some 'brittle', 'nasal' and 'shrill' effects.

T.F. Comment

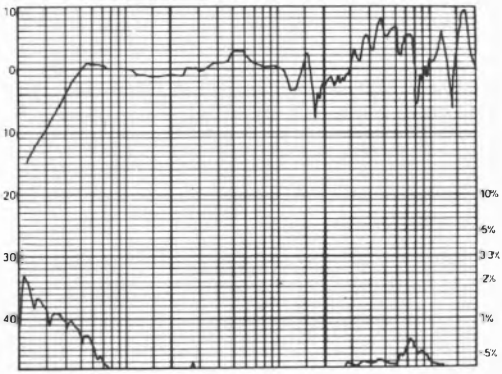
Despite a poor mark for stereo image, which I found confused, this system was only just below average. Extreme HF seemed to consist of pencil-beams which changed the overall quality and balance with head movement.

Summary

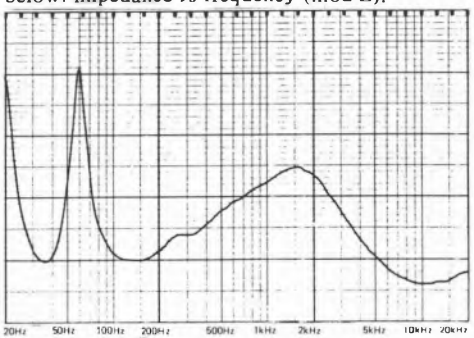
A sensitive loudspeaker offering good clarity, fine sensitivity and outstanding bass, the *HPM100* is clearly marred by moderate levels of coloration, a fairly difficult amplifer loading, and a strong position-dependant frequency balance. It is this latter unpredictability which largely prevents this speaker from gaining a recommendation.

Size	67(26.3) H; 39(15.3) W; 39.3(15.5) D; cm(inches)
Weight	26.7(59) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	38Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	92dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£290

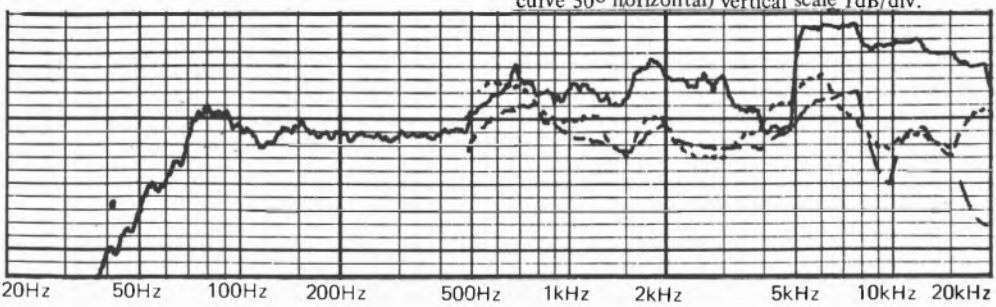
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Revox BX350

F.W.O. Bauch Ltd., 49 Theobald Street, Borehamwood, Herts. WD6 4RZ 01-953 0091.

The *BX350* represents a new and serious entry into the loudspeaker market for Revox. A 'linear phase' system, the treble driver is set back on the stepped front baffle to bring it into time alignment with the bass-mid array, an open frame grille exploiting the gap to the upper cabinet step as a deliberate visual feature. Pushbuttons allow selection of treble output in 2dB steps, and as the system is quite compact, it is presumably primarily intended for shelf mounting.

Technical details

This sealed box enclosure uses four 122mm pulp-cone bass-mid units, operating in parallel, with the driver panel being concave in pyramidal sections to angle each driver onto a central axis. The crossover is set at 3.5kHz, above which a 25mm fabric dome tweeter takes over.

Lab results

Matching between left and right hand systems was excellent to 3.5kHz, above which an acceptable 1.5dB difference occured. An average 88dB sensitivity was noted which is marginally prejudiced by the low impedance characteristic; with minima of 4 ohms at 160Hz and 3.5 ohms at 3.9kHz, the typical value was close to 5.5 ohms. The system resonance came in at 60Hz, with a corresponding —6dB rolloff at close on 50Hz.

Coincidentally, the Revox spec on distortion relates only to third harmonic values, and so our own results could be directly compared with those of the manufacturer. In fact the *BX350* attained an 'excellent' rating, the spec quoting 1% max. at 50Hz to 20kHz at a similar measurement test level to our own 96dB at 1 metre, while our test showed the whole range above 100Hz to be essentially at the threshold value, with 1% at 50Hz and a reasonable 10% at 30Hz.

The 1 metre sine wave reference curve showed how misleading curves for this type of speaker can be; for example, a 15dB notch was visible at the crossover frequency. At 2 metres things improved somewhat, although certain anomalies were still in evidence; for example, a 3-4dB hump at 200Hz; a gentle LF rolloff below 100Hz; a mildly tilted upper midrange; and a significant fall in treble output above 12kHz. The off-axis responses were also weak, the characteristic nulls and suckouts near crossover indicating poor driver integration even at this measuring distance. The bass-mid driver array proved to be surprisingly directional, although away from the crossover region the responses were much improved.

Sound quality

On an overall basis the Revox scored 'average' for sound quality. Live comparisons resulted in a higher mark, as the speaker was found to produce a fairly clean bass spectrum, and also proved capable of accepting up to 50 watts average of electric bass guitar. However a general feeling of increasing hardness with volume set the subjective limit on the maximum level test at 101dBA, which is nevertheless pretty loud.

Colorations were moderate in degree and included 'hard', 'honky', 'boxy', 'tubey'

effects, with a mild dulling and loss of extreme treble.

On the stereo tests imaging was consided to be below average, this result conflicting with the design intentions. Coloration and balance imperfections were more noticeable here — comments of 'shut-in', 'leaden', 'boxy', 'sibilant', 'hard' and 'nasal', plus a lightish balance to the mid-range, were all recorded. These were, however, mild enough to justify the 'average' rating.

T.F. Comment

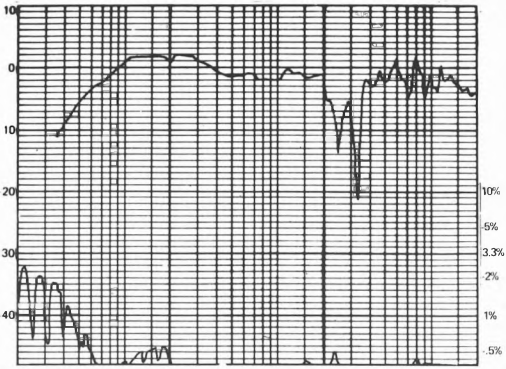
Around average, my main reservations concern the slightly confused stereo image, occasionally hard treble and lumpy bass. Overall balance and accuracy were above average, but at this price rather better results might be expected.

Summary

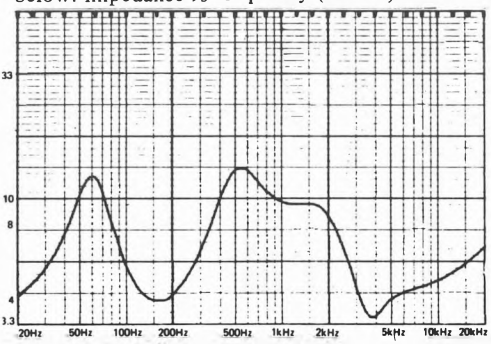
This speaker offers little advantage over its competitors in terms of response, sensitivity, amplifier load, coloration levles or stereo imaging, although its power handling was good as were the third harmonic distortion results. With an average performance at a marginally above average price, it is not the stuff of which recommendations are made.

Size	52(20.5) H; 35(13.8) W; 29.5(11.6) D; cm(inches)
Weight	14(31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	poor
Forward response uniformity	acceptable
Typical price per pair inc. VAT	£300

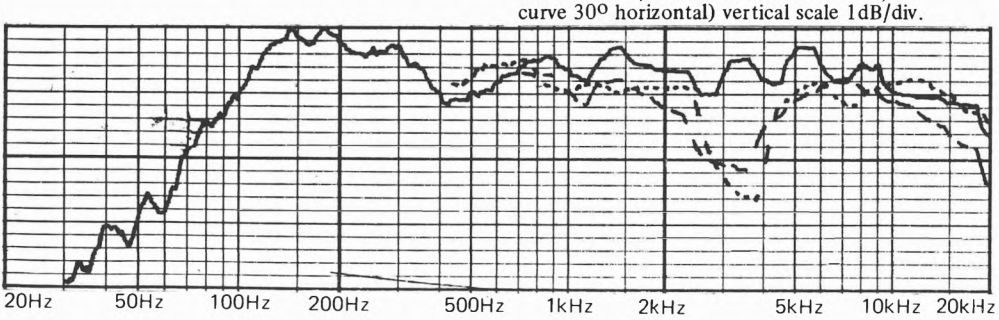
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).

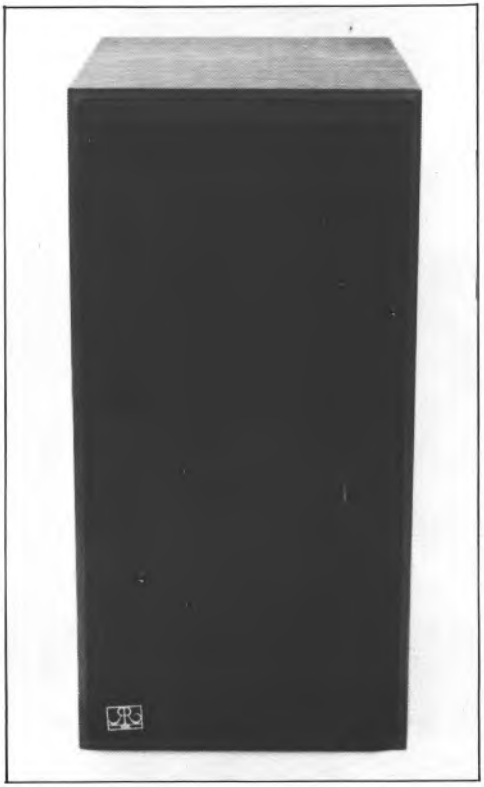


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RAM 150

R.A.M. Ltd., Clarke Road, Mount Farm, Milton Keynes, Bucks. (0908) 74764.



The *150* is a fairly compact desiogn specifically intended for open stand mounting well clear of room corners. It belongs to a current range of 5 models including the *'Mini Bookshelf'* which is also reviewed here. The suggested power rating ranges from a minimum of 15 to a maximum of 70 watts per channel.

Technical details

Bass-midrange up to about 3kHz is provided by a 200m bextrene-cone driver (Dalesford), which is reflex loaded at low frequencies by a passive radiator based on another 200mm frame. The popular Son Audax 25mm fabric dome tweeter covers the remaining frequencies, and a good quality crossover is employed. The particle board enclosure has bituminous panel damping, and polyurethane foam internal absorption is also used.

Lab results

In general the pair match was excellent, with only a minor region from 450-550Hz which showed a 2dB error. 87dB is an average sort of sensitivity, allied to a fairly typical —6dB low frequency point at 44Hz. Possessing moderate reactance, the average impedance value was close on 7 ohms, and never dipped below 6; thus the speaker is classed as presenting an 'average' amplifier load.

The rise in third harmonic distortion at very low frequencies to 30% at 30Hz, suggests that a low filter on the pre-amp might be an advantage below 35Hz. Above this level good results were obtained; for example, a fair 2.8% at 60Hz, 1% at 100Hz and typically low values above.

Examination of the reference sine wave trace revealed an essentially well balanced response on which a small +3dB hump is visible at 330Hz, as well as a droop in the presence range. At 2 metres the characteristic response still showed a mild mid emphasis, this time shifted a little higher to 500Hz. The axial curve was a trifle lumpy, with a mild down-tilt towards the higher frequencies, but on the credit side, both 10° above and 30° horizontal traces conformed well with the axial trend up to 12kHz, showing good integration and stability in the forward plane.

Sound quality

An 'above average' sound quality rating was appropriate overall, which is good at the price. On the power handling test some minor buzzes were heard at fairly low 5-10 watt levels, but it was found that the pressure could be piled on thereafter to reach 250W average of electric bass guitar before overload — an exceptional result. In fact, a loud 103dBA maximum level was attained, which required the full 500W available for musical peaks.

The speaker fared less well on the live sound comparisons where the slightly 'middy', but 'dulled' frequency balance appeared quite obvious to the panel. The bass souded slightly 'fluffy' (quite common with ABRs); the mid somewhat 'boxy', 'hollow', 'nasal' and 'dead', with cymbal sounds definitely too rounded.

Normal domestic stereo sessions suited it better, where it scored well above average, with the imaging being highly regarded.

Nevertheless, a slightly dull balance was still apparent, giving a 'shut-in' quality, although this helped to reduce perception of unpleasant distortion on the disc passages. Judged slightly 'boxy', 'plummy' and 'hard' with a touch of 'sibilance', these comments to some extent reflect the mild uneveness in the frequency response.

T.F. Comment

I scored this system around average except for stereo image, which was above average. Bass was a little plummy, and there was a rather 'hollow' quality overall.

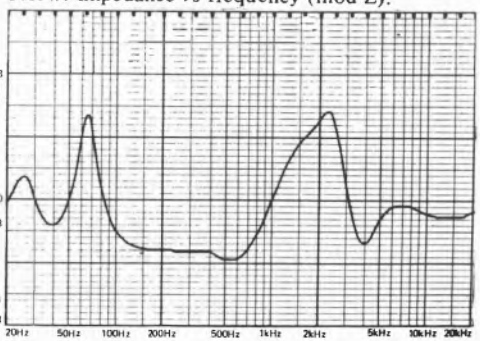
Summary

This is undoubtedly quite a good loudspeaker, its placing in the report strongly influenced by its warmish frequency balance, which suggests that suitable room conditions or system matching might bring it closer to the front rank. It has no obvious vices, is quite easy to drive and will accept considerable power inputs to deliver good sound levels with fairly low distortion. Scaled against the standard set by this group, it only just misses a recommendation.

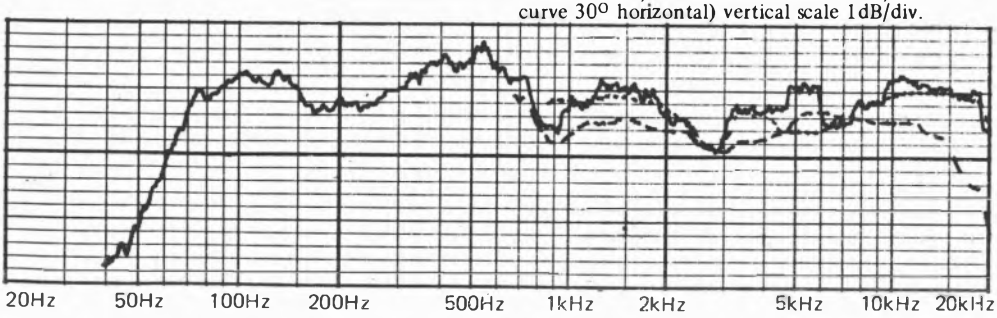
Size	58.4(23) H; 29.2(11.5) W; 25.4(10) D; cm(inches)
Weight	13.3(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	20 to 150W
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	44Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	87dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	average
Forward response uniformity	good
Typical price per pair inc. VAT	£180

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



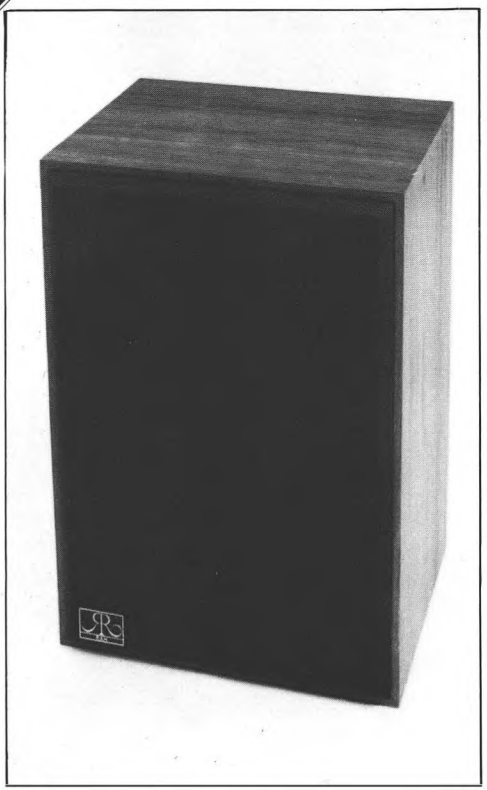
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

RAM Mini Bookshelf

R.A.M. Ltd., Clarke Road, Mount Farm, Milton Keynes, Bucks. (0908) 74764.



The smallest of the UK built range of RAM loudspeakers, the *'Mini'* is similar to the Audiomaster *MLS1,* as both systems use comparable components in a box of roughly similar dimensions. Furthermore, the two are also quite close in terms of performance and price. The *Mini* is certainly small enough for shelf locations, but its free field type response suggests that the most natural sound will be produced by stand mounting.

Technical details

A sealed box enclosure again incorporating drivers from Son Audax, a 170mm bextrene-cone unit covers the low and mid frequencies, with the ubiquitous 25mm soft-dome tweeter continuing the range above. The crossover is a complex one for a small and inexpensive speaker, containing 9 elements in a good quality assembly. Foam and bituminous treatments have been used to control enclosure resonances.

Lab results

The system resonance occurred at 72Hz with a corresponding —6dB LF point at 56Hz, this referred to the low sensitivity reading of 84dB. With about 6 ohms measured at 500Hz, the impedance was classed as 'average' in terms of amplifier loading, and the reactive content was quite well controlled.

Using a reduced 90dB reference level for the distortion trace, quite good results were obtained. A small region of 0.4% was apparent at 2kHz, with a rapid increase at the lower frequencies to 1% by 100Hz, and 8% at 50Hz; below this, the continuing rising trend indicated that a low filter at 45Hz or so might be desirable, to prevent overload at high sound levels.

From the 1 metre reference trace it can be seen that the general characteristic was quite even and balanced. However, a mild 2dB hump around 600Hz was followed by a recessed presence band, the characteristic Audax prominence at 14kHz was clearly indicated by this curve. At 2 metres the responses showed excellent conformity and integration, although they also exhibited some a mild uneveness, with the 15kHz prominence still apparent (the latter true of most systems employing the Audax driver.)

Sound quality

The Mini did remarkably well on the listening sessions, scoring 'above average' throughout, this all the more commendable in view of its very low relative price.

A reasonable 98dBA was achieved on the maximum loudness test, and while the low frequency power handling was clearly restricted, up to 10 watts average of electric bass guitar was tolerated without ill effects — the bass described as quite even, if lacking weight on the 'E' string.

Coloration and balance faults were obviously mild in degree and related to a 'small box' sound. Comments of 'tubby', 'nasal', 'occasional sibilance' and 'edginess', were made, together with upper treble prominence, cello range emphasis and slight 'hollow' and 'honky' effects.

RECOMMENDED

T.F. Comment

My enthusiasm for the *Mini* was not as great as that of the rest of the panel. The lack of bass 'miniaturized' the program sources too much for me, but my marks were still close to average, which is a good result for the price.

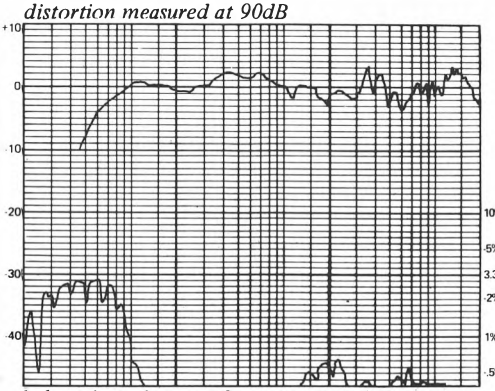
Summary

Scanning the comparison chart, it can be seen that no parameter has been awarded a less than 'good' score, with several 'very good' ratings also appearing; for example, for stereo imaging. Accepting its small size and consequent power handling and bass response limitations, the *Mini* remains a fine loudspeaker, well deserving of its recommendation.

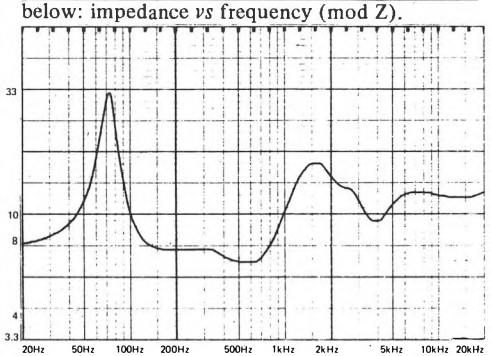
Size	41(16) H; 25.9(10) W; 23(9) D; cm(inches)
Weight	8.75(19.3) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	stand (! see title)
Frequency response within ±3dB (2m)	75Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	56Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£95

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

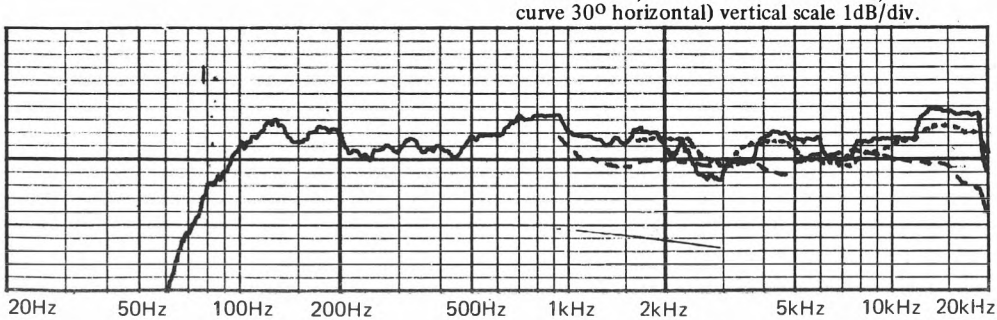
distortion measured at 90dB



below: impedance *vs* frequency (mod Z).

