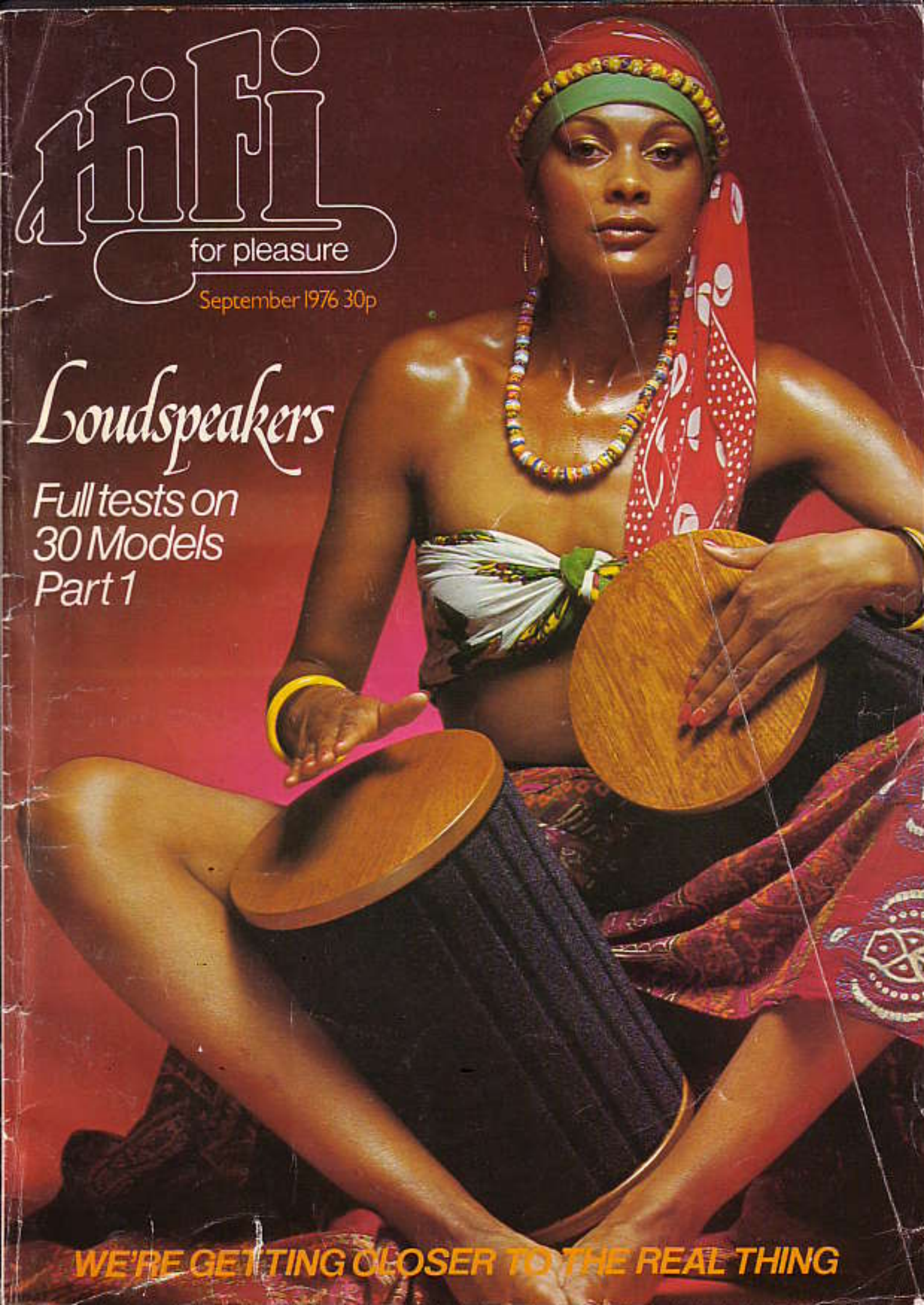
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for pleasure
September 1976 30p
Loudspeakers
Full tests on
30 Models
Part 1
WE'RE GETTING CLOSER TO THE REAL THING

Yamaha NS 500M

ON TEST 30 LOUDSPEAKERS

This two unit bass reflex design is the latest model from the 'Natural Sound' people. Measuring 61cm H × 33·5cmW × 33·8 cmD, and weighing 19·3kg, it employs a 250mm rigid paper pulp coned bass-mid driver, in conjunction with a unique 25mm beryllium dome HF unit, fabricated by vapour deposition. The crossover point is set at around 1·8kHz. The specified impedance is 8 ohms and the maximum amplifier rating given as 60 watts. The quoted frequency response of 40Hz to 20kHz apparently means little; the brochure curve was inspected and revealed a ±4dB 60-17kHz range (taken at 1m on sine wave).

LAB REPORT

Pair matching

A very close match was shown by the review pair of better than 1dB over the entire frequency range, with the absolute sensitivity agreeing within 0·25dB.

Sensitivity

77dBA was recorded at 2·5m which is high compared with the average for the group. The equivalent 1 metre axial figure for 10 watts into 8 ohms at 1 metre is 98dBA, or about 6 watts for the standard 96dBA.

Impedance

The well controlled impedance curve shows a 6·5 ohm minimum thus confirming the 8 ohm specification. The low reactive content — a maxium of 22° — coupled with the 8 ohm rating, indicate that this speaker should be easy to drive, and that the high sensitivity recorded is genuine and not falsely augmented by a lower than average impedance.

Response

Showing a pretty well balanced characteristic, the axial trace fell within ±3·5dB limits over the range 63Hz — 16kHz. Extending the minus limit to 6dB gave +4-6dB 50Hz to 17kHz, the rolloff being pretty rapid outside this range. This result was in good agreement with the manufacturer's own curve.

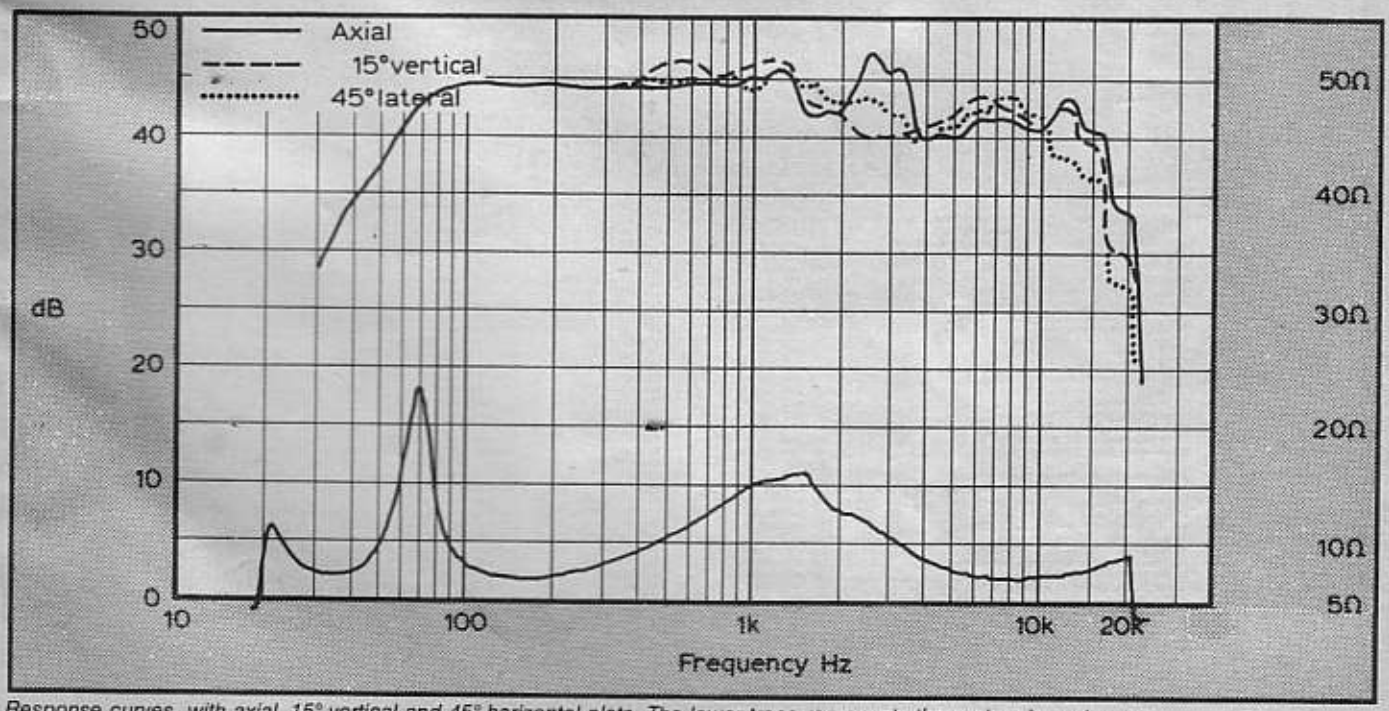
The off axis responses at ±15° in the vertical plane were fairly even, with some irregularity around the 1·8kHz crossover point, the +15° axis proving to be somewhat smoother. A listening position slightly above the speaker axis is thus suggested, which is likely to occur if the model was stand mounted. (The Yamaha brochure shows it supported on large building bricks.) At these 15° microphone positions, some loss of high treble was obvious — about −5dB at 20kHz.

At 45°, in the lateral or horizontal plane, a 3-4dB mid band loss, 300-1kHz, was evident, plus a falling extreme treble measuring −8dB at 20kHz, which is not severe. The left and right 45° responses were not particularly well matched, suggesting that handed mirror pairs might be advantageous, (check this is not the case) but overall the off axis loss was not severe considering the size of the bass mid range driver.

Accuracy

Overall this model was ranked second equal at just below 5·2 — a fine result.