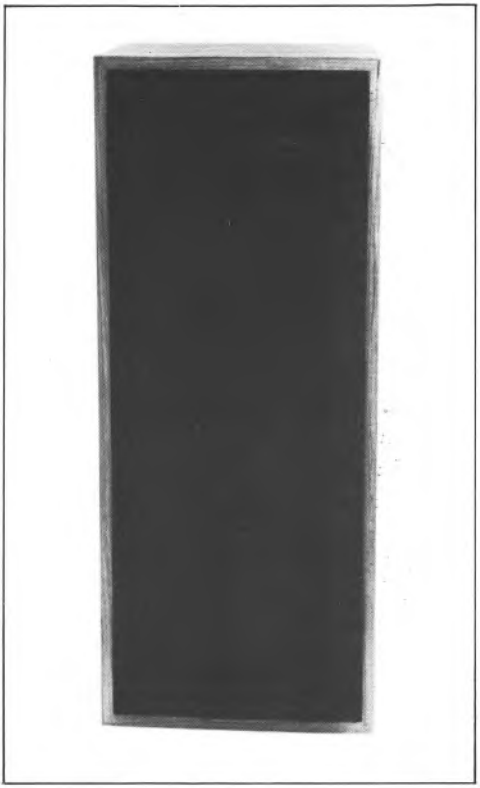


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Richard Allan Maramba

Richard Allan Radio Ltd., Bradford Road, Gomersal, Cleckheaton, Yorks.
(0274) 872442.



A newcomer to the Richard Allan range, the *Maramba* is a slim enclosure whose dimensions and driver arrangement owe something to the *Ditton 15* produced by Celestion. Light cones are employed in an effort to gain sensitivity, an acoustic foam front grille is fitted, and the enclosure is available in teak or walnut veneer.

Technical details

Bass-mid coverage is provided by a 200mm unit with a light pulp-cone carrying a surface treatment. Instead of a vent, a reflex loaded 200mm passive radiator is used in the form of a rigid polystyrene diaphragm, with a half roll surround. Richard Allan's own 25mm fabric-dome treble unit completes the vertical-in-line array. The crossover is simple, this claimed to increase the efficiency.

Lab results

While the pair matching was satisfactory up to 8kHz, above this point the imbalance was significant, reaching 4dB at 9kHz and beyond, with markedly dissimilar responses evident from the two treble units. A quite high 90dB sensitivity was recorded, with a —6dB LF point at 62Hz. The impedance curve gave a low value of 4.4 ohms at 10kHz, so despite the mean 10 ohms value, an 'acceptable' amplifier loading is indicated.

The high sensitivity meant that little power input was required to achieve the normal 96dB test level. Third harmonic distortion was rather high; for example, 3% at 7kHz, with 1-2% typical above 1kHz. Below this frequency things improved until the bass range is reached where the level quickly rose again to 3% at 90Hz. By today's standards these results are not very good.

The reference curve at 1 metre illustrated a lumpy low frequency range with poor extension, uneven mid and treble ranges, and a marked loss in upper treble; for example, —8dB at 15kHz. At 2 metres the characteristic averaged axial response showed a +3dB low frequency hump; a 500Hz to 1.5kHz plateau and a presence suckout thereafter, with a falling high frequency range. While the 10° vertical trace was satisfactory, the 30° lateral response possessed a deep 16dB notch at 6kHz.

Sound quality

The *Maramba* did not find favour with the panel during the listening sessions, the rating being 'poor' on both counts. A maximum level of 98dBA was generated, at which point the sound was clearly beginning to break up. Considerable rattles were produced on quite modest levels of electric bass guitar, the bass quality rated as uneven, lacking in power, and possessing little depth.

The panel described considerable coloration in all areas of the spectrum. The mid-range possessed noticeably 'boxy', 'tunnel', 'chesty', 'cardboard', 'pipe', 'honky', 'hard', and 'dull' effects, and bore little resemblance to the live sounds. Almost all the panellists also noted the uneven loss of high treble.

T.F. Comment

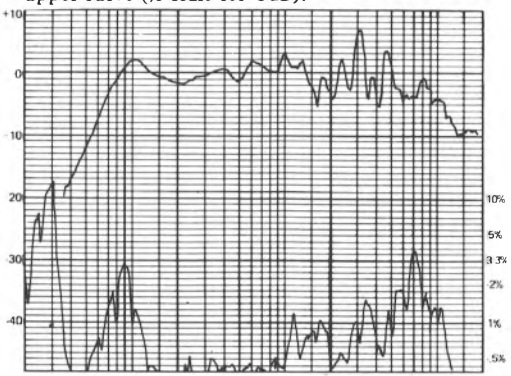
Except for an average stereo image, this system was not particularly liked, being rather fatiguing with an 'aw' coloration. Live comparisons were not convincing.

Summary

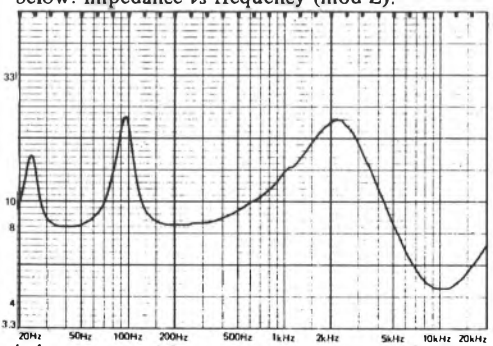
This loudspeaker could well sell in markets where considerations of sensitivity, packaging and cost outweigh those of coloration, but in the context of this report it did not compare well with the high standards attained by so many other directly competitive models. Its limited bandwidth, significant distortion and poor treble balance (plus bass rattles) were all unsatisfactory, both subjective and objective data agreeing well on all these points.

Size	59.7(23.5) H; 24.8(9.75) W; 21.9(8.5) D; cm(inches)
Weight	9.5(21) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	90Hz to 15kHz
Low frequency rolloff (—6dB) at (1m)	62Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	90dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	acceptable
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	poor
Typical price per pair inc. VAT	£90

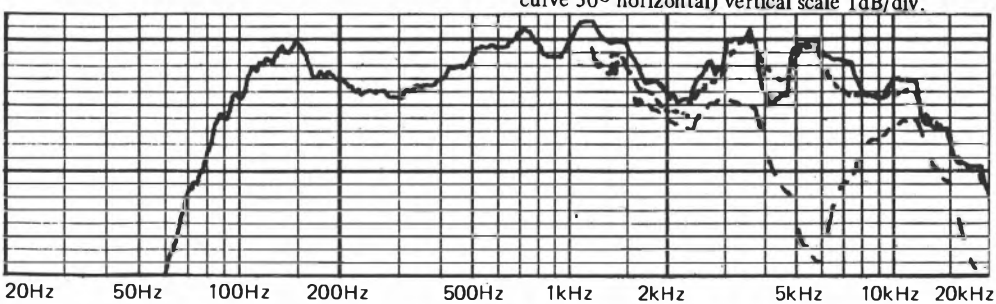
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



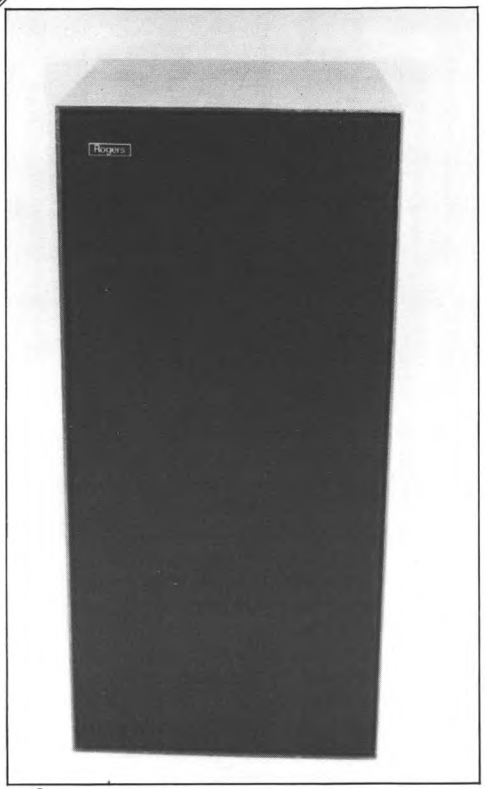
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Rogers Export Monitor

Swisstone Electronics Ltd., 4-14 Barmeston Road, London SE6 3BN. 01-697 8511.



Rogers' experience in the production of the BBC LS3/6 loudspeaker has stood them in good stead in the design of their own new model, of identical proportions. This employs a different bass-mid driver and a revised crossover eliminating the costly auto transformer. Stand mounting is recommended, clear of room corners.

Technical details

A bass reflex enclosure with a small port, the low and mid ranges are alloted to an exclusive 200mm bextrene-cone driver manufactured by Dalesford. The range 3-13kHz is handled by a version of the Celestion HF1300 hard dome tweeter, with an additional Celestion HF 2000 supertweeter filling in the final octave. The top quality crossover uses the best components in a 17 element circuit, and the cabinet is built from bitumen loaded 12mm multiply panels.

Lab results

The left and right pairs aligned within a fine 1dB tolerance as judged by the reference curves. The corresponding sensitivity was slightly below average at 86dB, with the —6dB LF point at a fairly low 43Hz. Above 100Hz the distortion figures were very good at less than 0.5% third harmonic. Increasing values were recorded at the lower frequencies, with 2.5% at 75Hz, 7% at 40Hz and 20% at 30Hz. The latter suggests that if the system is to be driven hard, a low filter on the amplifier may be desirable, at say 35Hz. Showing a fair reactive content; for example, the impedance modulus registered 6 ohms, at 4.5kHz falling to 5 ohms at 10kHz, and 4.7 ohms at 20kHz. As such the amplifier loading was judged 'acceptable.'

The sine reference curve at 1 metre was a good one, with a mild —2.5dB suckout in the mid, 400Hz to 2kHz, and the treble range slightly elevated by comparison.

At 2 metres the characteristic responses were also pretty uniform, being very flat up to 700Hz, slightly irregular on to 5kHz, and then rising in the treble by 1.5-3dB, up to 13kHz. The off axis curves corresponded well, with no suckouts or symmetry anomalies.

Sound quality

While the price is at the mean level for the test group, the overall sound quality rating was placed firmly above average.

The Export Monitor performed well on the live sound sessions although with some slight reservations. For example, the LF power handling was very good, sustaining up to 100 watts average of electric bass guitar, but a minor rattle was noticed on the 'D' string.

The speaker produced a fairly loud 98dBA maximum level, at which point it sounded a little muddy and hard. Slight colorations were observed: 'chesty' on voice, plus, 'sibilant', mid-recessed and 'steely' effects, with a tilted HF spectrum.

The speakers performed less well under stereo testiong, although the imaging itself was of a high order. Some panellists complained of a slightly dulled treble which was 'breathy' higher up the range. Disc distortion showed some emphasis, and mild 'boxy', 'hollow' and 'hard' effects were also present, with a metallic quality on occasion.

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T.F. Comment

I found this good performer above average in all respects overall; the bass was slightly boomy and the treble a little uneven, and the system sounded marginally less good at higher sound levels.

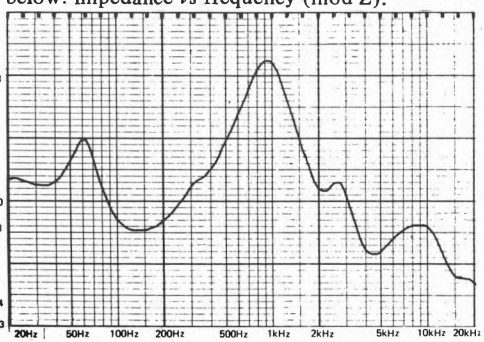
Summary

Put in perspective, this model demonstrates an impressive line up of 'good' and 'very good' scores on the comparison chart, which is a significant achievement at the price. Coloration and balance faults were slight in degree and did not significantly prejudice its subjective qualtiy; a hallmark of its sound engineering was the fact that the various performance parameters appeared to present a reasonable balance. On this basis, the Export Monitor clearly belongs to a necessarily restricted group of recommended speaker systems.

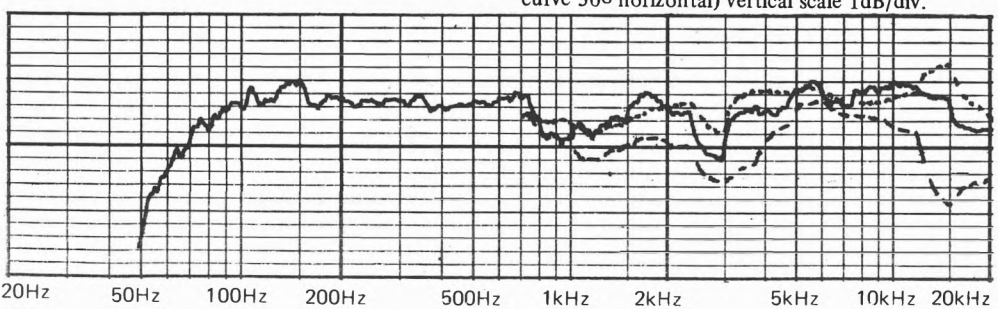
Size	63.5(25) H; 30.5(12) W; 30.5(12) D; cm(inches)
Weight	14(31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	43Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	v. good
Typical price per pair inc. VAT	£245

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Rogers LS3/5A

Swisstone Electronics Ltd., 4-14 Barmeston Road, London SE6 3BN. 01-697 8511.

The other two companies licenced by the BBC to produce the *LS3/5a* were covered in the previous issue of *Loudspeakers*, and now it is the turn of Rogers. Early on during testing it was noted that these speakers sounded marginally different to the previous *3/5a* models I had heard, and accordingly this matter was taken up with the manufacturers. It transpires that small balance changes can occur within the official specification, due to slight batch alterations in the response of the bass-mid unit. This is under review by the BBC and by all the licensed manufacturers concerned, as the variation is a common problem to all. Its should be said that while the change is audible, it is neither severe nor does it appreciably alter the sound of the *LS3/5a* concerned, but I personally feel that a more, for want of a better word, 'typical' *LS3/5a* would have performed a little better on the listening tests.

Technical details

A very small sealed box system, the *LS3/5a* incorporates a precision crossover to provide subtle equalisation and give a neutral sound balance. Fine level matching for unit sensitivity differences is also present. Two KEF drivers are used, namely a selected 110mm bextrene-coned bass/mid unit, and a 19mm plastic-dome tweeter.

Lab results

In the crossover region a mild 1-2dB mismatch between left and right reference traces was noted, but elsewhere an excellent correspondance existed. A low 82.5dB sensitivity was measured with the —6dB point at 59Hz. The system resonance was placed at 75 Hz, and the speaker was easy to drive, the modulus of impedance being typically 12 ohms and never falling below 8. Understandably the test level for third harmonic distortion was set at the lower 90dB level, and under these conditions an excellent result from 70Hz upwards was recorded.

At 1 metre the reference curve showed a very uniform mid band, 200Hz-3kHz, with an equally uniform HF range, although this was mildly lifted by 1-1.5dB relative to the mid; upper bass was marginally exposed as a +3dB hump.

At 2 metres the characteristic responses were seen to be remarkably well integrated. All curves, 30° lateral and 10° vertical, conformed with that on axis to within 2-3dB throughout the frequency range.

Although smooth, the response was however characterised by a 3dB hump at 150Hz, with a related area of dip at 400 Hz.

Sound quality

The table showed that the sound quality was about average on an overall basis, which is not only a good result for the price, but is also remarkable considering the speaker's diminutive size. No allowance was made for the latter during the listening sessions.

Rated well above average on the live sound comparisons, colorations were only of slight degree, and included 'tubby', 'edgy', 'bright', 'chesty', 'thin' and 'mid-recessed' effects, In general, however, its rendition of the live sounds was very good.

While imaging was very good, the subjective

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frequency balance would appear to have affected the speaker's stereo programme performance. The panel described slight to moderate 'hollow', 'edgy', 'fizz', 'sibilant' and 'metallic' effects, with a thinned mid-balance, and a light, 'plummy' bass. Little bass depth was perceived, although detail and clarity were both of a high order.

T.F. Comment

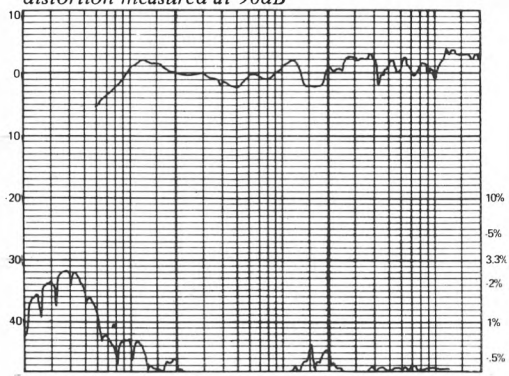
On the live comparison tests I found the LS3/5A one of the very best. Despite some chestiness on speech, this was one of the few systems to convince. On the stereo tests I was less enthusiastic, due to the lack of bass and rather 'wiry' top.

Summary

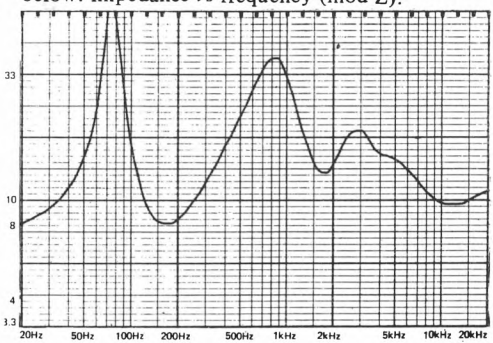
The *LS3/5a* remains a good system for its size and price. The review pair were little on the 'mid-distant' side of a neutral balance, a more 'typical' *3/5a* showing less of this tendency. This mid distant effect in fact gave an impression of slight treble lift and bass uneveness; nevertheless, the *3/5a* proved convincingly accurate on live sounds, its real design objective as a monitor loudspeaker. Offering a unique performance combination of albeit limited volume and power handling, the *3/5a* can thus be recommended.

Size	30(12) H; 18.5(7.5) W; 16(6.5) D; cm(inches)
Weight	5.5(11.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	high stand (or shelf)
Frequency response within ±3dB (2m)	90Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	59Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	82.5dB at 1m
Approximate maximum sound level (pair at 2 metres)	93dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£160

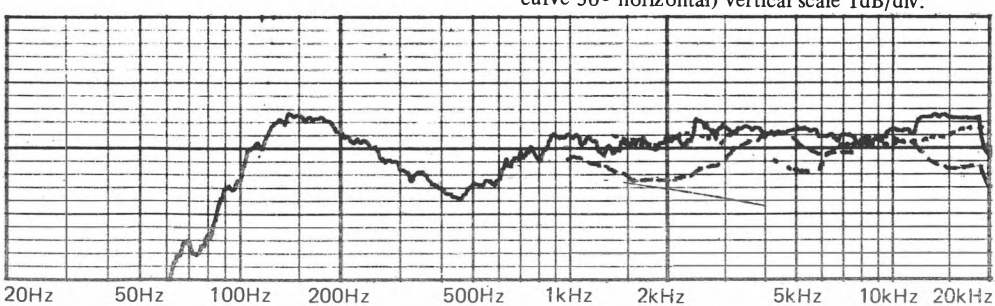
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).
distortion measured at 90dB



below: impedance *vs* frequency (mod Z).



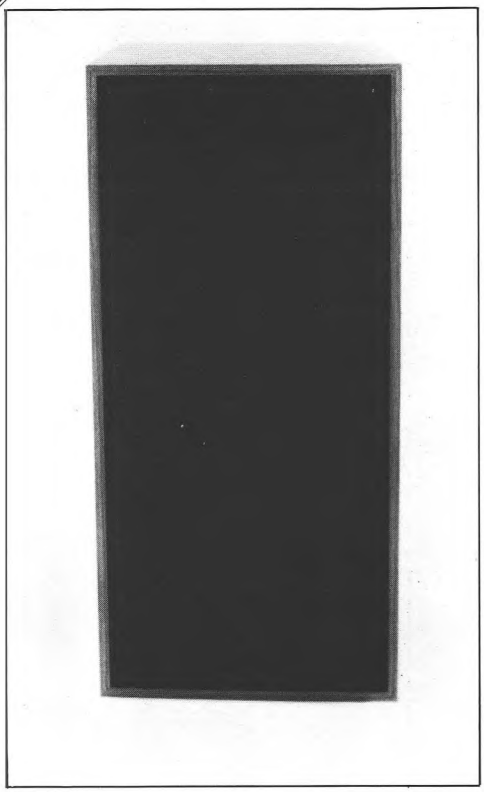
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Sansui ES207

Vernitron Ltd., Thornhill, Southampton SO9 5QF (0703) 444811



Showing how seriously a Japanese manufacturer has taken British standards of sound quality, the *ES207* is the first of a new range of speakers from Sansui to utilise UK design techniques. Assembed at their Belgian factory, the drive units for this model are made in Japan, the *ES207* being a compact enclosure designed for vertical positioning. Open stand mounting is recommended, and response control is afforded by a high frequency level adjustment under the open cell foam grille. The finish is in a dark 'walnut' vinyl.