Regarding the individual sounds, it did slightly better on speech and pedal drum than on the other material, but overall the results were fairly even.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Wharfedale Airedale SP

ON TEST 30 LOUDSPEAKERS

The largest model in the Wharfedale SP series, the Airedale is a relatively new floor standing bass-reflex system of considerable dimensions. 100 litres in volume, and 88cm H × 46·8cm W × 41·5cm D, it claims to have a −3dB point at 27Hz when floor mounted. A four way system, the drivers comprise a 250mm Bextrene bass cone; a 170mm Bextrene lower mid; a 100mm paper cone upper mid range and finally, a 25mm phase corrected, plastic dome tweeter. Internally the enclosure is highly damped with volume and panel resonance absorbents.

Specified at 6ohms, the maximum amplifier rating is given as 150 watts, with the axial frequency response at 27Hz to 20kHz, within ±3dB limits. All in all it seems a considerable quantity of loudspeaker for the money.

LAB REPORT
Pair matching

The sensitivity readings matched within 0·25dB, but rather greater deviation was observed between the measured curves for the two speakers. Although in general they were in agreement to within a dB, at the somewhat less important high treble area — 18 to 20kHz — a 4dB imbalance was noted.

Sensitivity

71dBA was recorded, which corresponds to 92dBA for 10 watts at 1 metre or alternatively 25 watts to produce the standard 96dBA level. Considering the fairly low specified impedance of 6 ohms, this 8 ohm based drive power indicates a low sensitivity.

Impedance

The specified 6-ohm nominal impedance was confirmed with minima of 5 ohms at 100Hz, 800Hz and 4kHz. Phase angle was generally low, averaging 15° over the whole mid band and rising to a moderate maximum of 35° at 6kHz, where the impedance was satisfactorily high at 8 ohms. Taking into account the 6 ohms nominal value, this speaker would present an undemanding load for an amplifier.

Responses

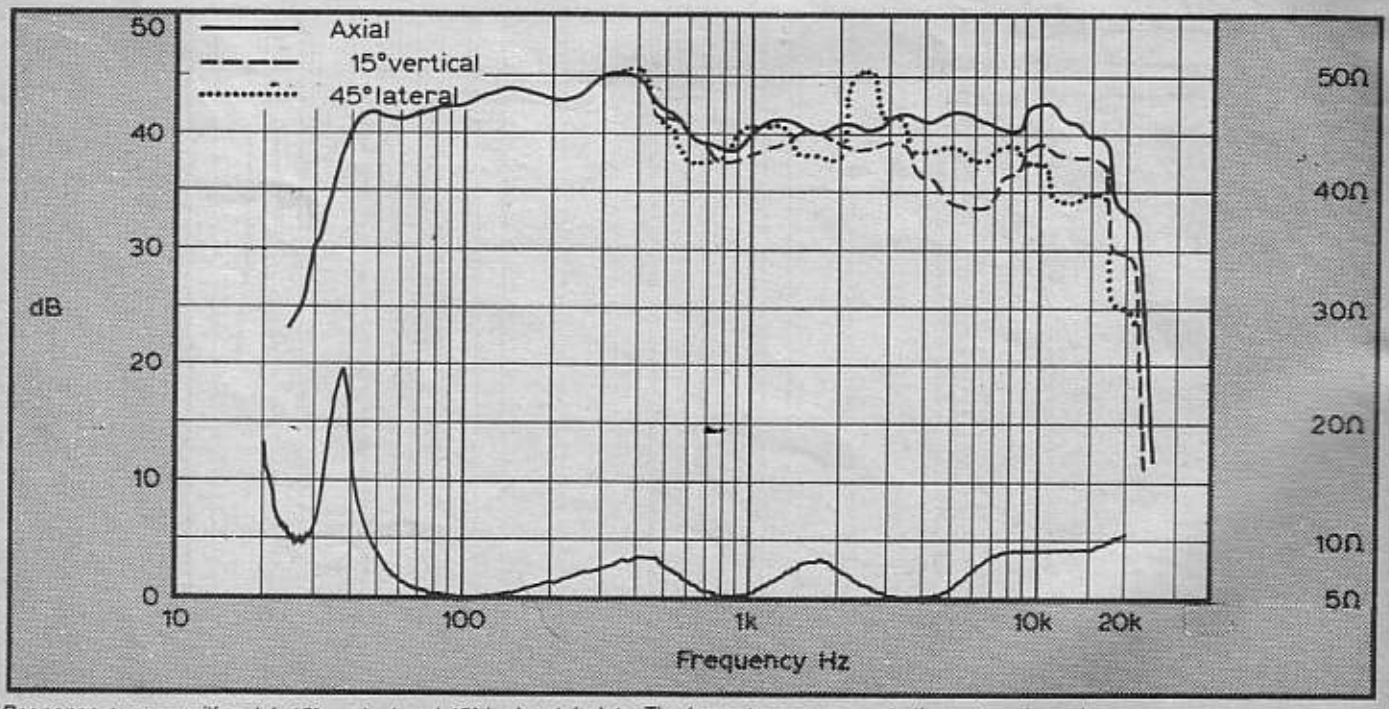
A dominant hump 3-4dB high and centred on 350Hz appeared in the response — otherwise a pretty flat characteristic was maintained. Over the limited range 500Hz to 18kHz, fine ±2·5dB limits were met, and extending the amplitude to ±3·5dB limits resulted in a wider 35Hz to 18kHz response. The benefit of the large cabinet showed clearly in the extended bass.

Off axis, the ±15° curves in the vertical plane were satisfactory, in that they showed a close matching with the axial response, with the exception of the following deviations. +15° gave a 2dB droop between 300 and 700 Hz, in addition to a 10dB trough for 5·5 — 7kHz. The high treble beyond 9kHz was also down 2dB.

Lateral ±45° curves showed increased response irregularities throughout the spectrum, the left and right hand curves differing by 4-5dB over several regions, namely 600Hz, 1800Hz, 6kHz and 10kHz. The average 45° off-axis loss was some 3-4dB over 500Hz, increasing to −6dB over 4kHz and levelling out at a typical −10dB towards 20kHz. The lateral assymetry suggests that left and right handed pairs might well result in improved stability of stereo image.

Accuracy

The Airedale ranked fairly low at 3·6- significantly below average. This was confirmed by the ranking on individual sounds, with the exception of the pedal drum, where a position slightly above average was noted.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Toshiba SS470

ON TEST 30 LOUDSPEAKERS

This relatively compact (bass reflex/resistive) system measures 54·8 cmH × 30·8 cmW × 29·5 cmD and weighs 15 kg. It manages to pack in three drivers and a treble control, with all the unit diaphragms manufactured from paper/pulp material. They comprise a 250mm bass, a 100mm mid, cone unit, with a 25mm dome treble unit completing the lineup.

Rated at 8 ohms impedance, the system is specified for amplifiers up to 60 watts and the frequency response is given as 35kHz to 20kHz.

LAB REPORT

Pair matching

Below 800Hz a 3dB mismatch was noted which could result in a stereo imbalance. Above this range the responses agreed quite closely.

Sensitivity

76dBA was recorded which corresponds to 97dBA for 10 watts or 8 watts for the standard 96dBA.

Impedance

Reactive components were low with the phase shift not exceeding 32°. A minimum of 4·8 was recorded, thus implying a nominal impedance of 6 ohms — rather less than the spec, and thus degrading the sensitivity by about 2dB. Nevertheless this system should be fairly easy to drive.

Responses

A moderately flat central region of ±3·5dB, 300Hz to 11kHz was obtained but to extend the range wider limits were required, with +3−6dB sufficing for 70Hz to >20kHz. The bass extension was poor for a 250mm driver.

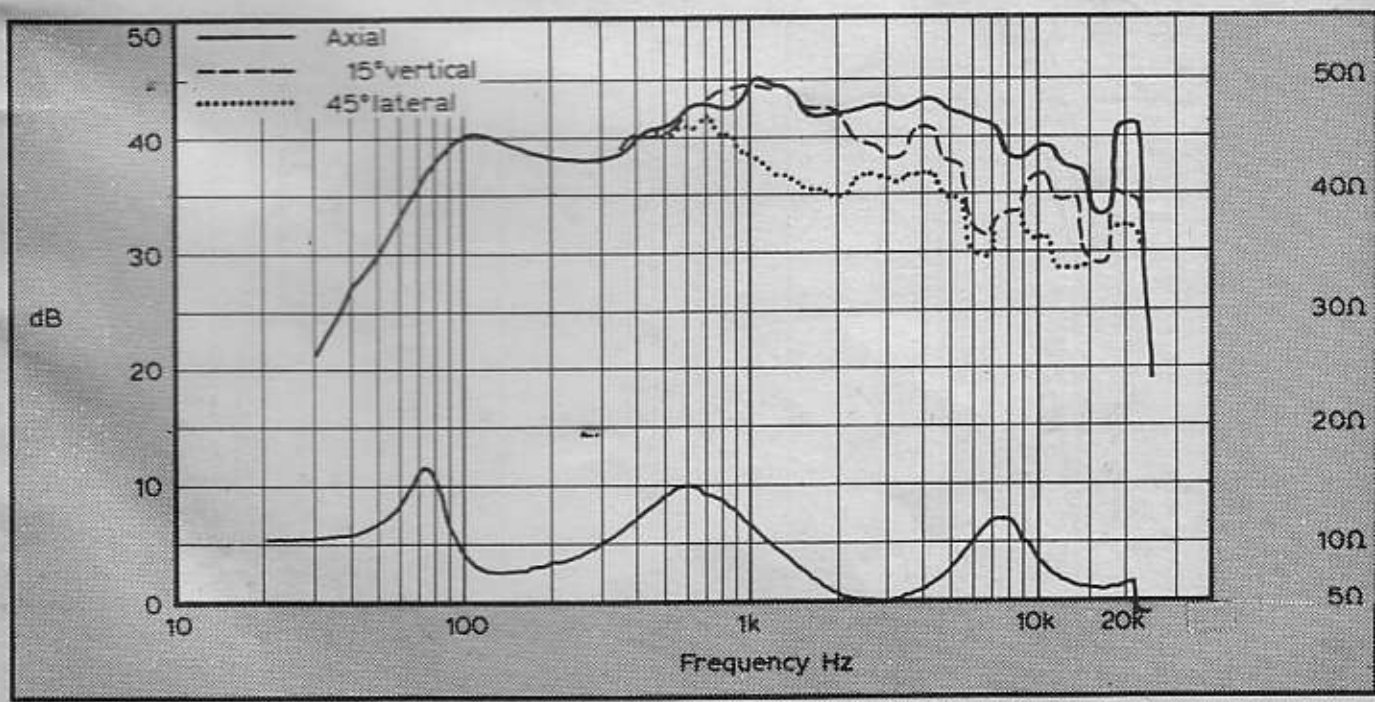
Strong phasing problems were evident from the ±15° vertical responses, with quite severe broad band irregularities appearing on both.