Technical details

A two-way bass reflex model, the vent action is provided by a 200mm passive radiator. Bass/midrange coverage comes from a synthetic surface-treated cone of optimised flare, based on a 200mm long throw chassis. A complex 18dB/octave crossover divides power at 2.5kHz, the treble arm resembling the KEF Acoustic Butterworth network, with a 25mm plastic-dome unit operating over the treble band. The enclosure panels are damped with bituminous material and lined with acoustic foam.

Lab results

Up to 10kHz, a fine 1dB match was recorded, with the range above reasonable at a 2dB difference (pre-production prototypes.) A typical low sensitivity of 86dB was recorded, with a usefully extended 40Hz, —6dB LF point. Very easy to drive, the impedance did not fall below 8 ohms throughout, and on third harmonic distortion, good 0.5% readings were obtained in the mid band. Some rise was apparent at higher frequencies, but the overall curve was very good, particularly in the bass where the readings did not attain a 2% level until 40Hz. The rise below this suggests that a low filter at 35Hz might be worthwhile if the speakers are to be driven hard.

The sine wave reference trace illustrated a commendably extended and uniform response to 700Hz, followed by a mild 2-3dB trough up to 2kHz, beyond which the HF recovered. A gentle rolloff above 14kHz was also apparent. At 2 metres the characteristic frequency response was little altered, although the 500 – 700Hz area looked a trifle exposed, and the balance was slightly 'rich'. Overall, the on- and off-axis responses were well integrated in all planes.

Sound quality

Despite its reasonable price, the high sound quality of the *ES207* is unmistakeable, with an 'above average' ranking on all counts. On the live sound comparisons it absorbed the full 500W peak output of the source amplifier without distress, generating a farily loud 100dBA. The low frequency range was highly praised, being considered both even and powerful. In fact, the ES207 accepted a high 50W average of electric bass guitar, producing a satisfying bottom 'E' note, with no audible rattles. Coloration was felt to be mild, and included 'hollow', 'quack', 'boxy', 'hard' and 'brassy' effects, with a thickened balance and some uneveness in the treble register.

On the stereo tests, good imaging was apparent, with realistic scale and depth rendition on the classical organ program.

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Slight 'sibilant' and 'edgy' effects were noted, the sound occasionally 'honky' and 'middy' (for example, on piano), with the overall character a trifle rich and heavy.

T.F. Comment

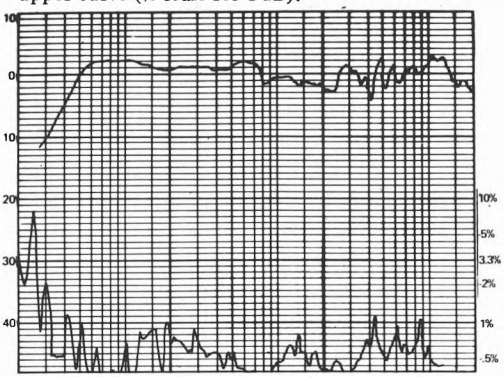
Overall slightly above average, most criticisms were aimed at the treble, which was slightly rough and uneven, noticeable on strings and worn disc. It is certainly good overall at the price, nevertheless.

Summary

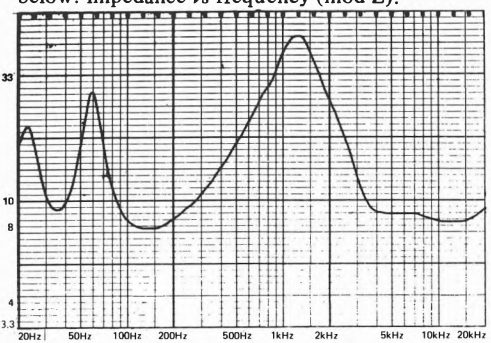
This is undoubtedly a fine loudspeaker system, the mildness of panel comment in the listening sessions reflected in the high scores attained; the bass performance was exceptional, neutrality high, coloration moderate and frequency balance pleasing. Easy to drive, it could produce satisfying levels, although it did require a fair amount of power to do so. A visual scan over the comparator table reveals its true merit, and at the price asked the *ES207* is certainly worthy of recommendation.

Size	59.3(23.3) H; 28.2(11) W; 28.1(11) D; cm(inches)
Weight	13.2(29) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£160

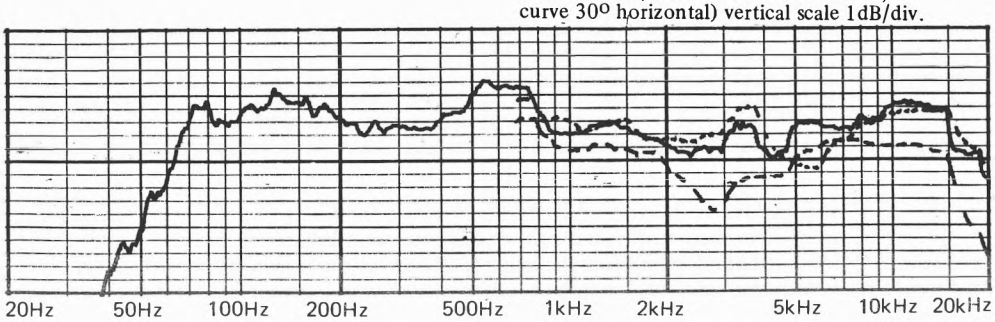
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



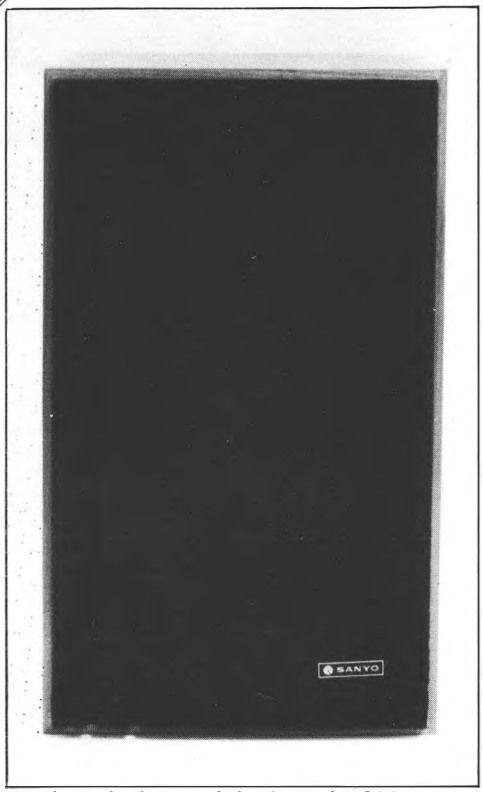
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Sanyo Hi-Fi One

Sanyo Marubeni (U.K.) Ltd., 8 Greycaine Rd., Watford, Herts. Watford 46363.



Hard on the heels of the Sansui *ES207* comes this Sanyo model, one of three models made in the UK, using Son Audax drive units. A compact system, the *Hi Fi One* is ostensibly intended for open-shelf locations, but as their response is specified flat in free field anechoic conditions, stand mounting at a realistic height should also be permissible. Despite its modest price the *One* was immaculately presented with full surface veneering, flush mounted drivers, and a contoured foam grille. Connections are via a DIN socket with cables supplied.

Technical details

A sealed box system, with a vertical-in-line driver arrangement, the low- and mid-frequencies are handled by a 200m bextrene-cone unit, with the range above the crossover at 3kHz or so alloted to a 25mm fabric-dome tweeter.

Lab results

An excellent pair match was observed, with a reasonable 50Hz, —6dB LF point, this referenced to a typically low 86dB sensitivity. The system resonance was placed at 62Hz, and with its nomial impedance of 10ohms and a minimum value of 7.5, this speaker clearly represents an easy amplifier load.

Measured at the higher 96dB test level, and apart from a mild distortion rise to 0.8% at 200Hz, the third harmonic content was low. Below 100Hz, a fair rise occurred; for example to 6% at 50Hz, but no further increase was recorded at the lower frequencies.

On sine wave, a flat response was apparent to 1kHz, as well as throughout the treble range. The 1-4kHz range, however, showed moderate irregularities. Moving out to 2 metres with $\frac{1}{3}$-octave averaging, the trend was less uniform, the whole showing a mildly mid-prominent character, 600Hz-2kHz. The lateral responses were good, as was the 10° vertical trace, with the exception of a mild 5dB suckout near the crossover point at 3kHz. Nevertheless, the curve was considered to be pretty good, bearing in mind the system price.

Sound quality

Without reservation the sound quyality ranked as 'very good' — a truly excellent result at the price. Admittedly these results do apply to pre-production samples, but providing reasonable care is taken in manufacture, there is no reason to suppose that this performance standard cannot be maintained.

A high 103dBA was achieved on the loudness session, the speaker accepting a 500W peak input. While a slight bass buzz was apparent at some low frequencies (10W), the speaker could take up to 50W average of electric bass before overloading. Criticisms of the sound were clearly very mild, though one or two panellists did find parts of the range less than pleasant. Voice was considered to be a little 'thin' and 'boxy' with dulled presence and some hardness, while extreme low frequencies were down in output.

On the stereo testing the image was highly rated and coloration comments were still of a mild nature — 'metallic', 'gritty', 'fizz', 'quack' and 'hollow' effects were all noted. Overall the frequency balance sounded pretty

RECOMMENDED

neutral.

T.F. Comment

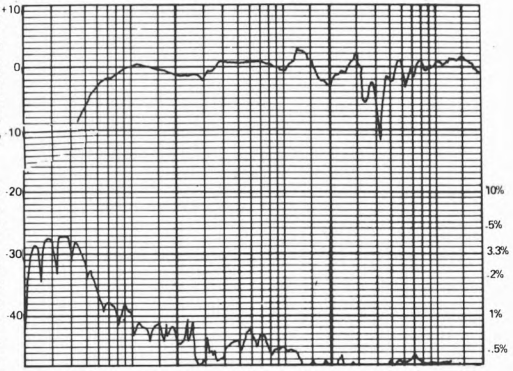
On or above average throughout, this speaker was slightly overbright, brittle, and lacking in deep bass. At its price the performance must be considered very good.

Summary

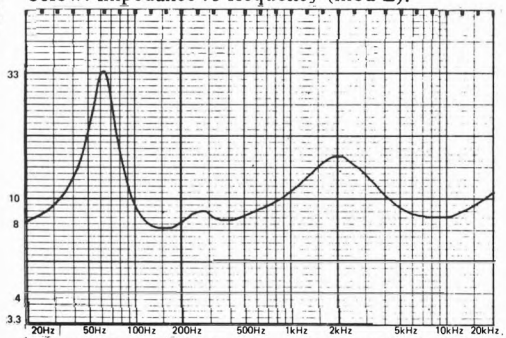
All the speaker's performance parameters were classed as either 'good' or more often, as 'very good', and while it was not quite as subtle as some of the more expensive and highly rated models, its ability to cope well with every test was remarkable. The *Hi Fi One* is thus strongly recommended.

Size	45.5(18) H; 21.5(10.8) W; 17.8(7) D; cm(inches)
Weight	7.5(16.5) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	25 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	102dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	good
Typical price per pair inc. VAT	£85

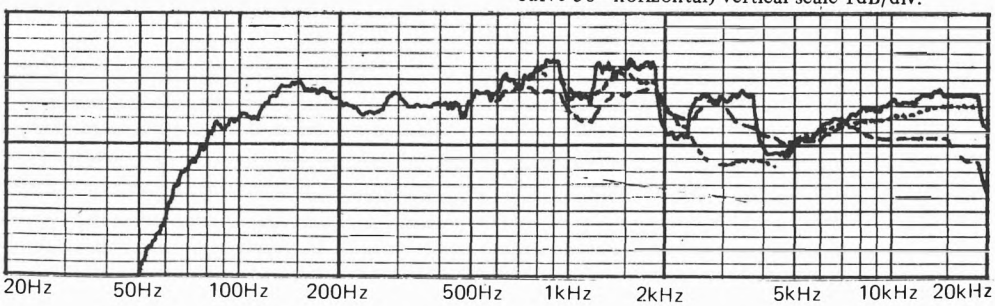
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



SMC Super Saturn

SMC Loudspeakers, 76 Bedford Road, Kempston, Beds. MK42 8BB. (0234) 854133.

A compact design, the SMC *Super Saturn* is manufactured in the UK and carries a two year guarantee. The speaker is specified as suitable for amplifiers of 15-50 watts per channel and the instructions suggest that for optimum results vertical positioning should be adopted, with the upper section of the cabinet near to ear level. Corner mounting should be avoided, and presumably the use of open stands is also permissible.

Technical details

A sealed box enclosure, low- and mid-frequencies are handled by a 200mm bextrene-cone driver (Dalesford), crossing over at 3kHz via a complex 10-element network to the 25mm fabric dome tweeter (Son Audax). Fair quality electronic components are used for the crossover, and the simple enclosure is filled with polyester wadding.

Lab results

The *Super Saturn* exhibited a closely controlled pair match, within 1dB over the whole range. A low 85dB sensitivity was recorded with a corresponding 50Hz, —6dB low frequency rolloff, this in turn allied to a rather high system resonance at 70Hz. Rated as relatively easy to drive, a minimum of 6.5 ohms was noted, with the typical impedance value at 8 ohms. Reactive elements were under good control.

The third harmonic distortion at 96dB SPL was higher than expected, with values of 1% at 7kHz and 2% at 300Hz; in addition, the distortion rose fairly quickly at low frequencies, for example, to 3% at 80Hz and 30% at 40Hz. The indications are that the 96dB was rather a high test level for this system and things are likely to improve at lower volumes.

The reference sine wave trace indicated a 4dB trough from 500Hz to 3kHz, a mildly erratic high frequency range with a slight 14kHz hump, this followed by a gentle rolloff to —5dB at 20kHz.

At 2 metres mike spacing, the system looked better integrated on the whole. A fairly uniform trend was shown, slightly falling in energy with increasing frequency. No special characteristics were noted bar the 4dB loss at 4.3kHz on the 10° above position, and on-axis listening is clearly to be preferred.

Sound quality

Taken overall, an average sound quality rating is denoted for this loudpseaker, which is quite good considering its relatively low price. Performing better on the domestic stereo tests, the imaging was good with some moderate colorations observed, notably 'chesty', 'boomy' and 'boxy' effects, with slight 'grating' and 'edgy' comments. It appeared dim in the lower treble and bright above, and the low frequency range was neither very distinct nor extended.

The *Super Saturn* compared less well against live sounds. The colorations appeared more pronounced and were extended to include 'tubby', 'hollow', 'ringing', 'fizz' or just plain 'coloured'.

A fairly low 98dBA was reached on the high level tests, the mid appearing to saturate at

this level. While no buzzing was apparent, the bass was heard to overload comparitively early, allowing only 5 to 10 watts average of electric bass guitar input, with the output clearly restricted in terms of power and depth.

T.F. Comment

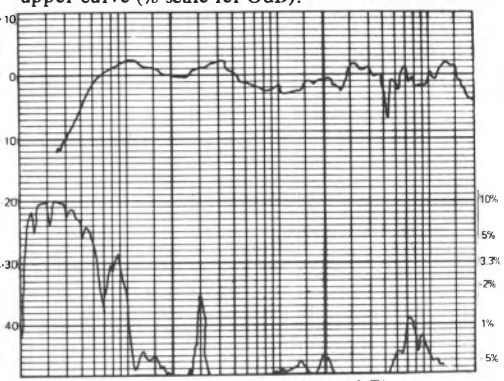
Slightly below average in all respects, some boxiness and chestiness in the bass veiled the sound quality, while mid coloration also caused me concern. At higher volumes the HF became a little fatiguing.

Summary

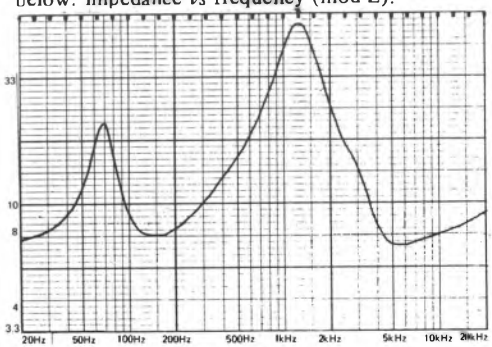
This model has some quite good points and made a creditable showing on the stereo programme sessions. It was caught out, however, by the live sound comparisons, and also showed a limited power handling. While clearly not a poor loudspeaker, is not sufficiently accurate to merit a recommendation, despite its modest price.

Size	46.5(18) H; 25.5(10) W; 24(9.5) D; cm(inches)
Weight	8.7(19) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 75W
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	85dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA
Third harmonic distortion (96dB at 1 metre)	acceptable
Impedance characteristic (ease of drive)	good
Forward response uniformity	v. good
Typical price per pair inc. VAT	£120

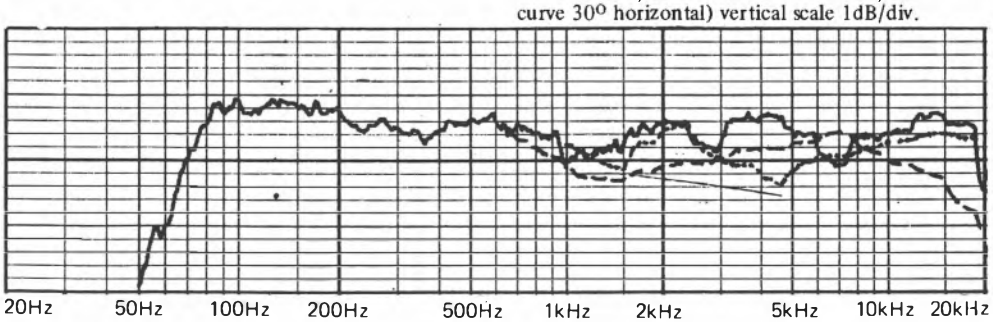
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Sony G5

Sony (U.K.) Ltd., 134 Regent Street, London W1R 0DJ. 01439 3874.

A costly enclosure from Sony, the *G5* is the smaller brother of the substantial *G7*. Some special features are incorporated, the most noteworthy being the the high sensitivity and the unique 'grooved lattice' front panel, the latter termed 'AG' pair of specially designed stands were supplied to us with the enclosures.

Technical details

The 300mm low frequency driver has a pulp cone with a proportion of carbon fibre, and a large motor coil. Covering the 600Hz-5.5kHz range is a cone/dome mid unit, 80mm diameter and with a small cone-section edge. A 25mm dome tweeter completes the vertical-in-line array, the units positioned so that their effective sound origins are also in line. The enclosure is reflex loaded by a ducted port, and the crossover, a good quality assembly with 12dB octave slopes, comprised 14 elements including attenuator sections.

Lab results

With less than 0.5dB difference between curves, the speakers demonstrated excellent pair matching. The sensitivity was exactly as specified by the manufactureres at a very high 93dB, although the LF range was somewhat curtailed for this size of enclosure, possessing a 60Hz, —6dB rolloff point. The mean impedance value was 7 ohms, with minimum figure of 5 ohms occurring at 12kHz; hence the speaker is described as possessing 'average' amplifier loading characteristics.

Truly excellent third harmonic distortion curves were measured for the *G5,* values being at or below threshold throughout, except for an insignificant rise to 0.5% at 90Hz (the upper system resonance.)

On the sine reference trace some irregularities were observed, which are considered to be significant. At low frequencies the early rolloff was accentuated by a +2dB hump at 100Hz, while another +3dB hump appeared at 500Hz, to be followed by a trough. The range above was none too smooth, with the high treble also curtailed beyond 15kHz. At 2 metres the characteristic response was more even, although the trough at 15kHz was still present. The HF band was somewhat better, although both a peak at 12kHz followed by an early rolloff were still apparent. The response at 10° above was poor, exhibiting 10dB suckouts, and hence an axial listening position is essential. In the lateral plane the characteristic was much improved, showing fairly good integration up to 10kHz.

Sound quality

Having balanced the listening test results, the *G5* attains an overall 'average' rating which is rather disappointing in view of its high price. However plus and minus aspects were recognised, which means that this is an interesting speaker which might well suit certain applications.

For example, a very high 108dBA maximum level was recorded and at this level the general sound quality still held together. Good power hanling was also demonstrated at low frequencies', the sound, although slightly reduced in output on the 'E' string, was described as powerful, even and clean.

A fair amount of coloration was described which caused the speaker to be marked down

to 'poor' on the domestic stereo sessions. This rating also applied to the stereo imaging which appeared to have very little 'depth'. The panel described the speaker as 'hard', 'tubey', 'middy', 'boxy', low bass deficient, 'coloured', fizzy', and 'honky', with suckout effects, while distortion in program was emphasised. However, it should be noted that one or two panellists favoured the *G5* sound, and thus as a whole the group clearly had rather mixed feelings about this speaker.