At 45° lateral, the left and right hand symmetry was poor with the former representing the smoother side. Here the loss off axis as held to 1dB up to 4kHz before falling a moderate 4dB until the high treble, where −10dB at 20kHz was recorded.

Although there were indications of promising unit performance the combination was poorly integrated and produced uneven responses at different forward axes.

Accuracy

Scoring around the mean at 4·3, the Toshiba did well on pedal drum but was held to be below average on the other sounds.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Tannoy Devon

ON TEST 30 LOUDSPEAKERS

This two way, compact, reflex enclosure measures 58·6cm H × 40cm W × 26cm D, and incorporates the latest version of Tannoy's long established, dual-concentric 300mm driver. The reinforced paper pulp cone of the bass section forms the horn assembly of a concentric treble unit fitted behind the magnet assembly; its pole piece containing a number of sound channels to acoustically link the HF diaphragm to the cone/horn.

The amplifier rating is 60 watts, with rated sensitivity at 5W for 96dB DIN, and an impedance of 8 ohms. As taken from the manufacturer's data sheet, the frequency response measures approximately ±4dB 65Hz to 18kHz.

Controls are provided for both treble roll off and treble attenuation.

LAB REPORT
Pair matching

The pair match was excellent, within 0·5dB over the entire range.

Sensitivity

This was exactly to spec with 78dBA recorded, which is high. This translates into 99dBA for 10 watts or 96dBA for 5 watts at 1 metre.

Impedance

Meeting spec easily, the minimum recorded value was 7 ohms, with the phase angle fairly small at 32° over most of the range. This result confirms the accuracy of the sensitivity rating, and indicates an undemanding drive characteristic.

Responses

On axis the Devon returned 70Hz to 20kHz ±3dB, a curve confirmed by a 0·5m sinewave response which gave the same result. The bass roll-off was rapid; as extending the limits to +5dB—6dB only gave a small extension, 60Hz to 20kHz.

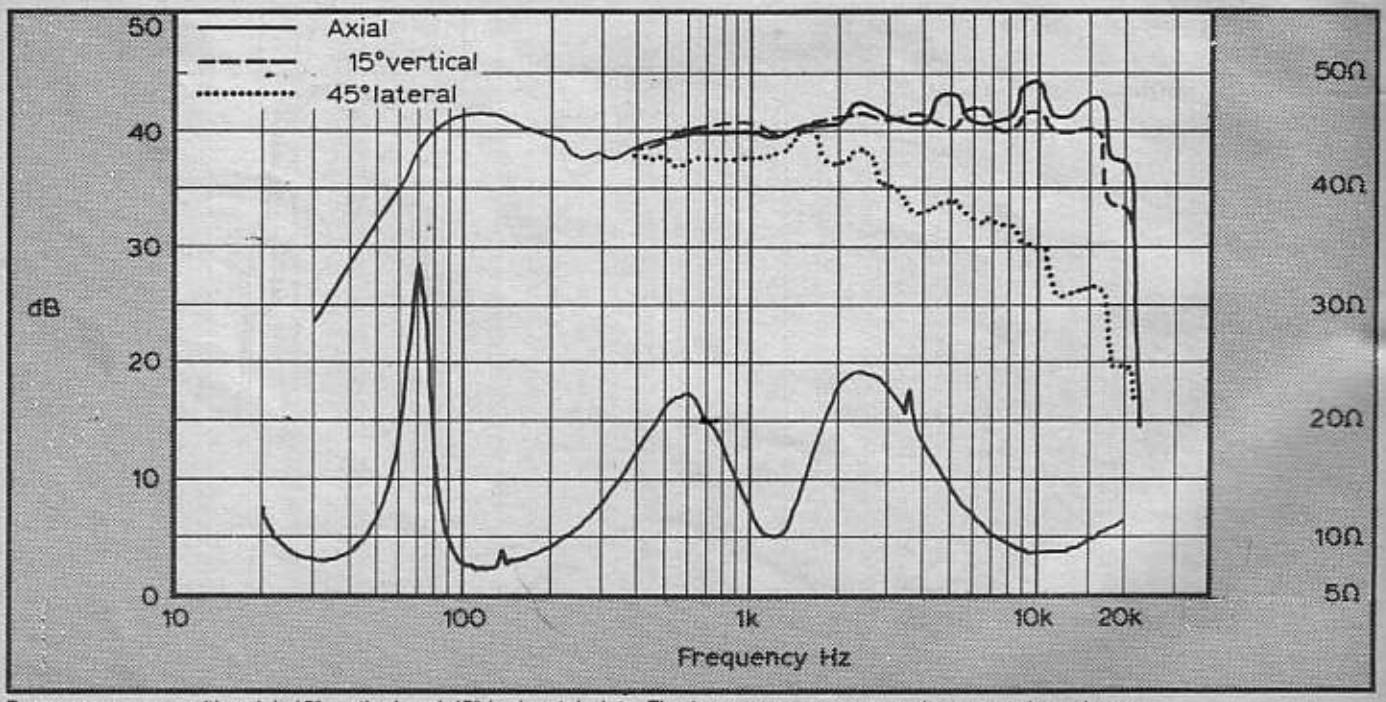
The concentric design ensured almost perfect symmetry in all directions. At 15°, the response showed little deviation until beyond 5kHz, where the treble began to droop slightly to −2dB at 15kHz and −4dB at 20kHz.

At 45° off axis, the curve was still quite even, only falling 2-3dB from 500Hz to 3kHz, and subsequently moving into rapid rolloff due to the size of the treble horn: −8dB at 5kHz, −15dB at 10kHz, and −20dB at 20kHz.

Overall the curves show an even, slightly rising axial response, with very good integration over moderate radiation angles. At 45° the treble loss was fairly considerable.

Accuracy

At 4·35 the Devon ranked almost exactly average. It did quite well on voice and guitar, less well on cymbal and musical box, and average on the remaining material.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Tandberg TL5020

ON TEST 30 LOUDSPEAKERS

Tandberg's largest domestic speaker is the TL5020. Bass is handled by a Celestion 300mm paper/pulp cone unit; the mid range by a 100mm paper cone unit and the treble by two 25mm plastic dome HF units working in parallel, to increase the power capacity of the system. Sealed box loading is employed and a special fuse and relay system protects the treble units. A DIN frequency response of 35Hz to 20kHz is quoted together with a 100W DIN music power rating equivalent to about 60 watts continuous. The nominal impedance is quoted at 8 ohms, and a relatively high efficiency is claimed — 3 watts for 96dB (linear) at 1 metre.

LAB REPORT

Pair matching

This was excellent — within 0·5dB over the entire range.

Sensitivity

77·5dBA was recorded, which corresponds to 98·5dBA at 1 metre for 10 watts input, or 5 watts for 96dBA, one of the most sensitive speakers on test. (This agrees with the 'lin' specification.) Tandberg's claim of a high power capacity is confirmed, as the maximum allowable input power would give 106dBA at 1 metre.

Impedance

Reaching a minimum of 6 ohms, the nominal value would be placed at 7·5 which is close enough to agree with the specified 8 ohms. The phase angle of impedance remained satisfactorily low at 30° and the bass resonance was noted at 52Hz.

Responses

The characteristic was a trifle lumpy, thus dictating ±4dB as the narrowest limits and allowing a 70Hz to 18kHz range. Extending the lower limit to −6dB gave 60Hz to just over 18kHz. The main trend was that of an elevated treble register. Excluding the treble, the axial response was much flatter:- ±2dB 70Hz to 3kHz.

Measurement 15° above the forward axis produced a 5dB suckout between 3kHz and 9kHz, with recovery above 9kHz and then a rolloff to −8dB at 20kHz — quite severe for a 15° response, and almost certainly due to the use of parallel units.

15° below gave rise to dips of 10dB around 1kHz and 6kHz but otherwise little change from the axial characteristic could be seen, except in the high treble.