T.F. Comment

I found this speaker's performance rather poor, with an unstable stereo image (producing transients unpredictably) and exaggeration of record surface noise on the stereo tests; although better on live comparison, I did not like it overall.

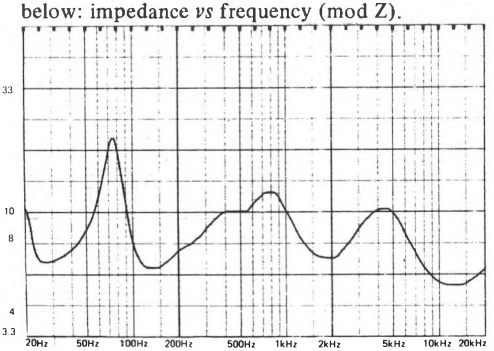
Summary

A costly loudspeaker, the *G5* was certainly finished and engineered to the expected high standard, but fell short in terms of its sound quality. Stereo imaging was really only just acceptable in the context of this report, and although sensitivity, distortion, power handling and maximum level were all excellent, the frequency response was restricted at the audio band extremes.

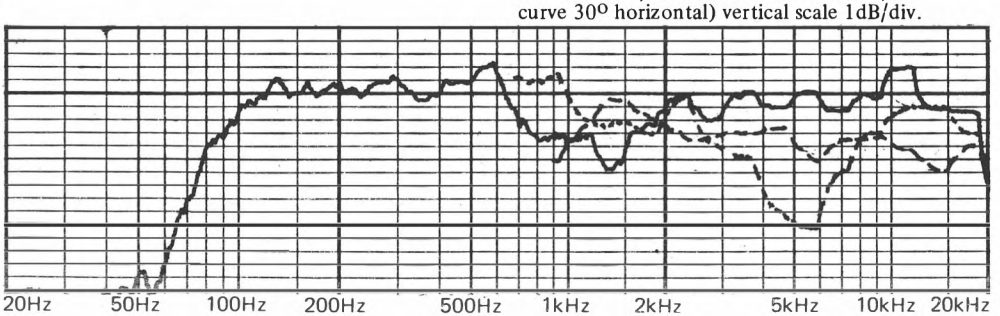
Size	72(28.4) H; 41.5(16.4) W; 35(13.6) D; cm(inches)
Weight	26(58) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	80Hz to 18kHz
Low frequency rolloff (—6dB) at (1m)	60Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	93dB at 1m
Approximate maximum sound level (pair at 2 metres)	108dBA
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	average
Forward response	uniformitacceptble
Typical price per pair inc. VAT	£420

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



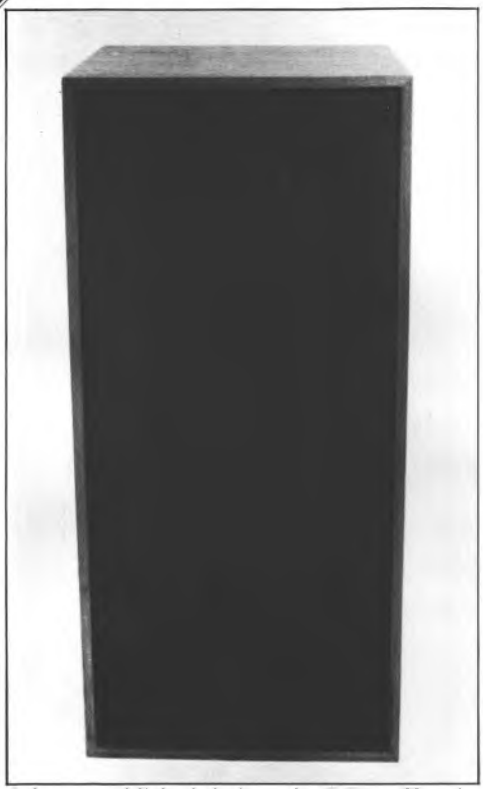
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Spendor BC1

Spendor Audio Systems Ltd., Unit 12, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER. (0323) 843474.



A long established design, the BC1 suffered a little in recent years from slight production changes. A year or two ago an alteration in cone surround exaggerated a known power handling and bass response problem, and the previous issue of *Loudspeakers* reviewed a pair of these speakers which were censured on these grounds. Further development provided a solution, and our test programme commenced with a pair of these improved speakers. However on early auditioning we still felt they were not quite right in terms of the mid/treble accuracy of the earliest *BC1s,* and Spendor revealed that the Celestion HF13000 had been responsible for a hitherto unsuspected coloration effect. Accordingly, with this identified and now under control, a second pair of speakers was delivered to *Choice.* These new speakers also incorporated a minor port modification consisting of a 7mm thick foam ring lining, this appearing to smooth out and extend the bass response a little.

Technical details

Low-mid frequencies are provided by Spendor's own 200mm bextrene-cone driver. The main HF range is allotted to a Celestion HF1300 hard-dome tweeter, which has undergone a rigorous programme of selection, with the final half octave covered by a Coles(S.T.C.) 19mm plastic-dome. The complex crossover incorporates full equalisation and sensitivity matching, and the ported enclosure has critically damped multi-ply walls.

Lab results

Excellent pair matching was recorded with only minor isolated 1dB differences at 10kHz and 15kHz. Sensitivity was fairly low at 86dB with the —6dB LF point at a 45Hz (43Hz with port liner). The amplifier loading is rated as 'good', the minimum figure of 6 ohms occurring at an unimportant 18kHz. Excellent third harmonic distortion readings at or near threshold were obtained above 100Hz, using the 96dB test level. Moderate values were recorded at the lower frequencies, for example 1% at 60Hz and 3.5% at 50Hz and 40Hz, but they rose quickly below this and, if driven hard, a low filter on the matching amplifier at 40Hz might be an advantage.

The excellently even sine wave response was characterised by a mild +2dB hump in the bass, a mild hump at 12kHz on axis, and some inevitable irregularity at the high crossover point. The 150Hz-3kHz range was outstanding, and on the 2 metre characteristic trace excellent conformity and integration was apparent, although the overall trend was somewhat less uniform at this increased measuring distance.

Sound quality

Despite my personal initial reservations, on checking the test results the first pair were found to have performed well on the stereo sessions (they were not included in the live comparisons); however the second pair were outstanding in almost every respect.

The *BC1* tolerated a full 500W peak input producing a maximum 101dBA which did not sound unbearably 'loud'. The low frequency performance was now quite good, with an

RECOMMENDED

even, powerful and accurate output on electric bass guitar.

Stereo imaging was very good, with precise loational focuseing and excellent depth and ambience. The speaker sounded quite transparent, by comparison with certain other models in the group. The colorations which were described were small in degree; slight 'box', 'hard', and 'plummy' effects were all noted, together with moderate restriction felt at low frequencies. The mid-treble balance was near perfect on axis, with the HF register outstandingly accurate.

T.F. Comment

Despite slight bass boom and a generally warm balance, the *BC1* received some of my highest marks . . . the sound was well focussed with clear stereo image and perspectives.

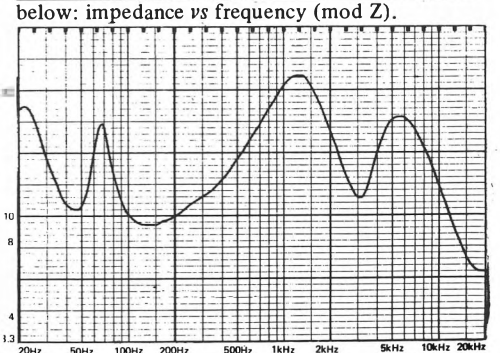
Summary

It would appear that after a minor detour the *BC1* is back on the tracks again. The mid and treble were exceptional, the bass much improved, with an overall large increase in power handling. Stand mounting clearof room corners is essential for the least coloration and best balance, and at its still moderate price, this latest *BC1* can be strongly recommended.

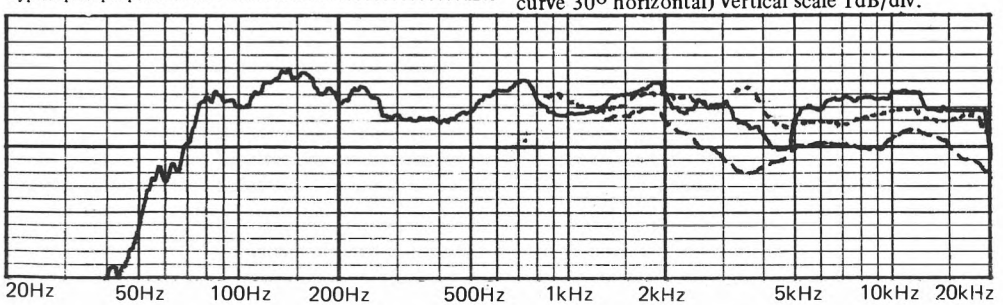
Size	63.5(25) H; 29.8(11.7) W; 30.5(12) D; cm(inches)
Weight	14(30.8) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 150W
Recommended placement	stand
Frequency response within ±3dB (2m)	70Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	44Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	86dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA*
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	good
Forward responseuniformity	v. good
Typical priceper pair inc. VAT	£240

below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.

below: impedance *vs* frequency (mod Z).



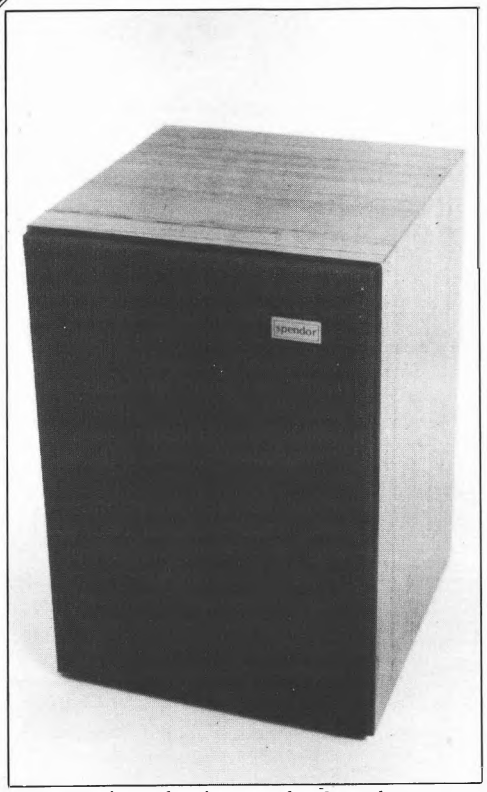
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Spendor SA1

Spendor Audio Systems Ltd., Unit 12, Station Road Industrial Estate, Hailsham, Sussex BN27 2ER. (0323) 843474.



A recent introduction to the Spendor range, the diminutive *SA1* has some features in common with its larger brother the *BC1*, namely the same damped box technique, a free field or stand mounted frequency balance, and a complex high quality crossover. Clearly a 'no compromise miniature' (if this is not a contradiction in terms), the *SA1* is consequently quite expensive.

Technical details

Spendor's new 165mm bextrene-coned bass-mid unit is employed, the enclosure being of the sealed or so-called infinite baffle variety. Above about 3kHz, a selected Son Audax 25mm fabric-dome tweeter takes over.

Lab report

Excellent matching was observed, with less than 0.5dB difference throughout the range. A very low 82dB sensitivity was recorded, indicating a minimum amplifier power of 25-30 watts per channel. The —6dB point was measured at 53Hz, about average, this corresponding to a system resonance at 63Hz.

Reactive components were present in regions of high impedance, and with a minimum modulus of 9 ohms and a typical value of 12, the *SA1* was particularly easy to drive.

At the reduced 90dB test level the distortion results were excellent at under 0.4% even at 50Hz; clearly this small box could have tolerated a higher input power without any real problems. On sine wave excitation at 1 metre mike spacing, the response was commendably even; a slight +2dB lift could be seen from 80-140Hz, with a similar lift at 15kHz and a gentle rolloff thereafter.

Out at 2 metres, the overall response met fine ±2dB limits from 80Hz to 15kHz. While the low frequency range showed an early rolloff, no hump was present higher up, so bass lift is permissible when needed. A mild prominence at 700Hz was also visible on the response. Examination of the family of on- and off-axis curves show that they were both consistent and uniform, and hence well integrated. As such, the system has predictable frequency balance which is not critical of listening axis.

Sound quality

An 'above average' overall sound quality ranking was achieved by the *SA1* which is commendable at the price, and perhaps surprising considering its size.

It was discovered on decoding the test sheets that the *SA1* had sustained the full 500 watts peak output on the high level test, attaining a respectable 98dBA. On electric bass guitar it was also surprisingly good, accepting a not inconsiderable 25W average with fair eveness and depth.

It scored consistently 'above average' on both the live and the stereo sessions, and while the panel were aware of coloration and balance defects, these were considered to be only slight, and included 'fizz' and 'sibilance,' 'dull,' 'boomy,' 'rich,' 'gritty,' 'tubby' and occasional 'thin' effects.

T.F. Comment

I scored this speaker above average in all respects except stereo image, which I found slightly overwide and out of focus. Slight

RECOMMENDED

tubbiness and sibilance were also noted, but overall performance was good.

Summary

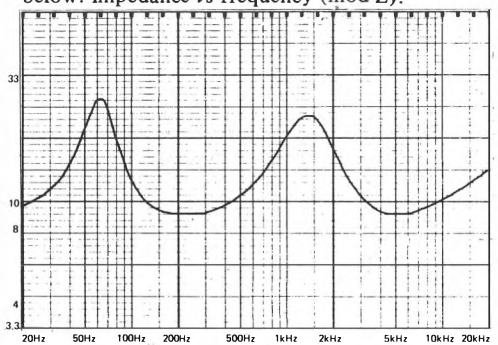
Despite the fact that some coloration could be heard, it was not severe enough to spoil the brew, and hence the overall quality rating was a good one. The speaker was easy to drive, possessed good power handling of excellent distortion with fine matching and uniformity in evidence, all this contained within exceedingly compact dimensions. The *SA1* certainly makes the grade and, while it is especially recommended for those seeking a 'small' system, it could well appeal to purchasers for whom size is not the prime consideration.

Size	30.4(12) H; 22.5(8.9) W; 21.6(8.5) D; cm(inches)
Weight	7.2(15.8) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 75W
Recommended placement	high stand (open shelf)
Frequency response within ±3dB (2m)	95Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	53Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	82dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA*
Third harmonic distortion (96dB at 1 metre)	excellent
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	excellent
Typical price per pair inc. VAT	£150

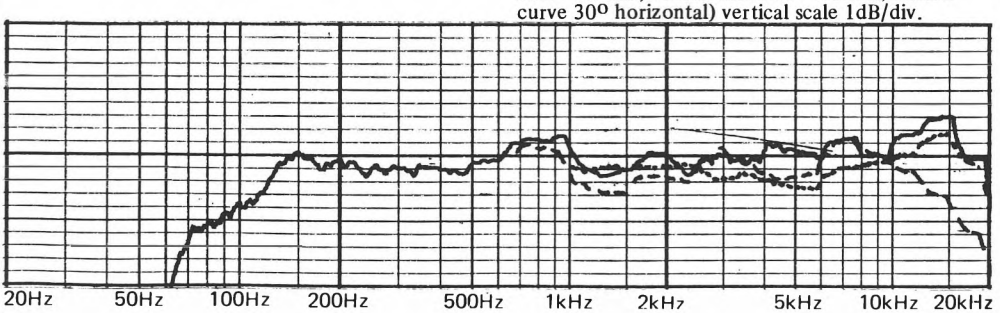
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

distortion measured at 90dB

below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Studiocraft 330 II

Bose U.K. Ltd., Trinity Trading Estate, Sittingbourne, Kent ME10 2PD. 0795 75341/5.

A high sensitivity system from a division of the American Bose Corporation, the *Studiocraft 330* achieved success a year and a half ago, in another group test (*HFP* Sept/Oct '76). These more recent samples, however, performed less well, and even taking into account the different test procedures, location, panel and programme involved, the conclusions were too divergent for a change in the design not to have occurred in the interim. In fact, comparisons of the response curves and impedance runs for the earlier and later *330*s confirmed that some alteration had been effected.

Technical details

A bass reflex system of compact dimensions, the *330* uses a 200m pulp-cone bass-mid unit and (if the enclosure is positioned vertically), two horizontally angled c.75mm tweeters. A simple crossover is included, the input connections made via binding posts on the rear panel. A large ducted vent is fitted, this tuning the system to a fairly high resonance.

Lab results

Above 15kHz the pair matching was erratic due to interference effects on the response curve, but below this frequency the matching was judged as very good. A high 92dB reference sensitivity was recorded, in no way prejudiced by the impedance, and the speaker was also rated as presenting a 'good' amplifier load, as no value below 7ohms was recorded (the old version measured 5.5Ω at 10kHz.)

Quite good third harmonic distortion curves were demonstrated at the higher 96dB test level, typically 0.5-0.6% up to 1.5kHz. A good 1.3% was measured at 50Hz but values rose at lower frequencies, for example to 25% at 30Hz, so a low filter on the amplifier at 40Hz would not come amiss under high level drive conditions.

The trend showed a tilted up response, suggesting that shelf mounting would give the best subjective mid balance, albeit at the expense of increased room coloration relative to a stand location. An axial prominence 6dB high was evident at 2.5kHz.

Out at 2 metres with $\frac{1}{3}$-octave averaging the curve should have smoothed out sufficiently for the characteristic balance and uniformity to be classified. However, considerable variation was exhibited by the three curves, with the 10° vertical traces the best. Averaging through these forward responses, the forward energy can be seen to be fairly even, but the actual perceived frequency balance changes rapidly with angle. Noteworthy was the limited band-width of the system.

Sound quality

The *330* scored an 'acceptable' or 'below average' rating for sound quality which is not impressive, even taking into consideration its price.

While the system offered a high sensitivity and will thus work with amplifiers of as little as 10 watts per channel, the maximum sound was found to be limited to a nonetheless fairly loud 101dBA, above which the quality rapidly deteriorated.

The *330* coped better on the live sound comparisons, achieving an 'average' rating. While moderate power inputs caused minor

rattles, the speaker went on to accept a very high 100W average of electric bass guitar and sounded surprisingly good — a clear affinity is indicated here! The treble range was disliked by some panellists who noted 'brittle', 'brash,' 'sizzle,' and 'accentuated' comments, but felt that it was lacking in very high frequencies. 'Boxy,' 'tubby,' and 'hard' effects were also heard.

Image quality was fairly weak, particularly at the higher frequencies, and on these stereo tests, the overall quality was ranked as 'poor'. Numerous colorations were described and the restricted bandwidth was also apparent.

T.F. Comment

I found this speaker rather fatiguing, with considerable mid band coloration and weak imaging. Although capable of high sound levels, it was harsh in the top and not to my taste.

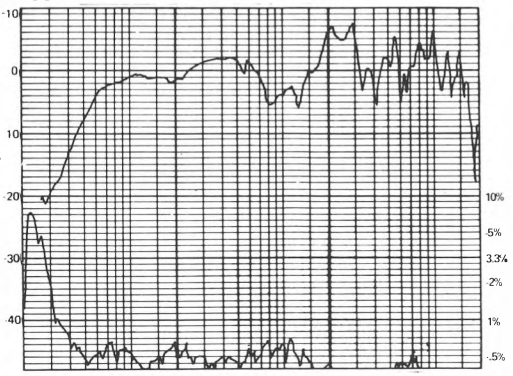
Summary

This loudspeaker's strong point was undoubtedly its powerful handling (by hi-fi standards that is) of electric bass guitar, and this suggests that if realistically loud sound levels on relatively punchy rock programme is the prime objective, the moderately priced *330*s might fit the bill, particularly in view of their modest amplifier requirements.

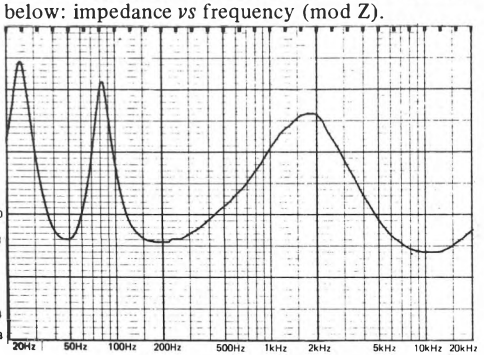
Size	53.3(21) H; 34.3(13.5) W; 22.3(9) D; cm(inches)
Weight	15.5(34) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 50W
Recommended placement	shelf
Frequency response within ±3dB (2m)	NA*
Low frequency rolloff (—6dB) at (1m)	55Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	92dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA*
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	good
Forward response uniformity	average
Typical price per pair inc. VAT	£146

*See text.

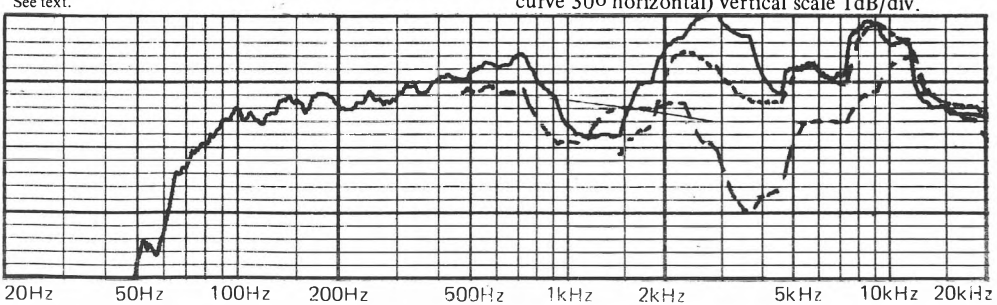
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).