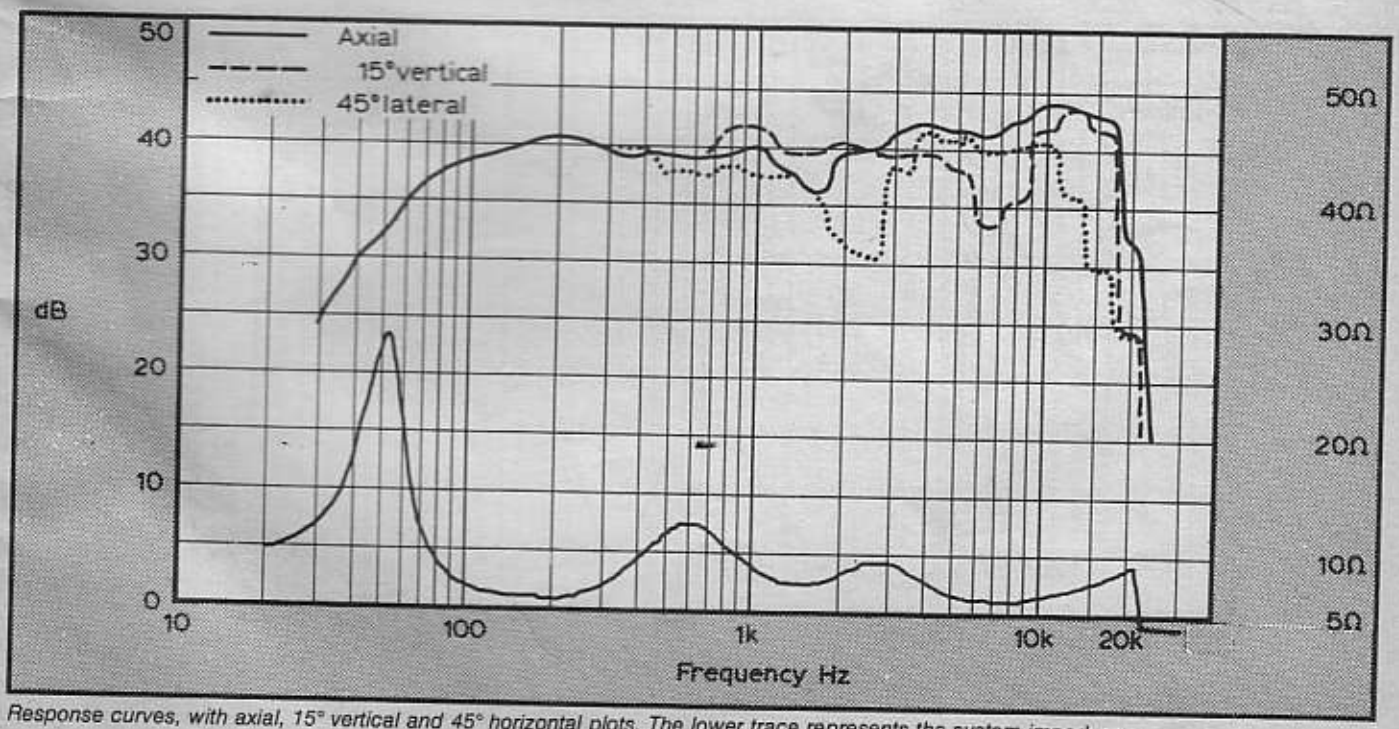
At 45° right in the horizontal axis, a typical 3dB droop at frequencies higher than 500Hz was shown, but an irregularity was also evident, namely a 12dB dip at 2·5kHz. At 12kHz the loss increased to 12dB, with −15dB at 15kHz and −10dB at 20kHz.

Despite the unpromising position of the drive units, the lateral radiation symmetry was good with the 45° left response essentially similar but lacking the 2·5kHz dip.

In view of the 5020's elevated treble characteristic, Tandberg appear to have adopted the fashion for a flat power response. Apart from this feature, the axial response was smooth, if not very extended, and this aspect was continued by the lateral off axis curves. Small variations in vertical angle gave rise to noticeable irregularities, and hence this model could be classified as fairly critical in terms of ear listening level.

Accuracy

Ranked fractionally higher than average at 4·4, the Tandberg did well on voice and guitar, and about average on the rest.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Studiocraft 330

ON TEST 30 LOUDSPEAKERS

A bookcase system produced by a division of the US Company Bose, the 330 is a bass reflex system employing a 200mm paper cone bass-mid range driver and two laterally beamed 40mm treble units, the crossover frequency is placed at 1·8kHz.

The specified ratings give an 8ohm impedance with a maximum amplifier rating of 60 watts and when mounted as the manufacturers suggest, namely on a wall but clear of corners, a flat room response is said to be achieved.

LAB REPORT

Pair matching

Up to 10kHz the matching was good at better than 1dB, but above this level a moderate 3dB discrepancy was noted.

Sensitivity

The recorded sensitivity was the highest measured at 79dBA, marginally greater than that for the Tannoy and Pioneer and a full 12dB higher than the LS3-5A. Thus in terms of loudness, to match the Studiocraft's output at 10 watts, ie, 100dBA, 160 watts would be required for the LS3-5A. At 1 metre, the nominal 96dBA required only 4 watts; (8 ohm equivalent).

Impedance

The curve was basically smooth with little reactive effects except at bass resonance. The minimum of 5 ohms occurred at 1kHz implying a nominal impedance of 6·5ohms, which although not low enough to cause great concern, was clearly below spec. Overall it should prove easy to drive.