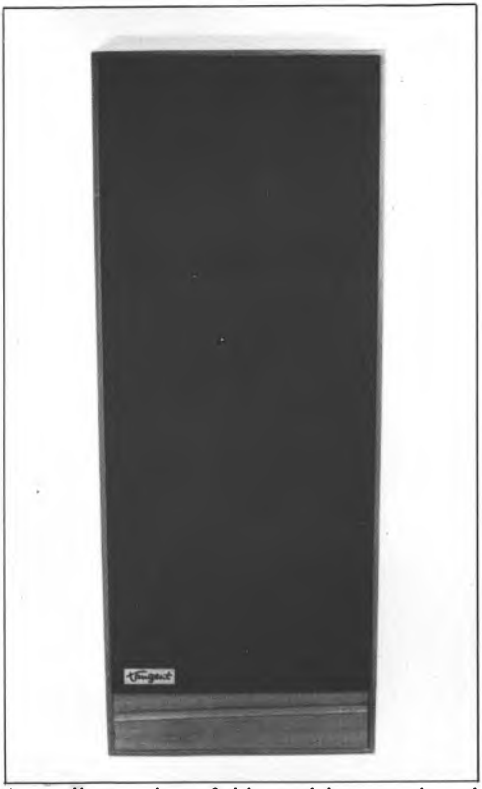


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Tangent RS6

Tangent Acoustics Ltd., Viking Way, Bar Hill, Cambs. CB3 8EL. (0954) 81377.



An earlier version of this model was reviewed in the previous volume, where readers may recall that a steep phase notch was noted in the response curve at the lower crossover frequency. A similar result was in fact obtained with our newer samples, and led us to contact Tangent. They explained that at the time of supply the *RS6* was in great demand, and they sent us whatever pair they could find; suspicious of the bass unit, they had replaced the units in both enclosures, inadvertently wiring them out of phase. This mistake was not detected prior to shipping the speakers to *Choice,* and to resolve the matter we were sent, to quote, 'correct specimens delivered fresh from the line'.

Technical details

Previously recommended for floor mounting, the *RS6* is now designated as suitable for use on an open stand. This enclosure uses two versions of the Son Audax 200mm bextrene-cone driver, one for bass (reflex loaded by a square duct) and the other for midrange. As the latter is not isolated at the rear, it is effectively acoustically coupled to the bass unit. The treble range is alloted to a KEF 19mm plastic-dome tweeter.

Lab results

An excellent pair match was shown, within 0.5dB throughout. However sensitivity was undoubtedly low at 84dB and the —6dB LF point at 51Hz was disappointing for this size of enclosure.

On measurement, power handling problems were evident, which were later confirmed during the listening sessions. The choice of drivers and loading technique seems to have resulted in considerable third harmonic distortion at the lower frequencies; in contrast, the *RS2* uses the same bass unit but is free of this effect. At 150Hz the *RS6* showed a fairly high 1.5%, below which 3% at 100Hz, 12% at 50Hz and a 'mythical' 100% at 40Hz were recorded. At higher frequencies it was still in doubt, measuring 0.8% at 300Hz and at 1.2kHz.

The 1 metre sine wave trace shows the first and second samples, the former demonstrationg a suckout 24dB deep at 300Hz. While this is cured on the later curve, a 3-4dB hump is now present, and the trend is that of a 'rich' frequency balance, tilting down towards the HF. At 2 metres it can be seen that the low bass is restricted, with the upper bass accentuated by comparison. A strong downtilt is apparent in the response, amounting to 6dB over the 200Hz-20kHz spectrum and a suckout is also evident in the lower treble, near 6kHz. The off-axis curves however demonstrated good integration and consistency.

Sound quality

Scaled to the new samples, the *RS6* achieved only an 'average' rating for overall sound quality, which is somewhat disappointing at its price level. The panel verdict on the domestic stereo tests was critical, with coloration effects, together with a strong recess in the treble robbing the system of 'immediacy', 'airiness', and 'openness'. In contrast, the upper ranges of the orchestra was distant and muted. Mid coloration included

moderate 'boxy', 'hollow', and 'honky' effects, and the bass was accentuated and lacking in depth. The coloration was clearly exagerated by the overall dull balance.

Better marks were awarded on the live sound comparisons, although some limitations were noted on the power handling tests. A modest 96dBA proved to be the subjective quality limit on our test progamme, this corresponding to a 100W peak input. The bass guitar did not sound particularly accurate, and inputs in excess of a 5 to 8W level resulted in overload. Voice rendition was 'chesty', slightly 'boxy' and generally too dull, and this pattern was repeated on most instruments and sounds.

T.F. Comment

The apparent lack of top and general bass wooliness spoilt this system for me, making the live comparisons rather disappointing

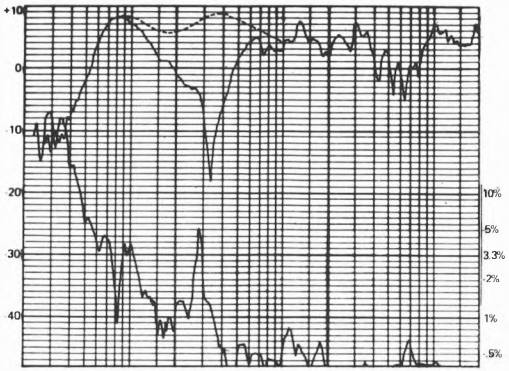
Summary

While it is possible that the *RS6* might produce fair results with a bright disc playing system in a 'live' room, under the controlled conditions for *Hi Fi Choice,* the results were not satisfactory. In addition to coloration effects, notable power handling difficulties existed, the latter exacerbated by the system's low sensitivity.

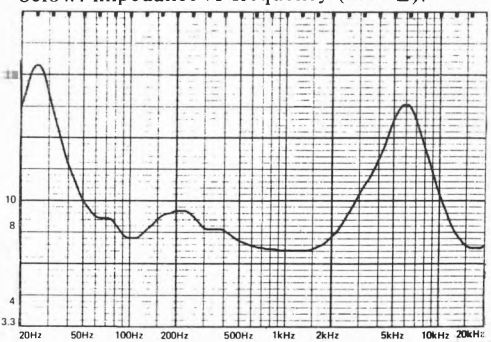
Size	80.1(31.5) H; 30.5(12) W; 31.5(12.4) D; cm(inches)
Weight	18(39.6) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 50W
Recommended placement	stand
Frequency response within ±3dB (2m)	60Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	51Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	84dB at 1m
Approximate maximum sound level (pair at 2 metres)	96dBA*
Third harmonic distortion (96dB at 1 metre)	poor*
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£325

*See text.

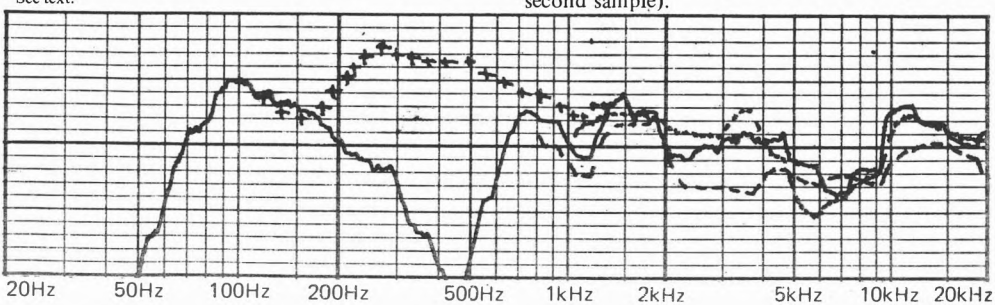
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB). (dotted curve second sample).



below: impedance *vs* frequency (mod Z).



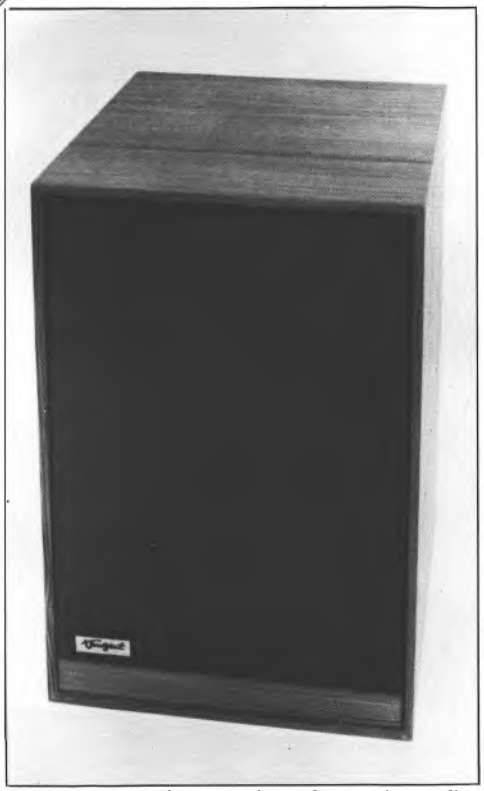
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal, curve marked + represents second sample).



RECOMMENDED

Tangent RS2

Tangent Acoustics Ltd., Viking Way, Bar Hill, Cambs. CB3 8EL. (0954) 81377.



A compact enclosure, the *RS2* carries a five year guarantee in common with the *RS6*, both systems being designed and built in the UK. The *RS2* is rated for use with amplifiers of up to 60 watts per channel, and no response controls are included.

Technical details

A two-way design, the enclosure is of the sealed box type. A 200mm bextrene-cone bass-mid unit (Audax) operates up to 3.5kHz, above which a KEF 19mm plastic-dome unit continues. Thick foam absorption is provided within the enclosure, but the walls themselves are not damped. A 10-element crossover using good quality components is incorporated. Only four screws are used to fix the driver baffle, which might account for the minor buzzes heard in one test.

Lab results

Pair matching could have been better, with up to 1.5dB difference noted in the midrange. The reference sensitivity was low at 83dB, although the —6dB LF point at 45Hz was good for this size of enclosure, this aligning with the system resonance at 60Hz. With a minimum impedance value of 6.5 ohms at 15kHz, and the reactive components well controlled, the system clearly offered a 'good' amplifier load.

Third harmonic distortion readings were very good, vastly better than for the larger *RS6*, with typical values at 0.6% or less from 100Hz upwards. Even at 50Hz a moderate 3% was recorded, this at the relatively high 96dB test level.

The 1 metre sine wave trace showed a fairly even trend, but with a small mid prominence, a presence band suckout, and a mildly erratic treble range. Moving out to a 2 metre mike position, the characteristic responses demonstrated a mild 4dB trough above 400Hz, which left the region above, 700Hz- to 2kHz, a trifle prominent, and with a —6dB presence dip beyond that. The off-axis responses however showed fine uniformity and integration referenced to the axial trend.

Sound quality

Overall the *RS2* scored 'above average' which is a notable achievement at the price. Faring best on the domestic stereo sessions, the imaging was highly rated with precision and depth both apparent. Some moderate colorations were noted, these partly associated with the mild reponse irregularities previously mentioned. The panellists commented upon treble lift and low bass deficiency, with 'small', 'fizz', 'chesty', slight 'box', 'hard' and 'presence dull' effects noted.

Scoring a reasonable 'average' on the live comparisons, a loud 104dBA was raised on the high level test, the speaker accepting the 500W peak input without distress. While minor buzzes and chuffing was heard, the bass performance was also commendable; up to 50 watts average of electric guitar could be applied before overload though the sound lacked some low frequency differentiation. The speaker at times appeared muffled and yet it generally gave a good rendition of musical detail; as with the *Sony G5*, panel opinion was divided, some favouring the sound while others did not.

RECOMMENDED

T.F. Comment

In the stereo tests I found this speaker very easy to listen to, albeit with a slightly 'wiry' top. The bass boomed a little, but the image remained well-focussed.

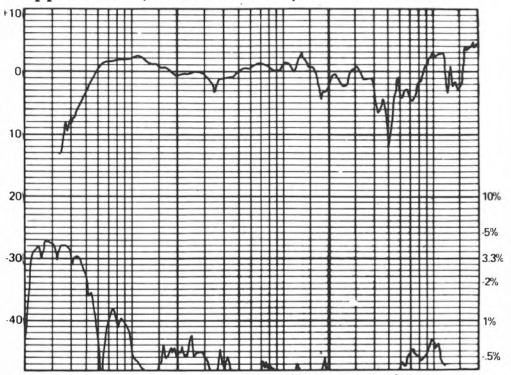
Summary

The *RS2* was easy to drive and has a good power handling capacity, which is essential when its low sensitivity is taken into consideration. A glance at the comparator table reveals that it achieved good ratings on many aspects, sufficient to gain a recommendation at the price; in fact, by the standards of this report, its performance comfortably exceeded that of its larger brother, the *RS6*.

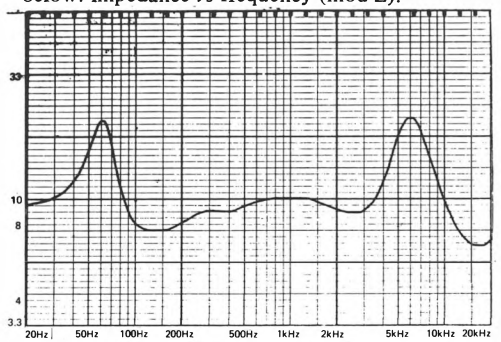
Size	37(14.6) H; 25.5(10) W; 28.5(11.2) D; cm(inches)
Weight	4(8.8) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	NA*
Low frequency rolloff (—6dB) at (1m)	45Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	83dBat 1m
Approximate maximum sound level (pair at 2 metres)	104dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	good
Forward response uniformity	good
Typical price per pair inc. VAT	£162

*See text.

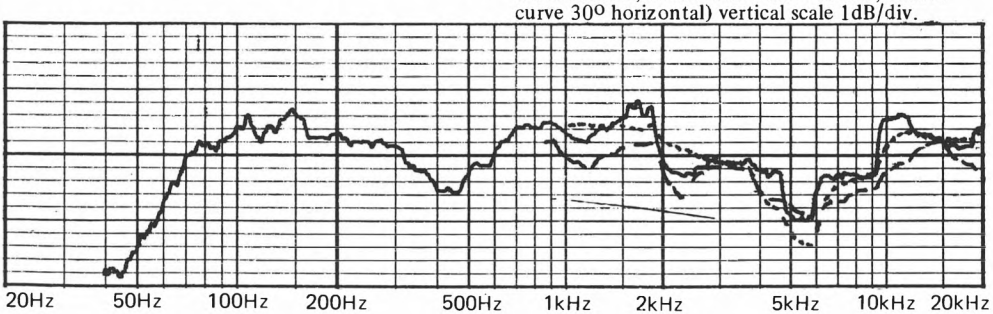
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Technics SB6000

National Panasonic U.K. Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR. (0753) 34522.

Belonging to the well known group of Technics 'linear phase' systems, the *SB6000* is a substantial two-way design. While it is large enough for floor mounting, the instructions do suggest that its placement on open blocks or a stand will increase the clarity of the bass sounds. An adjustment is provided for attenuation of the treble range should this be required, and the quoted system sensitivity is high, allowing smaller amplifiers to produce high sound levels.

Technical details

Bass-mid coverage is achieved by a 305mm pulp-cone driver of excellent constructional quality working up to 1.5kHz. The range beyond is handled by a 32mm fabric-dome tweeter, which is set back relative to the bass driver frame in order to bring it into time and phase alignment. The solid enclosure is reflex loaded by a slot vent, which offers broadened tuning.

Lab results

The left and right enclosures matched closely to within 1dB. Confirming the specification, the reference sensitivity was a high 93dB, this aligning with a fairly hgih —6dB LF point (for this volume enclosure) at 50Hz. The impedance characteristic suggested that an 'acceptable' amplifier loading was justified, as two minima of about 4.5 ohms were present at 1kHz and 7kHz, with the mean value at 5.5 and significant reactive components also measured in places.

The third harmonic distortion results were good, though the 0.7-0.9% rise in the mid-range, 600Hz-1kHz, caused mild concern. Outside this band the results were excellent, with nothing of significance measureable at all at the lower frequencies.

While 1 metre sine wave response is rather an unfair measurement for this kind of speaker, it does tell us something. A dominent rise in response with frequency was evident, notably a 6dB increase from 60Hz-600Hz. The latter frequency was emphasised by the following mild trough, and the treble range was also none too even, with a 4dB hump at 15kHz.

At 2 metres the response should be better integrated, but the curve showed the 600-700Hz region to be dominant, at +5dB above the mean level. However, the characteristic was more uniform elsewhere, but with a tendency to depression in the treble range, particularly in the presence area. The 10° vertical response was not too good, but the 30° lateral was rather better controlled, and was surprisingly good in view of the large diameter of the main drive unit.

Sound quality

This louspeaker was ranked as 'average' on an overall sound quality basis, which is not encouraging considering the price level.

Described as relatively poor on the stereo listening sessions, its imaging was however considered reasonable. Coloration was unfortunately rather evident; 'boxy', 'middy', 'hollow', 'shut-in', 'fizz', 'wooden', 'hard', 'thick', 'sibilant' and 'chesty' effects were all described, with the uneven frequency balance more than obvious to most panellists.

It fared rather better on the live sound sessions, scoring an 'above average' rating,

this in part due to its strength on the loudness and bass power handling tests. A very loud 108dBA was possible, and this was attained using only 150W peak. Furthermore it withstood 100W average of electric bass guitar without complaint, generating a clean, powerful and accurate bass sound. On the other comparisons however, the comments on coloration were repeated, with 'boxy', 'dull', 'tubby' and 'middy' effects all in evidence.

T.F. Comment

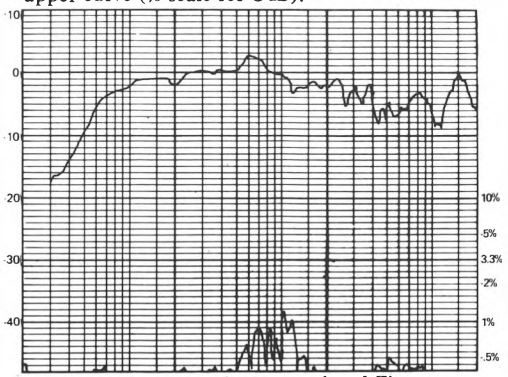
I placed this system below average because of a rather tubby quality in the bass, and a slightly confused stereo image at my (central) position; general response unevenness was also apparent.

Summary

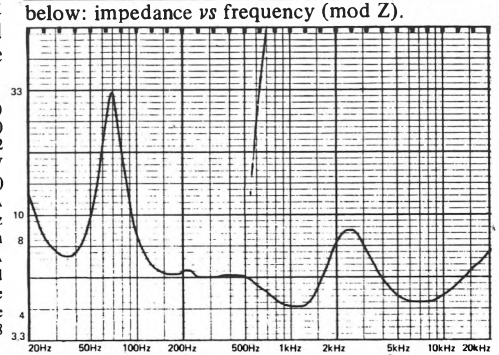
The *SB6000* possesses some good features, notably a clean, powerful bass, good stereo imaging, high sensitivity, and an even lateral frequency response. On the other hand it represents a fairly severe amplifier load and is somewhat colored by the standards of the test group; as a result, its only average sound quality ranking coupled with its high price precludes a recommendation.

Size	84.6(33.4) H; 42.5(16.8) W; 34(13.4) D; cm(inches)
Weight	25(55) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 150W
Recommended placement	floor (stand?)
Frequency response within ±3dB (2m)	NA
Low frequency rolloff (—6dB) at (1m)	50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	93dBat 1m
Approximate maximum sound level(pair at 2 metres)	108dBA
Third harmonic distortion (96dB at 1 metre)	good
Impedance characteristic (ease of drive)	acceptable
Forward response uniformity	average
Typical price per pair inc. VAT	£418

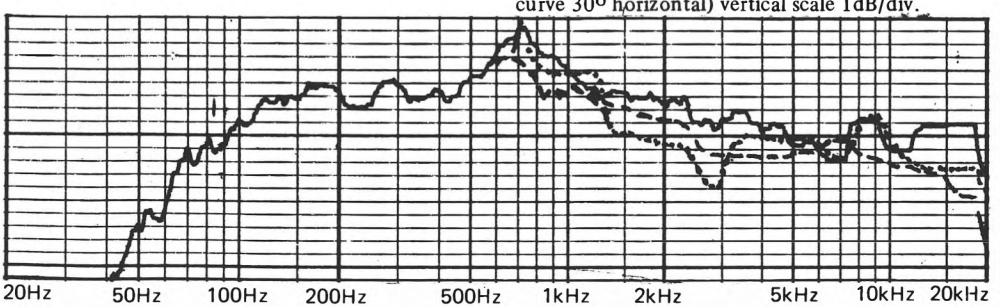
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Visonik David 50

Uher Ltd., 28 Spencer Street, St. Albans, Herts. AL3 5EG. (0727) 30236.

Misgivings were expressed as to whether this diminutive loudspeaker could lay any real claim to enter a hi-fi survey such as this. In volume it would take four Visoniks to make up one *LS3/5A,* and that system is small enough! On test no concessions to its size were made, bar the reduction of the distortion test level to 86dB, but in the event, enough good points were revealed to warrant serious attention.

Technical details

Possessing an internal volume similar to a large breakfast cup, this two-way sealed box design incorporates a 70mm long-throw bass-mid unit, and a 19mm fabric-dome tweeter, these two together occupying the entire front plate of the enclosure. An LED power overload lamp is fitted, this being a necessary safeguard, as the speakers were found to accept considerable power without audible distress.

Lab results

Very good pair correspondance was shown, within 1dB throughout. The reference sensitivity was very low at 83dB (only to be expected of such a small enclosure), but was not unduly compromised by the low impedance which measured typically 5.5 ohms, with minimum of 4 at a relatively unimporant 20Hz. An 'average' amplifer loading was applicable, the system resonance being at a high 135Hz, with the —6dB LF point at 95Hz.

Noting the 10dB reduction in test level, the third harmonic distortion results were good, except for an 0.8% peak at 1.5kHz. The third harmonic distortion values were at the threshold level (the noise floor is due to the lower output from the this speaker) and did not rise significantly until 100Hz, reading 1%. Even at 50Hz a reasonable 4% was recorded.

While the sine wave response was generally flat, a noticeable +5dB rise occured at 20kHz, as well as a rolloff below 100Hz and a gentle uptilt of output with increasing frequency — in other words a 'light' balance.

At 2 metres the LF range could be seen to fall away rapidly with a hump at 200Hz under these anechoic conditions. Mounted flush in a wall of books, this rolloff may at least be subjectively restored to a large extent. As expected, the tiny enclosure demonstrated superb off-axis dispersion and integration, the 30° lateral curve, for example, barely distinguishable from the main axial trend.

Sound quality

Such a speaker could not be expected to excel in a test of this sort, due to the great technical limitations imposed by its small size. However, it scored an 'acceptable' overall rating, with its stereo image commended, and in view of price and more particularly size, this result should be seen as outstanding.

This game little box withstood 500W peak without damage, attaining a respectably loud 98dBA in virtually free field conditions. Though light and thin with only the harmonics effectively reproduced on electric bass guitar, the *502* tolerated 15 watts average input before overload, and was free of buzzes and rattles up to this point.

It sounded worse on the stereo sessions

where its obvious lack of bass and thin balance excited censure. Coloration was however fairly good — mainly of the 'small box' type, and the clarity was always excellent. The emphasis in the high treble did not pass unnoticed, and did exaggerage distortion somewhat, with some 'tizz' also ascribed to the sound.

T.F. Comment

Except for the stereo image, this speaker did not fare particularly well, due to an apparent complete absence of bass. Extreme treble also seemed rather excessive, producing 'birdies'.

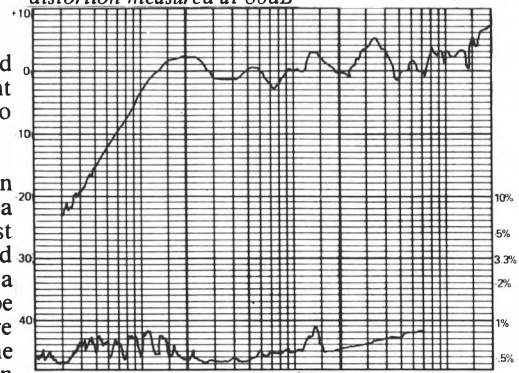
Summary

Some might regard the *502* as a joke, but in context it did not fare all that badly against a large number of vastly bigger and in most cases costlier models. Its sound quality and light balance do not permit a recommendation, but conversely it cannot be dismissed out of hand. In circumstances where a 'visible' loudspeaker cannot be tolerated, the 502 offers an alternative; moderately driven with some treble cut and mild bass lift, fitted close to a wall or in a shelf of books, a reasonable sound quality is possible, with very little loss of midrange or treble detail.

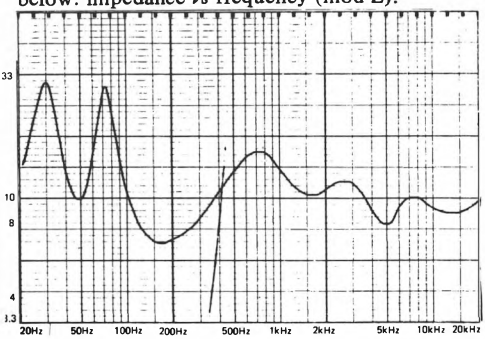
Size	17(6.7) H; 10.3(4) W; 10.7(4.2) D; cm(inches)
Weight	2.5(5.5) kg(lb)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	30 to 100W
Recommended placement	shelf
Frequency response within ±3dB(2m)	130Hz to 20kHz
Low frequency rolloff (—6dB) at (1m)	95Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	83dB at 1m
Approximate maximum sound level (pair at 2 metres)	98dBA*
Third harmonic distortion (96dB at 1 metre)	good*
Impedance characteristic (ease of drive)	average
Forward response uniformity	v. good
Typical price per pair inc. VAT	£115

*See text.

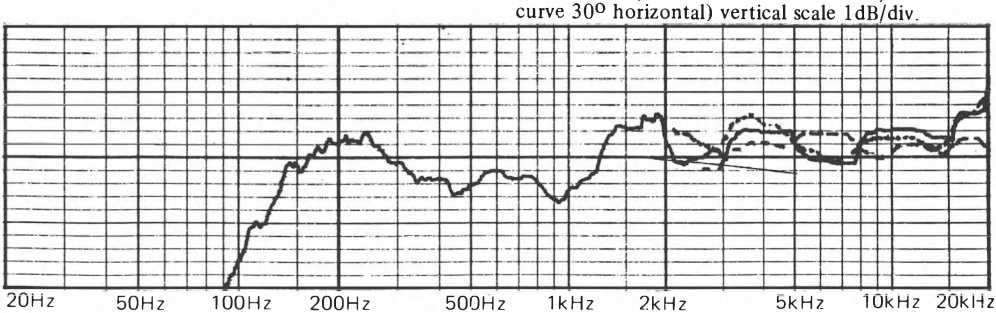
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.
distortion measured at 86dB



below: impedance *vs* frequency (mod Z).

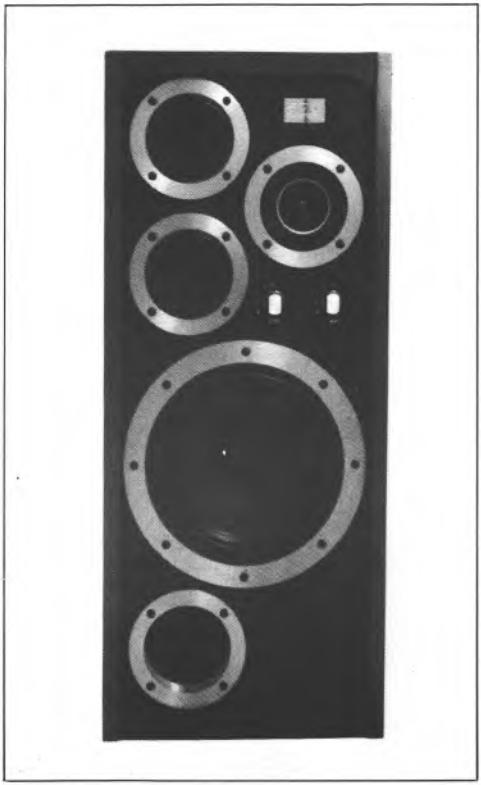


below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



Wharfedale E70

Rank Hi-Fi, PO Box 70, Great West Road, Brentford, Middx. TW8 9HR. 01-568 9222.



This relatively expensive loudspeaker sets out to offer a high sensitivity, and consequently it will achieve good sound levels with a comparatively modest amplifier input; in fact the comparator table shows its sensitivity to be the highest of the entire group. A relatively tall enclosure, a floor position is indicated although mounting on a small stand did offer a slight subjective improvement in the upper bass range.

Technical details

An unusual design, the enclosure is reflex loaded by a large vent with a short duct. A 250mm pulp-cone driver covers bass to low-mid frequencies, the crossover to a pair of 100mm mid units occuring at 800Hz. A horn-loaded 25mm hard-dome tweeter operates above 7kHz, this laterally mounted with respect to the mid units. A good quality if simple 6-element crossover is employed, with a further 13 elements used for the versatile 'contour' frequency balance controls.

Lab results

A good pair match was shown by the *E70s* except in the 2-7kHz range, where up to 4dB mismatch occurred. This was partially due to the inherent character of the speaker itself, ie its variability of output with axis. A very high 94dB sensitivity was recorded — right on spec — with a correspondingly restricted low frequency range, the —6dB LF point occuring at 56Hz. Low reactive elements were present in the impedance and a typical value of 10 ohms was recorded, with a minimum fractionally below 7 at 150Hz. The speaker was thus easy to drive.

Third harmonic distortion was quite good in the mid range, at 0,6% from 200Hz-3kHz, but quickly rose to 4% at 150Hz. It improved at lower frequencies, measuring 1.5% at 50Hz, before rising rapidly again to 10% at 40Hz; a low filter is thus to be recommended. In fact, considering the very low power input required to produce the test level, the distortion does seem a little on the high side.

On sine wave at 1 metre mike spacing, an even rising response trend was apparent with a total lift of 8dB from 60Hz-2kHz, suggesting that the speaker might balance better when backed against a wall. Irregularities were present in the crossover region, and on this near ideal axis, the HF fell away above 15kHz. At 2 metres the outputs were better integrated, illustrating a generally smooth if unbalanced character. The 30° off-axis traces were weak, demonstrating marked asymetry between left and right directed axes, the significance of which was realised when the results of the listening tests were analysed.

Sound quality

With the controls set to 'zero' for all our tests, the *E70*s developed maximum efficiency, but upon experimenting we found they actually sounded better on the 'minus 2' settings, this agreeing with Wharfedale's curves printed on the loudspeaker rear panel.

Taken overall, this speaker scores about average on sound quality. In mono and compared with live sounds, it did fairly well, producing a surprisingly limited (in view of the high sensitivity) but still loud 103dBA maximum. Problems were apparent in the

bass — the electric guitar sound was 'altered' and it would not attain high volumes. Coloration comments included 'hard', 'steely', 'fizz', 'bright', 'LF distortion', 'HF ringing', poor driver integration and 'hollow' effects.

On the stereo tests the situation was much the same, with comments of 'metallic', 'sibilant', 'thin', 'HF directional', 'tizz' and 'honky', effects together with lack of extreme treble. It did produce a satisfying degree of musical detail, but stereo image problems were evident.

T.F. Comment

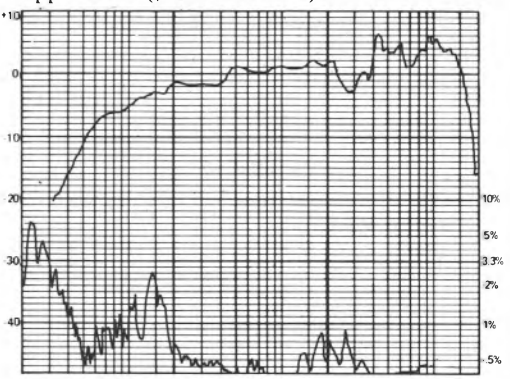
I found this system below average overall, mainly because of a serious dispersion problem; stereo image change dramatically with head movements, as did the treble balance. An overall treble boost was apparent, giving a feeling of loudness, but not without some discomfort.

Summary

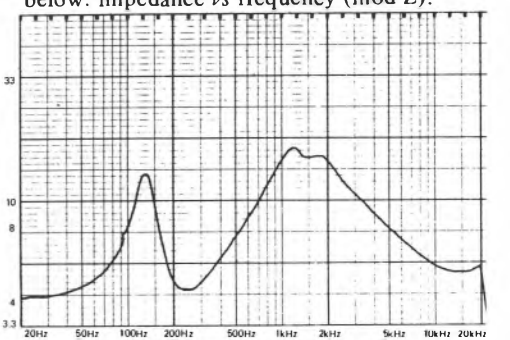
While it could not be driven particularly hard, the *E70* produced quite high levels on modest inputs; for example, a 100 watt peak produced 103dBA from a pair at 2 metres. The stereo image problem is undoubtedly its main weakness, and could be improved by the simple expedient of providing mirror pairs.

Size	81.5(32) H; 34.2(13.5) W; 36(14) D; cm(inches)
Weight	32(70) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	10 to 75W
Recommended placement	floor
Frequency response within ±3dB (2m)	150Hz to 15kHz
Low frequency rolloff (—6dB) at (1m)	56Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	94dB at 1m
Approximate maximum sound level (pair at 2 metres)	103dBA
Third harmonic distortion (96dB at 1 metre)	acceptable
Impedance characteristic (ease of drive)	v. good
Forward response uniformity	average
Typical price per pair inc. VAT	£345

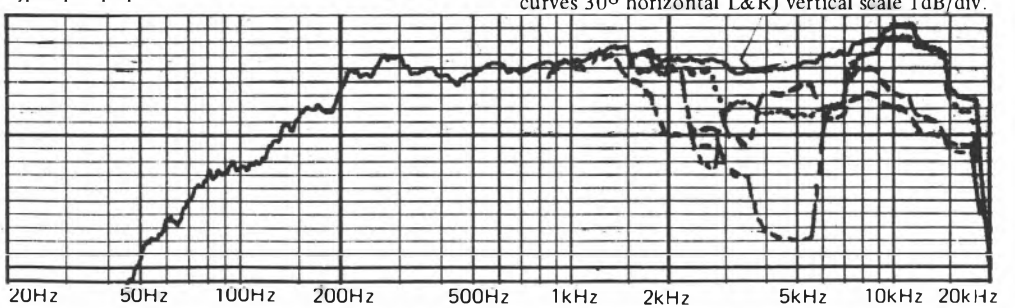
below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).



below: impedance *vs* frequency (mod Z).



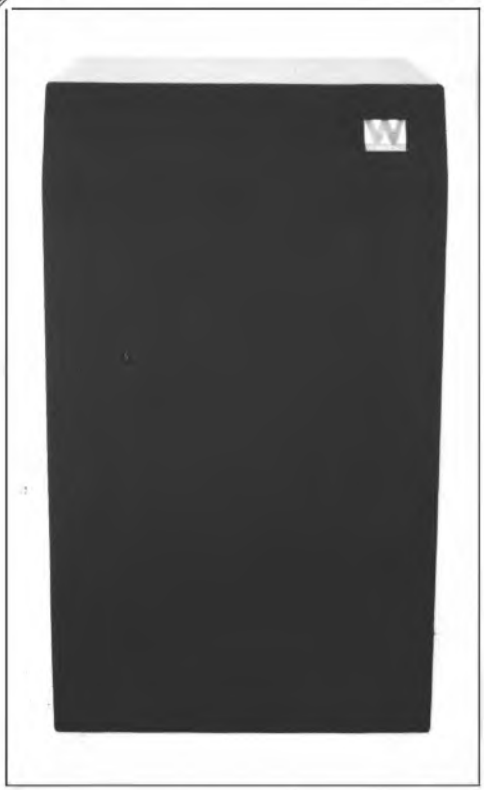
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical dashed curves 30° horizontal L&R) vertical scale 1dB/div.



RECOMMENDED

Wharfedale Teesdale

Rank Hi-Fi, PO Box 70, Great West Road, Brentford, Middx. TW8 9HR. 01-568 9222.



A recently introduced model from Wharfdale, the *Teesdale* is a full three-way system which sells at a very modest price. The HF unit incorporates a type of isodynamic ribbon element patented by Rank, all three drivers being of Wharfedale's own manufacture.

Technical details

The 200mm bextene-cone bass unit is loaded by a reflex enclosure, the latter tuned by a substantial ducted port. Mounted above is the established Leak/Wharfedale 100mm bextene-cone midrange unit, this operating over the 800Hz-5kHz range. Above 5kHz, the new ribbon tweeter takes over, the longer dimension of its rectangular window being vertically mounted, in order to maximise the lateral directivity. For the same reasons, all three drivers are positioned vertically-in-line.

Lab results

A fine 1dB match was shown throughout, with the reference sensitivity established at an average 88dB, and a usefully low —6dB cutoff point at 40Hz. Some reactive components were present in the impedance curve and this fact, together with a nominal value of 6 ohms plus a dip to about 4 ohms at 12kHz, means that only an 'acceptable' loading characteristic was indicated.

Apart from a minor rise in third harmonic distortion to 0.8% at 2kHz, and a suspicion of some distortion at the edge of the frequency band at 12kHz, the distortion values were low, right down to 70Hz. At 55Hz a fine maximum value of 1.5% was recorded, with no further deterioration occurring until 30Hz. Considering the 96dB test level, these are good results.

An extended, even and accurately tuned low frequency band can be seen on the reference trace, but a small prominence does occur at 600Hz, followed by a 2dB trough to 3kHz and a mildly erratic treble beyond.

At 2 metres with $\frac{1}{3}$-octave averaging, the characteristic trace showed a pretty even trend, albeit with a touch of lift at 700Hz, and some further boost from 4-7kHz. 10° above axis an 8dB notch near the upper crossover point appeared, so for the best results the listener should face the mid unit. In the lateral plane the 30° off-axis curve was very good, and due to the HF unit geometry, it is actually better maintained at 15kHz than was the 10° above response.

Sound quality

On an overall sound quality basis the Teesdale scored 'good'; in other words an 'above average' rating which is a fine result at the price. On the live sound sessions a fairly loud 101dBA was raised, with 500W peak input causing no audible problems. However, its handling of electric bass guitar was weak, with power inputs in excess of 5-8 watts average causing overload. The bass quality up to hits point, however, was described as clean, deep and even in character, if not very loud. Colorations included comments of 'boxy', 'treble bright' and 'breathy treble', with slight 'metallic' and 'presence dull' effects.

The stereo imaging was fairly good, but it lacked some depth, and on occasion it was felt to be 'hazy'. During these sessions the colorations were heard more keenly, giving rise to comments of 'middy', 'boxy', slight

RECOMMENDED

'fizz', 'nasal' and 'boomy' effects, with a thickening of the sound at certain frequencies. Detail however was good.

T.F. Comment

This system worked well in all respects, with somewhat limited bass power-handling and a slightly 'pinched' sound on human voice; nevertheless well liked.

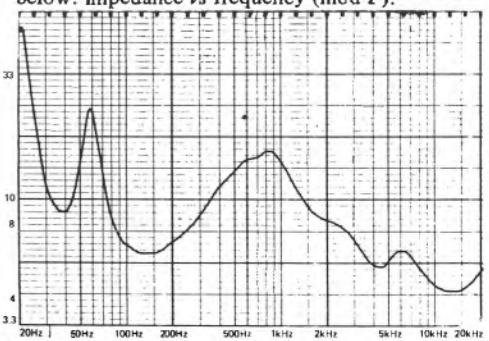
Summary

This inexpensive loudpeaker has some strong points, notably an extended bass response, marginally above average sensitivity with a pretty uniform frequency balance and fairly low coloration, while its loading requirements mean that a 4 ohm type amplifier is to be preferred to provide a good match. Considering its price and all that it offers, it is certainly worthy of a recommendation.

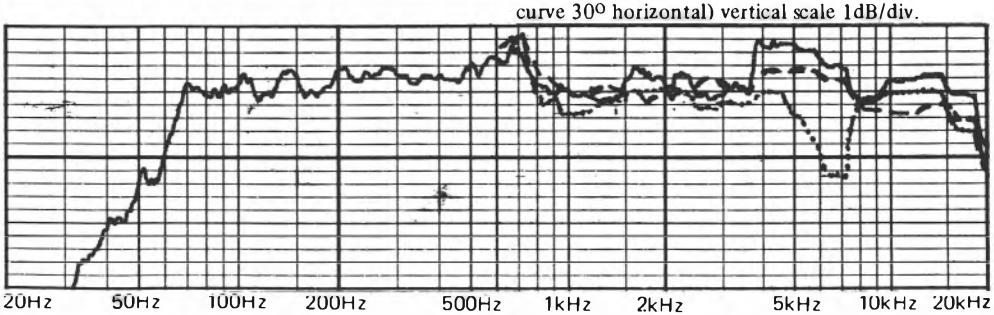
Size	57.8(22.8) H; 34(13.4) W; 27.8(11) D; cm(inches)
Weight	14.1(31) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)	15 to 100W
Recommended placement	stand
Frequency response within ±3dB (2m)	65Hz to 17kHz
Low frequency rolloff (—6dB) at (1m)	40Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)	88dB at 1m
Approximate maximum sound level (pair at 2 metres)	101dBA
Third harmonic distortion (96dB at 1 metre)	v. good
Impedance characteristic (ease of drive)	acc.
Forward response uniformity	good
Typical price per pair inc. VAT	£130

below: upper curve 1m sine wave reference; lower curve 3rd harmonic distortion ref upper curve (% scale ref OdB).

below: impedance *vs* frequency (mod Z).



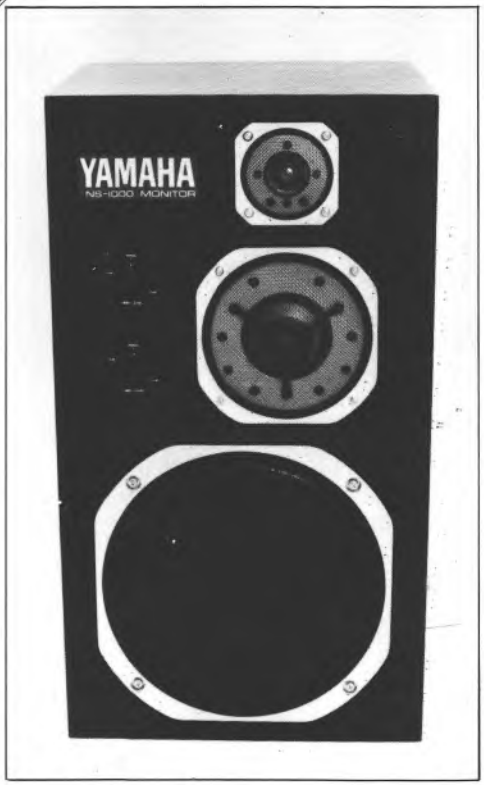
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



RECOMMENDED

Yamaha NS 1000M

Natural Sound Systems Ltd., 10 Byron Road, Wealdstone, Harrow, Middx. 01-863 8622



Reviewed in the previous issue of *Loudspeakers*, the *NS1000M* was included in this report partly to provide an element of continuity and parly to permit a comparison to be made between two test and listening programmes.

A relatively compact loudspeaker that can be used on stands or on a substantial open shelf, it is very sturdily constructed. While tests were conducted with the controls set 'level', we subsequently came to the conclusion that the '10 o'clock' position for the mid control gives the most pleasing balance, and that the listener should be on the mid axis, as an above axis position imparts a response suckout in the presence region.

Technical details

A sealed box design, a 300mm bass driver operates up to 500Hz crossing over to a 85mm beryllium-dome mid unit with a hollow pole piece and an absorbent chamber. At 6kHz another beryllium driver takes over — a 30mm unit with a phase correcting assembly.

Lab results

Pair matching was excellent at 0.5dB up to 12kHz, and within 1dB beyond. A high (particularly for a sealed box design) 90dB sensitivity was recorded, with the —6dB LF point at an early 50Hz, despite the system resonance being placed at 40Hz. (This proves that the low frequency end is overdamped, and bass lift may be applied.

A minimum impedance of 4.8 ohms was recorded at 120Hz, the typical value being 6, and with low reactive effects the system gained an 'average' loading classification. Above 200Hz the distortion on the third harmonic readings was below threshold. It rose gently at the lower frequencies to a still fine 0.6% at 100Hz, 1.2% at 50Hz and a maximum of 3% at 30Hz.

The 1 metre sine wave response was very even from 60Hz to 16kHz, but showed a mild mid prominence (this controlled by the 10 o'clock mid setting), with the early but slow low frequency rolloff clearly visible.

Out at 2 metres the 10° above response showed why the mid unit should be at ear level, or at least angled towards it. A mild hump at 300Hz was visible on axis, together with a slightly prominent 500Hz to 12kHz range. The HF was uniform to 16kHz, rolling off slowly beyond, but on the 30° lateral axis, the uniformity was fine, showing excellent integration in this plane.

Sound quality

The *NS1000M* matched its previous high quality ranking, even if it has not achieved quite the same level of commendation. Overall a 'very good ' sound quality was denoted, going a long way towards justifying the high price.

It did its best on the live sound comparisons, reaching a high 107dBA, and accepting a 500W peak input without audible breakup. It showed excellent power handling on electric bass guitar, with up to 75 watts average tolerated without distortion and while the bass character was lacking some warmth on the 'E' string, an even and powerful output was obtained. The mild colorations noted were 'dull', 'hard', 'tizz', and 'middy', together with a 'thin' balance.

RECOMMENDED

Scoring 'above average' on the stereo sessions, this Yamaha exhibited fine imaging and excellent rendition of musical detail. Some panellists were sensitive to a mid prominent hardness and brittleness which is a known feature of the *NS1000M,* and cannot be wholly alieviated by adjusting the mid control. Colorations were more readily perceived under these conditions, and included mild 'cup', 'nasal', 'hard' and 'presence dull' effects, with slight 'tube' and 'fizz' comments also apparent. One panellist felt that it might prove fatiguing.

T.F. Comment

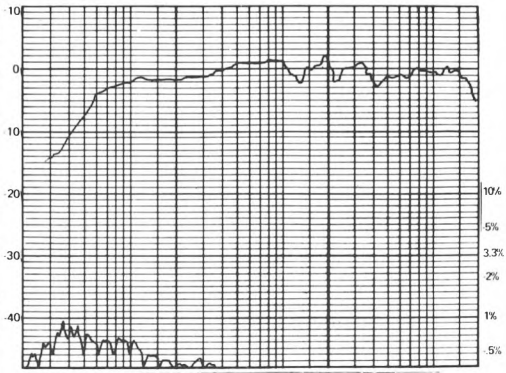
I found the *NS 1000*s above average in all respects, with slight hardness and brittleness, particularly noticeable at higher volumes. A good system at a high price.

Summary

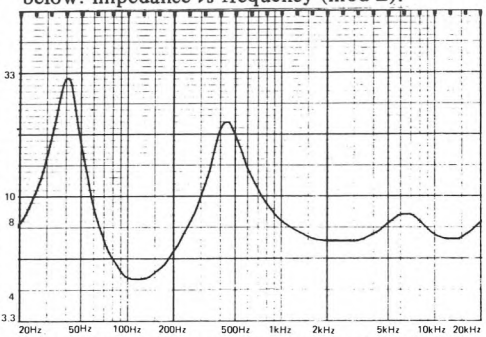
The *NS1000M* is clearly a very fine if expensive loudpeaker. It gains a recommendation despite its price, but with some reservations concerning is potential hardness and fatiguing properties — not severe, but sufficient to exite comment by one or two panellists. It can offer high volumes, with very clean if overdamped bass, and is both beautifully engineered and constructed.

Size . . . . . 67.5(26.5) H; 37.5(14.7) W; 32.6(12.8) D; cm(inches)
Weight . . . . . 31(68. 2) kg(lbs)
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) . . . . . 20 to 200W
Recommended placement . . . . . high or tilted stand
Frequency response within ±3dB at (2m) . . . . . 80Hz to 16kHz
Low frequency rolloff (—6dB) at (1m) 50Hz
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) . . . . . 90dB at 1m
Approximate maximum sound level (pair at 2 metres) 107dBA*
Third harmonic distortion (96dB at 1 metre) . . . . . excellent
Impedance characteristic (ease of drive) . . . . . average
Forward responseuniformity . . . . . v. good* (see text)
Typical price per pair inc. VAT £700

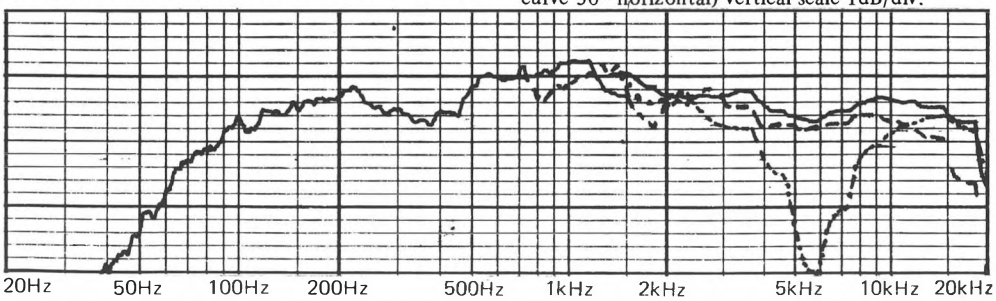
below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



below: impedance *vs* frequency (mod Z).



below: averaged frequency response at 2m (solid curve on axis, dotted curve 10° vertical, dashed curve 30° horizontal) vertical scale 1dB/div.



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While a review project on this massive scale can be extremely taxing for the author, it also has its compensations. One of the major problems facing any reviewer is undoubtedly that of maintaining a consistent standard against which to base opinion and judgment. The sheer quantity of product involved in *Hi Fi Choice* means that a reference is provided by the mean standards of the group as a whole, and furthermore one has a wide spectrum of performances available, ranging from arguably some of the very worst, to some of the best. Such a richness of data permits consistency of assessment far ahead of that which is possible from an individual or more limited group survey.

The size of the test group also allows the reviewer to probe more deeply than usual into the many facets of loudspeaker performance, by using highly accurate and elaborate lab facilities, and running carefully planned programmes of listening tests under calibrated conditions. For the latter a variety of material was used, including many live sounds. The greatly increased expense of such a test programme is impractical on a single review basis, but has become an essential part of the philosophy, standard and procedure of the *Choice* projects.

Stereo quality In addition to producing the individual reports, I set out to investigate certain aspects of sound quality that relate to speaker performance. Stereo imaging was one particular area where the use of new techniques is claimed to have enhanced subjective image accuracy, these variously described as 'linear phase', 'time delay compensated' or perhaps 'minimum phase'. In practice, such labels can only approximate to the truth, but claims advanced by several of their proponents suggest that only a speaker using these methods can deliver accurate stereo imaging, assuming they are fed with 'accurate' programme. Since stereo itself is essentially an illusion, this argument is rather weak to begin with. Nevertheless, great care was taken during this project to investigate whether such special techniques were effective. To this end we used original mastertapes of the highest quality using top class, crossed-pair microphones and correctly azimuthed on replay. Furthermore, the recording engineer/producer who actually mastered the tapes was present in the central front row position of the listening panel.

The results were in the main disappointing. A total of 12 models were auditioned which claimed some feature or features along special 'phase' lines, these including models from Technics, Bang and Olufsen, KEF, Bowers & Wilkins, Dahlquist, Nightingale, Keesonic, Leak, Revox, Sony and Tangent. One model, the KEF *105,* proved capable of precise spatial location with satisfying depth perception and ambience, but whether this was particularly due to its time delay compensation is impossible to say, since almost the same high quality of imaging was attained by another model, namely the Spendor *BC1,* which incorporates no special 'phase' or 'time compensated' features. The factors common to these two designs were in fact classical 'prime' performance aspects namely low colorations; excellent driver integration both in relative phase and amplitude terms; fine lateral directivity symmetry; low distortion; adequately wide bandwidth and a uniform frequency response naturally balanced. Many other conventional systems in the group which possessed a sufficiently good performance on the afore-mentioned parameters were also found to produce very good stereo image quality.

In conspicious contrast, the majority of the 'special' speakers under discussion were actually ranked below average in terms of their stereo image. A careful analysis of their remaining parameters revealed distinct shortcomings in either or both areas of frequency response balance and eveness, together with significant levels of perceived coloration. Discussion with the panel and other audio experts led to the conclusion that if 'phase' or 'time delay' aspects of speaker engineering were to have any chance of producing audible improvement, then the speaker to which the techniques were applied must already meet or exceed established high standards of sound reproduction, something which the majority would appear to fail to do.

The consensus of opinion was that whenever errors in frequency balance and/or coloration were present to any degree, the masking and distortion of the subtle clues

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which allow subjective perception of the stereo illusion were so great that the effect was greatly reduced; for example, a poor frequency balance can be shown to ruin imaging in the following manner. Taking a loudspeaker with a prominent treble range, a musical instrument with an extended harmonic ørange such as a violin will be reproduced with an altered spectral balance and will sound 'close', as if it were close to the microphone used to record it. While this might give an exaggerated impression of detail, it also distorts the natural perspective; the main body sound with the associated ambience and reverberation will be at one volume level and associated distance plane, while the harmonics will be reproduced louder than they should be, and are pushed forward in the image plane. Such an effect tends to mask ambience, and compresses the image so that the balance is 'thin' and two-dimensional — in the plane of the speakers themselves. In fact, some speakers are deliberately balanced in the reverse manner, to add artificial subjective depth, but if this is done to excess, all program tends to sound dull and lacking in detail, sparkle and immediacy.

Coloration is a sort of unwanted, unmusical hangover remaining after the real sound has passed on. There are many characterisations such as 'hardness', 'boomy', 'boxy', or 'fizzy', these appearing as a sort of 'noise' heard between the two speakers. Its lingering quality effectively reduces the dynamic range of the reproduced sound so that it masks the low level stereo clues such as hall reverberation, ambience and the back row musical instruments in the sound stage.

Thus levels of coloration are low enough and the frequency balance is accurate, sounds will be reproduced with the harmonics in their correct proportions. Subjectively the whole sound cannot then occupy its natural postion in the depth dimension of the stereo image.

So far we have discussed image depth, but other factors also influence locational effects. A speaker with fair coloration can still give relatively accurate stereo provided that the sound directed at the listener from each speaker integrates; that is balances or matches well at that position. However if the apparent frequency (and phase) response of a speaker alters greatly with small changes of listening angle, and furthermore is entirely different in the left and right hand directions, there is no way that a stereo pair is going to sound balanced and matched. Clearly this positional effect depends heavily on the phase and amplitude matching between the sounds from the left and right speakers, and without exception, those speakers which exhibited significant lateral asymmetry of radiated output gave poor locational information. (This excepting one or two systems with carefully optimised mirror image driver arrays, such as the IMF *TLS80* which did attain satisfactory image presentations.)

Tied in with this symmetry question is that of driver integration, or alternatively the consistency of the output over a sensible range of forward radiating angles. If the speakers were well matched in the first place, those possessing high slope crossovers in general showed excellent integration and output uniformity, giving consistently good stereo location effects. Conversely most systems incorporating much simpler crossover networks, with consequently wider overlap regions, possessed erratic forward responses and unpredictable stereo. (The JBL *L212* was an exception due to its use of unusually wide-band drivers, which helped to control the usual irregularities.)

A further factor which cannot be fully explained relates to the enclosure width. It is clear from the panel results that the narrower the enclosure, the greater the accuracy of source location. Hence most of the very small boxes gave good stereo, as well as those larger enclosures such as the Spendor *BC1* which were still relatively narrow, and particularly the *R105,* whose structure narrows progressively with increasing frequency.

The broader systems often sounded spacious; for example on multi-miked recordings, but blurred and expanded the images of smaller instruments. Speakers with marked lateral asymmetry sometimes exhibited remarkable image distortion — a violin ascending a musical scale gave an impression of a rapid lateral shift off-stage, as its pitch traversed a crossover region. In fact, a speaker system with an extended lateral array of many drivers will usually suffer badly

small is beautiful

Simon Hedges and Chris Hunt of What Hi-Fi? put their ears together to check out four British loudspeakers in the £100-£150 price bracket. Smallest of the units, the TANGENT RS2 came out best – they had this to say:-

"Listening to the RS2s it became obvious that the designer had gone all out for spaciousness of sound – and had achieved it in no uncertain terms. Imagery in terms of left-to-right spread, depth and space around the instruments was quite stunning.

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on these grounds, even if the general sound quality is otherwise favourable.

Frequency response and coloration

While some speakers demonstrated fine frequency response characteristics, they did not invariably sound good, particularly if coloration was in evidence. On the other hand, virtually all the systems which scored highly possessed relatively flat frequency responses devoid of any broad band spectral imbalances. This confirms my belief that an essentially flat frequency response together with the least possible coloration are the prime requirements of a good loudspeaker. I should point out in this context that a flat response should not be taken as a single trace taken at one metre on a particular axis; rather it refers to the total uniformity of response radiated in a sensible forward angle of say ±10° vertical and ±30° lateral.

In general the recommended loudspeakers were ones with low distortion, although the *R105* was an exception in that marginally above average values (although still relatively low) were recorded in the mid band, but did not appear to prejudice sound quality unduly. Low coloration speakers generally sounded least coloured when stand mounted, off the floor, and clear of both room corners and walls; in this respect the report contains and acknowledged bias in favour of those systems which audition well under these conditions.

Sensitivity did not seem to be a dominanat factor in influencing sound quality, though undeniably it is of importance to a purchaser in other respects. In general it would appear that the lower sensitivity models were more frequently recommended, usually because of their lower levels of coloration.

Significant differences in power handling were established; related systems of very similar price and performance but from different manufacturers could show a maximum sound level difference of as much as 6-8dB. No definite link was established between sensitivity and maximum loudness; some higher sensitivity systems could not be driven very hard, and yet some of the smaller low sensitivity enclosures withstood staggering peak power inputs and achieved respectably high sound levels in the process. Within the group, the measured sensitivity range was from 82dB/W to 94dB/W, with an average value of around 88dB/W. In real terms this means that 10 watts of amplifier input with an 82dB/W model will sound more like 150 watts into a 94dB/W example! This result is clearly important; if no sacrifice of quality is involved, it means that a given budget will allow a better high sensitivity speaker to be purchased and used with a smaller, less expensive amplifier.

While on the subject of power handling, it was a great surprise to find that so many models developed buzzes and rattles at quite moderate levels of pure bass input. These were not just the expected 'chuffing' from reflex ports etc near overload, but were attributable to sloppy workmanship. They included poor fixing of drivers to front baffles (inadequate screws, omission of a sealing gasket on either the driver frame or removeable panels), loose or inadequately fixed crossover assemblies and vibrating internal wiring, and, finally, a significant number of rear terminal panels were noisy, either as a result of poor sealing or bad attachment. There is no excuse for any of these faults.

At the end of the project we are left mildly surprised that arguably the best mid-price loudspeaker is the Spendor *BC1* — which is in its tenth year of production! As with all products, some weaknesses were present, and unfortunate combinations of environment, placement, and ancilliary equipment can all apparently worsen its subjective quality. Nevertheless, careful analysis of the listening data shows that under the controlled conditions of this test programme, its prime position at the £250.00 price level is unassailable. I feel this must reflect production care and quality control, as well as the accuracy of the original design. A fact which may surprise some readers who follow progress in new products is that the design of Celestion HF1300 tweeter used in the *BC1* and which the panel rated highly terms of musical quality, is in fact more than twice as old as the speaker system itself!

Thanks are due to the many manufacturers who have taken our criticisms with forbearance and who have endeavoured to correct problems as they occurred during the project, rather than accusing us of incompetance or, worse still, inaccuracy.

One good review deserves another

"*It was a pleasure for me to test the RAM 200. In appearance they are an attractive addition to the furniture of a home and in performance are excelled by few loudspeaker systems. I would recommend them as excellent value for money. In one sense they were a difficult loudspeaker to test, as their overall colouration is so low that there was little to be said about the actual sound quality of the loudspeakers – time and time again I found myself forgetting that I was at work and was aware only of the music that I was playing. This I believe is the best recommendation that can be made for a loudspeaker system.*"

Practical Hi-Fi and Audio, March 1978

"*No doubt this unusual combination of units helps to produce a bass quality – and quantity – that places the 200 in that class of speaker with a performance which would suggest a much larger cabinet. For almost every need, the 200 should offer an adequate performance, without the need for a larger pair of speakers to clutter up your living room.*

"Having complimented the bass performance and described the treble, there remains only the mid-range in between. Perhaps, because there doesn't seem to be a suitable adjective, they are just 'right'. Certainly, there was no feeling of forward or recessed sound, which is the usual criticism here. Voices sounded as natural as ever heard."

Popular Hi-Fi, December 1977.

The RAM 200, RAM 100, the RAM Bookshelf and the RAM Mini-Bookshelf. Manufactured with care, expertise and craftsmanship. Not only to produce good reviews. But to reproduce music the way it was meant to be. Hear them for yourself at all good hi-fi dealers.

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RAM Limited, Clarke Road, Mount Farm,
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Tel: Milton Keynes (0908) 75764.

RAM

Having devoted considerable thought to the problems of loudspeaker evaluation, it was decided that the usual *Hi-Fi Choice* 'Best Buy' classification was inappropriate. A prospective purchaser preferably should audition the speaker in which he is interested in any case, to make sure our 'meat' is not his 'poison'.

All speakers which have done well overall are recommended, virtually irrespective of their price. Those which were good either in their own right, or in terms of cost or to a lesser extent size, are also singled out for approval. Models which are highly recommended are the **KEF R105** (£785), which offers excellent stereo and high power handling, good production consistency and bass extension; the latest type of **Spendor BC1 (£240** + stands), an outstanding performer for its price, with fine stereo image depth and detail, and really no vices to speak of. At a much reduced cost we have the **Audiomaster MLS1** (£90) which is proving to be a consistently good performer, followed by the **Sanyo Hi-Fi 1** (£85), which offers excellent value for money.

Recommendations

£500-£1500 per pair (typical inc. VAT)

KEF R105: £785 (see above)

Yamaha NS1000M: £700 Compact, high sensitivity design attaining high loudness levels, though rather costly at new price.

£300-£500 per pair (typical inc. VAT)

Unfortunately we find we cannot with confidence recommend any model we have examined in this particular price category.

£175-£300 (typical inc. VAT)

Bolivar 64: £260 + stands. A system with good sensitivity and stereo, a high output and a powerful bass.

Chartwell PM210: £250 + stands. Offers a useful sensitivity with fair power handling; a good all-rounder.

Harbeth HL: £250 + stands. As for PM210, but possesses a limited power handling; offers low coloration, although some reservations exist concerning consistency.

Lentek S4: £205 + stands. A fine, neutral performer, in a compact well-finished, if expensive, package.

Monitor Audio MA4 Mk 11: £190 + stands. Good power capacity and output level at a realistic price and quality.

Rogers Export Monitor: £245 + stadsd. Good all round performer, if possessing a limited maximum output level.

Spendor BC1: £240 + stands. (see above)

£85-£175 (typical inc. VAT)

Audiomaster MLS1: £90 (see above)

B&W DM5: £110. A shelf mounting system with good LF power handling.

Bolivar 125: £160. Extended bass, with useful efficiency and power-handling.

Castle Richmond II: £90. Inexpensive higher sensitivity system, with good output and generally fine all round performance.

Celestion Ditton 22: £130. Inexpensive three way system of generally good performance and high ultimate sound level.

J.R.149: £125. Low efficiency system of neutral balance, low coloration and fine stereo. Unusual appearance.

KEF Corelli: £125. Well engineered all-rounder with powerful clean bass; needs a fair fair sized amplifier for the best results.

Philips AH487: £140. A highly sensitive three-way system with excellent clarity; generally a very good performer.

RAM Mini-Bookshelf: £95. Almost on a par with the highly recommended MLS1.

Rogers LS3/5A: £160. A highly accurate and detailed system of limited power handling and low sensitivity.

Sansui ES207: £160 + stands. Fine bass but a lowish sensitivity; generally all aspects are very good for the price

Sanyo Hi-Fi 1: £85. (see above)

Spendor SA1: £150. A small insensitive system with fine distortion and stereo imaging; a generally good performer.

Tangent RS2: £150. Typical low efficiency system, of pretty good quality at a fair price.

Wharfedale Teesdale SP2: £130. A full three-way system with extended bass and useful sensitivity.

Overall Comparison Chart

*refer to text

	Height		Width		Depth		Weight		Response controls	Recom. max. amp power per channel (watts)	Recom min. amp power per channel (watt)	Max sound level in room at 2m (dBA pair)	Lab sensitivity at 1m (dB lin) 2.83V input	Low frequency rolloff at 6dB down
	cms	ins.	cms	ins	cms	ins	kgs	lbs						
Acoustic Research AR17	47.3	18.6	25.4	10	22.2	8.7	7.7	17	1	100	20	105	86	47
Altec Model 5	64.8	25.5	36.8	14.5	30.5	12	14.5	32	—	100	20	103	89	47
Audiomaster MLS1	37.2	14.5	23	9	19.2	7.5	5.3	11.7	—	50	30	101	84	57
B&O M75 II	65	25.6	35	13.8	27	10.6	17	37.4	—	100	30	101	86	40
B&O S45 II	48	18.9	26	10.2	21	8.3	7	15.4	—	100	20	103	90	60
B&W DM7	90.3	35.5	27	10.6	36.7	14.5	30	66	var.	200	30	100	86	40
B&W DM5	45.5	18	22.7	9	24.1	9.5	9.5	21	—	100	20	102	87	54
Bolivar 64	67	26.4	31.2	12.3	35.6	14	20	44	2	200	10	105	92	42
Bolivar 125	58.4	23	31.8	12.5	27.4	10.8	16.4	36	2	100	15	100	88	36
Bose 601	64.7	25.5	38	15	33	13	16.4	36	var.	100	10	105	91	45
Castle Richmond II	41.5	16.5	23	9	25	10	8.5	18.7	—	50	10	104	90	48
Celestion Ditton 22	51	20	33	13	27	10.5	12.4	27.3	—	150	15	105	89	50
Celestion Ditton 15XR	56	22	25	4.7	24	9.5	8.2	18	—	100	15	105	88	48
Chartwell PM 450E	76	30	46	18	41.2	16.2	32	70.4	—	—	—	108	N/A	35
Chartwell PM 210	66	26	34.3	13.5	28.6	11.3	17	37.4	—	100	15	103	88	45
Dahlquist DQ10	80	31.5	77.5	70.5	22.9	9	27.3	60	1	250	50	103	85	40
Eagle L6600	62	24.4	33	13	30.5	12	N/A	N/A	1	50	10	98	89	40
Exposure 1	61	24	30.5	12	30.5	12	14	31	—	150	40	98	83	45
Goodmans RB35	62	24.4	32	12.6	25	9.8	12.5	27.5	—	50	10	101	92	48
Harbeth HL	64	25.5	32.5	12.8	30	11.8	13.5	30	—	75	15	97	88	45
IMF TLS 80 II	98	38.5	46	18	41	16	37	81	1	250	30	105	86.5	25
Isophon HI 100	53.3	21	29.2	11.5	24.1	9.5	N/A	N/A	—	100	30	99	83	45
JBL L212	48.1	38.5	43.2	17	33	13	45	100	—	250	20	111	91	20
JBL L19	53.3	21	33	13	25.4	10	13	29	1	100	10	106	89	50
JR 149	37	14.5	23	9	23	9	5.5	12	—	50	30	98	83	45
Keesonic Skout	56.4	22.2	28.5	11.2	31	12.2	10	22	—	50	15	99	89	50.
KEF R105	96.5	38	41.5	16	45.5	17.9	38	84	—	200	30	103	86	35
KEF Corelli	47	18.5	28	11	22	8.7	9	20	—	100	30	98	85	50
KLH 363	61	24	33	13	31.8	12.5	19	42	2	100	15	103	88	45
Leak 3030	52	20.5	25	9.5	28.3	11	14.4	31.8	—	40	25	97	86	55
Lentek S4	49.5	19.5	25	9.7	25.5	10	11.7	25.7	—	100	30	99	84.5	47
LNB LAB8	59.7	23.5	28	11	28.5	11.2	11.8	26	—	50	20	101	86	55
Marantz HD66	61	24	37	14.6	28	11	19.4	42.7	3	100	15	103	90	48
Monitor Audio MA4II	59.6	23.5	31.6	12.5	28	11	16	36	—	150	25	103	86	44
Monitor Audio MA8	40.5	16	22.8	9	20.3	8	8	17.5	—	50	30	90	82	48
Mordaunt-Short Pageant II	53.3	21	33	13	23	9	9.6	21	2	50	15	98	88	50
Nightingale NM1	86	34	40.6	16	28.6	11.5	24.5	54	1	100	30	100	86	46
Philips AH487	57	22.4	39	15.4	22.5	8.9	12.5	28	—	100	10	103	93	50
Philips AH486	48	18.9	32	12.6	22.5	8.9	10.5	22	—	50	10	106	93	60
Pioneer HPM 100	67	26.3	39	15.3	39.3	15.5	26.7	59	2	100	10	101	92	38
Revox BX350	52	20.5	35	13.8	29.5	11.6	14	30.8	1	50	15	101	88	50
RAM 150	58.4	23	29.2	11.5	25.4	10	13.3	29	—	150	20	103	87	44
RAM Mini Bookshelf	41	16	25.4	10	23	9	5.3	11.7	—	50	30	98	84	56
Richard Allan Maramba	59.7	23.5	24.8	9.7	21.9	8.5	9.5	21	—	50	10	98	90	62
Rogers Export Monitor	63.5	25	30.5	12	30.5	12	14	31	—	100	25	98	86	43
Rogers LS 3/5A	30	12	18.5	7.5	16	6.5	5.5	11.5	—	50	30	93	82.5	59
Sansui ES207	59.3	23.3	28.2	11.1	28.1	11	13.2	33.5	1	100	30	102	86	40
Sanyo Hi-Fi 1	45.5	18	27.5	10.8	17.8	7	7.5	16.5	—	100	25	103	86	50
SMC Super Saturn	46.5	18	25.5	10	24	9.5	8.7	19	—	75	30	98	85	50
Sony G5	72	28.4	41.5	16.4	35	13.6	26	58	2	100	10	108	93	60
Spendor BC1	63.5	25	29.8	11.7	30.5	12	14	30.8	—	150	30	101	86	44
Spendor SA1	30.4	12	22.5	8.9	21.6	8.5	7.2	15.8	—	75	30	98	82	53
Studiocraft 330 II	53.3	21	34.3	13.5	22.9	9	15.5	34	—	50	10	101	92	55
Tangent RS6	81	31.5	30.5	12	31.5	12.4	18	39.6	—	50	30	96	84	51
Tangent RS2	37	14.6	25.5	10	28.5	11.2	4	8.8	—	100	30	104	83	45
Technics SB6000	84.6	33.4	42.5	16.8	34	13.4	25	55	1	150	10	108	93	50
Visonics David 50	17	6.7	10.3	4	10.7	4.2	2.5	5.5	—	100	30	98	83	95
Wharfedale E70	81.5	32	34.2	13.5	36	14	32	70	2	75	10	103	94	56
Wharfedale Teesdale SP2	57.8	22.8	34	13.4	27.8	11	14.1	31	—	100	15	101	88	40
Yamaha NS1000M	67.5	26.5	37.5	14.7	32.6	12.8	31	68.2	2	200	20	107	90	50

Overall frequency response	Dispersion	Coloration	Amplifier loading	3rd Harmonic distortion	Overall subjective quality	Stereo image quality	Truth to life	Typical price per pair inc. VAT	*refer to text
ave.	v. good	acc.	ave.	good	acc.	acc.	good	125	Acoustic Research AR17
ave.	poor	poor	good	v. good	acc.	acc.	poor	325	Altec Model 5
v. good	v. good	good	v. good	v. good	v. good	v. good	ave.	90	Audiomaster MLS1
good	good	acc.	poor	good	ave.	acc.	ave.	375	B&O M75 II
ave.	good	ave.	poor	acc.	ave.	ave.	good	170	B&O S45 II
v. good	v. good	poor	v. good	good	acc.	ave.	poor	300	B&W DM7
good	v. good	acc.	poor	good	ave.	good	good	110	B&W DM5
v. good	v. good	good	ave.	v. good	good	v. good	ave.	260	Bolivar 64
v. good	v. good	ave.	ave.	v. good	good	good	ave.	160	Bolivar 125
*good	v. good	poor	good	excll.	poor	acc.	poor	400	Bose 601
v. good	v. good	ave.	ave.	v. good	good	good	ave.	90	Castle Richmond II
good	good	ave.	poor	good	good	good	ave.	130	Celestion Ditton 22
good	good	acc.	good	v. good	ave.	good	acc.	95	Celestion Ditton 15XR
good	v. good	good	N/A	excll.	good	acc.	good	1400	Chartwell PM 450E
v. good	v. good	good	good	v. good	good	good	good	250	Chartwell PM 210
ave.	poor	ave.	acc.	excll.	ave.	good	ave.	640	Dahlquist DQ10
good	good	ave.	ave.	v. good	ave.	ave.	good	200	Eagle L6600
good	good	ave.	v. good	good	ave.	ave.	acc.	175	Exposure 1
good	ave.	acc.	acc.	v. good	acc.	good	acc.	105	Goodmans RB35
v. good	v. good	v. good	v. good	excll.	good	good	good	250	Harbeth HL
good	good	ave.	acc.	v. good	good	ave.	good	550	IMF TLS 80 II
good	good	ave.	good	v. good	acc.	ave.	poor	150	Isophon HI 100
acc.	good	good	good	excll.	acc.	good	good	1462	JBL L212
ave.	good	ave.	ave.	v. good	ave.	good	ave.	236	JBL L19
v. good	v. good	good	good	v. good	good	v. good	ave.	125	JR 149
ave.	ave.	poor	poor	good	acc.	acc.	poor	160	KeesonicSkout
excll	v. good	v. good	*good	v. good	excll.	excll.	excll.	785	KEF R105
v. good	v. good	good	ave.	v. good	good	v. good	acc.	125	KEF Corelli
ave.	poor	ave.	good	v. good	ave.	ave.	acc.	245	KLH 363
ave.	ave.	acc.	good	acc.	acc.	good	acc.	140	Leak 3030
v. good	v. good	good	good	excll.	good	v. good	ave.	205	Lentek S4
ave.	good	ave.	ave.	—	ave.	good	acc.	125	LNB LAB8
good	poor	ave.	ave.	acc.	good	ave.	ave.	280	Marantz HD66
v. good	v. good	good	v. good	excll.	good	v. good	acc.	190	Monitor Audio MA4II
ave.	v. good	acc.	good	acc.	acc.	ave.	poor	115	Monitor Audio MA8
v. good	v. good	acc.	good	good	ave.	good	acc.	160	Mordaunt-Short Pageant II
ave.	*good	acc.	acc.	v. good	*acc.	ave.	acc.	385	Nightingale NM1
good	ave.	good	ave.	v. good	v. good	good	good	140	Philips AH487
good	v. good	ave.	ave.	excll.	acc.	acc.	good	110	Philips AH486
good	acc.	ave.	acc.	v. good	good	acc.	ave.	290	Pioneer HPM 100
good	ave.	ave.	poor	excll.	ave.	ave.	good	300	Revox BX350
ave.	v. good	ave.	ave.	v. good	good	good	acc.	180	RAM 150
good	v. good	good	good	good	good	v. good	good	95	RAM Mini Bookshelf
good	poor	poor	acc.	acc.	poor	ave.	poor	90	Richard Allan Maramba
acc.	v. good	good	acc.	v. good	good	v. good	v. good	245	Rogers Export Monitor
ave.	v. good	good	v. good	v. good	ave.	v. good	v. good	160	Rogers LS 3/5A
ave.	v. good	good	v. good	good	good	v. good	good	160	Sansui ES207
v. good	v. good	good	v. good	v. good	v. good	v. good	v. good	85	Sanyo Hi-Fi 1
poor	v. good	ave.	good	acc.	ave.	good	poor	120	SMC Super Saturn
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v. good	v. good	v. good	good	excll.	excll.	excll.	v. good	240	Spendor BC1
v. good	excll.	good	v. good	excll.	good	v. good	good	150	Spendor SA1
good	poor	acc.	good	good	acc.	acc.	ave.	146	Studiocraft 330 II
v. good	v. good	ave.	ave.	poor	ave.	good	good	325	Tangent RS6
ave.	excll.	good	good	v. good	good	good	ave.	150	Tangent RS2
v. good	good	ave.	acc.	good	ave.	good	good	418	Technics SB6000
ave.	excll.	acc.	acc.	good	acc.	v. good	acc.	115	Visonic David 50
acc.	ave.	ave.	v. good	acc.	ave.	poor	ave.	345	Wharfedale E70
good	good	good	acc.	v. good	good	good	good	130	Wharfedale Teesdale SP2
good	v. good	v. good	ave.	excll.	v. good	v. good	v. good	700	Yamaha NS1000M

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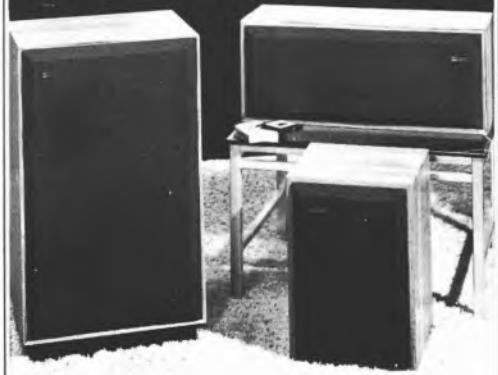

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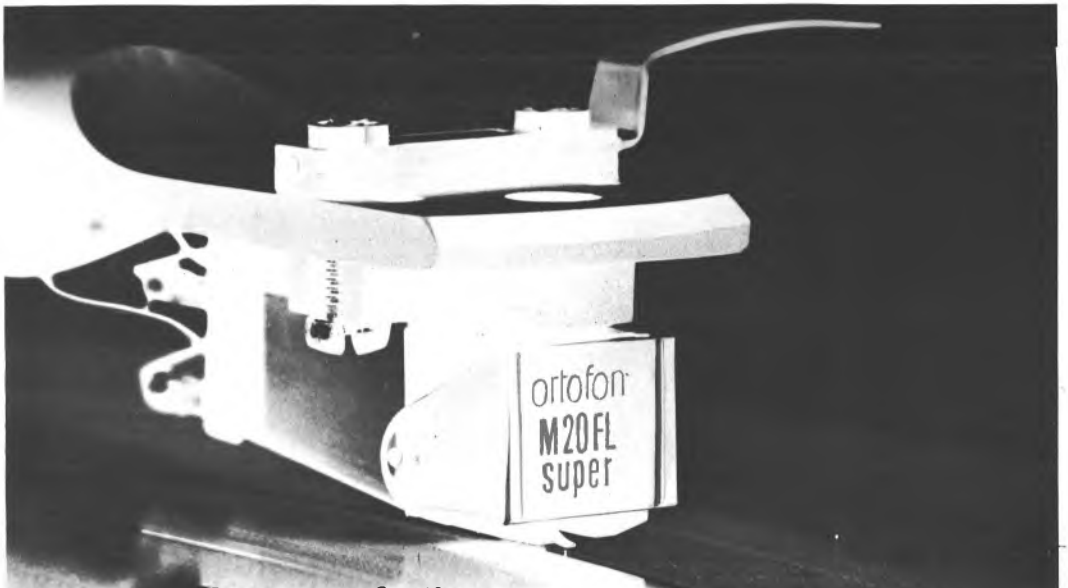

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Dimensions
495mm x 250mm x 255mm

Finish
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Stand (Optional)
Brushed Chrome, overall height 318mm

LOUDSPEAKER SYSTEM S4

The Lentek S4 two way loudspeaker system offers unusually smooth and uncoloured reproduction of all programme material. It preserves the depth and definition of stereo information available from modern recordings and radio broadcasts.

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Please send me details of the Lentek range of equipment and the address of my nearest dealer.

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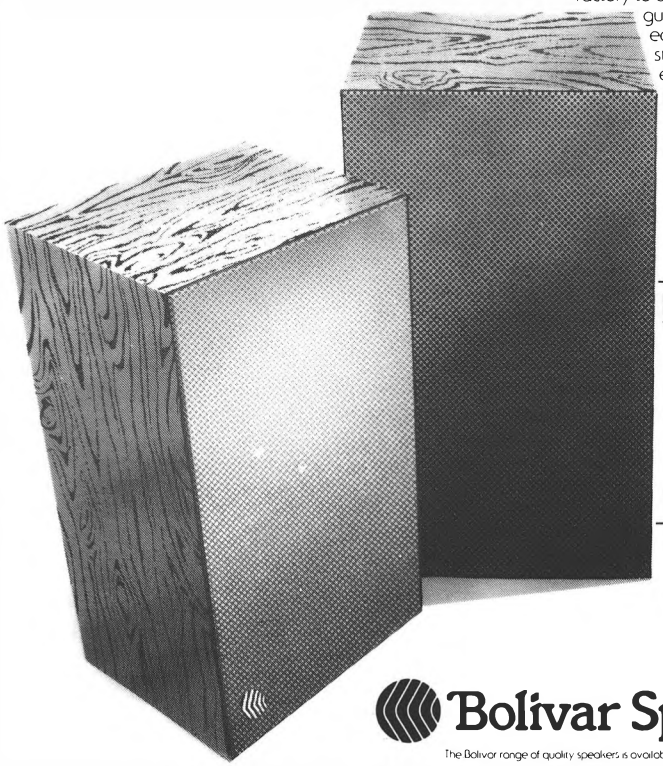

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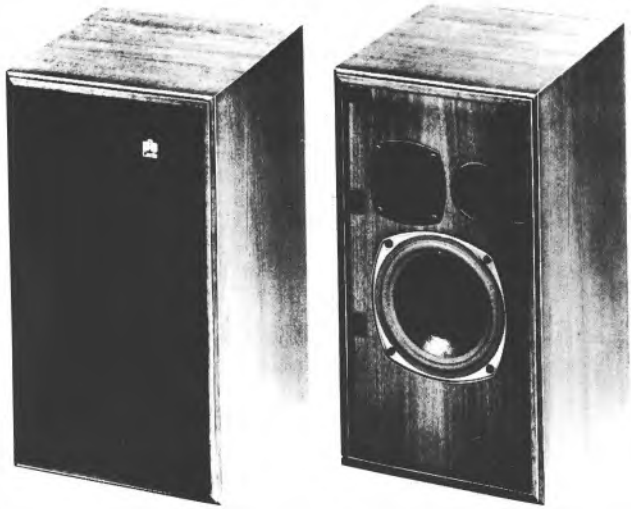

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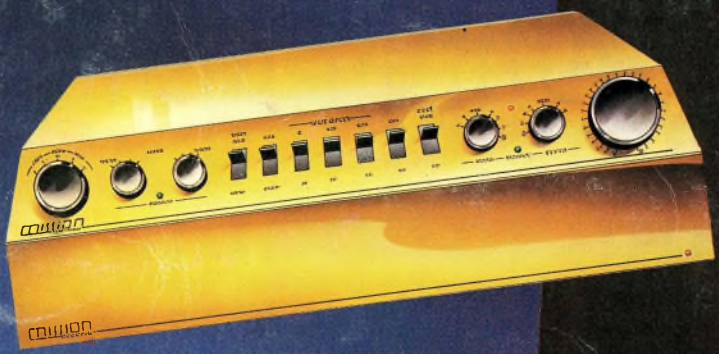

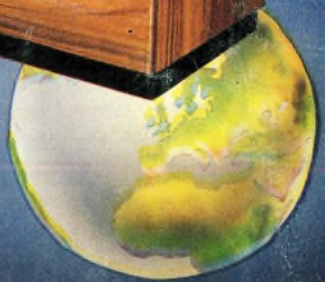

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