Responses

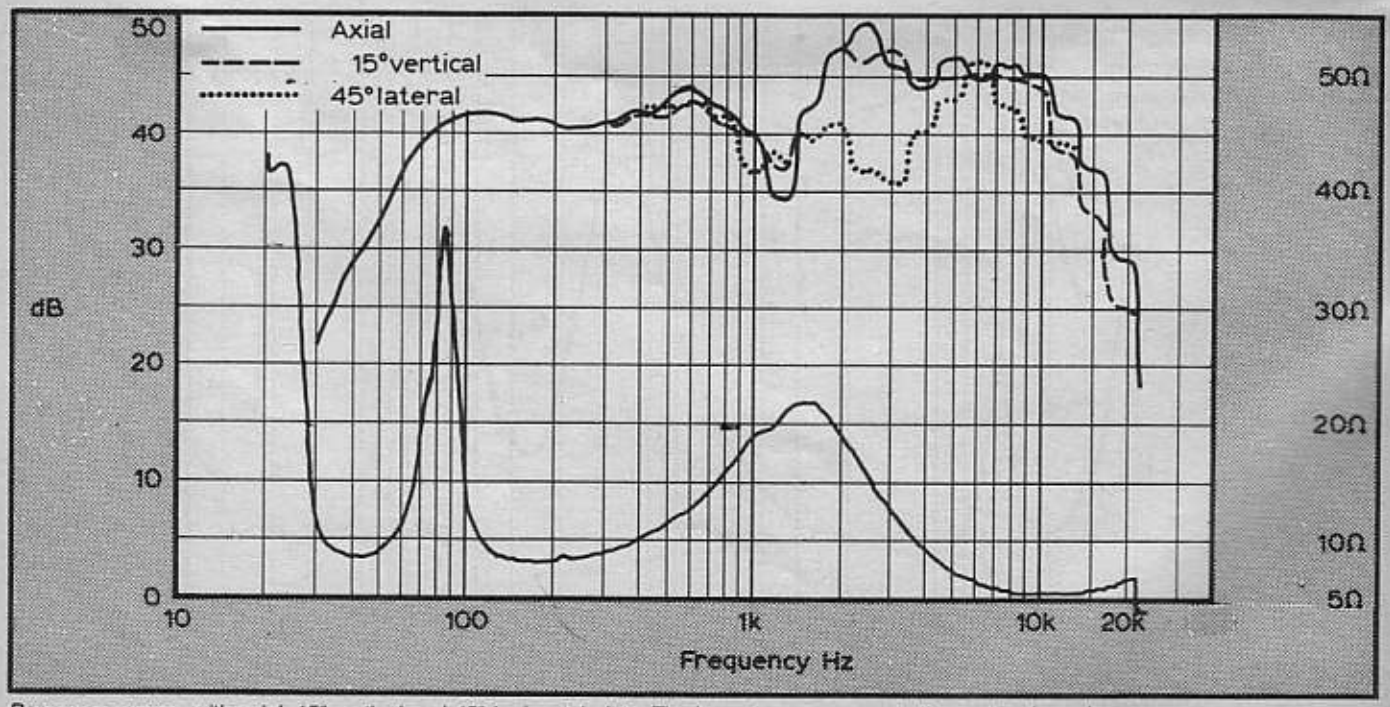
The axial response was somewhat uneven and showed a dip at 1·3kHz with an elevated HF band coupled to a rapid falloff in the high treble. To produce 55Hz to 16kHz the narrowest limit possible was ±5dB:- there is strong evidence that the curve is intended to produce maximum subjective and weighted loudness.

The 15° responses were moderately close to the basically uneven axial characteristic, although some treble rolloff was noted. However the 45° responses illustrated certain severe effects — in particular a 13dB deep irregularity around 2-3kHz and an overall loss of some 5-8dB from 500Hz onwards.

This system thus proved to have quite an uneven amplitude response in all favoured planes, the dual treble units and the type of crossover employed being held partially responsible.

Accuracy

Against life the 330 ranked a little above the mean at 4·5, scoring around average on drums and a little better on speech and musical box but lower on cymbal and guitar.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Spendor BC1

ON TEST 30 LOUDSPEAKERS

The BC1 is a well established British speaker based on the BBC LS3/6 system, and originally designed some 10 years ago. In recent months it has undergone a small change regarding construction of the 200mm Bextrene cone bass mid range driver, which is manufactured by Spendor themselves and where the original white PVC cone surround has been replaced by a new black material. Two further drivers complete the three way system — an HF1300 38mm phenolic dome treble unit plus a 19mm mylar dome super tweeter. Crossover points are placed at approximately 3kHz and 14kHz. The bass reflex plywood cabinet measures 63·5cm H × 29·8cm W × 30·5cm D, and incorporates heavy bituminous cabinet damping, this largely accounting for the speaker's relatively high weight for its size.

A frequency response of ±3dB 60Hz to 14kHz was specified, together with an 8ohm impedance and a 40 watt matching amplifier rating.

LAB REPORT
Pair matching

A close match was confirmed; within 0·5dB overall.

Sensitivity

69·5dBA was recorded which is low. The 10 watt 1 metre equivalent is 90·5dBA or 35 watts for the standard 96dBA.

Impedance

The impedance curve was uneven but this was not considered important, as it is the minimum values which can cause problems. The lowest was 5·5 ohms at 20kHz, allowing confirmation of the specified nominal value of 8 ohms, and being high enough to be out of danger. Up to 60° of phase shift was present at an impedance value of 12 ohms (11kHz) but the combination should not prove troublesome.

Responses

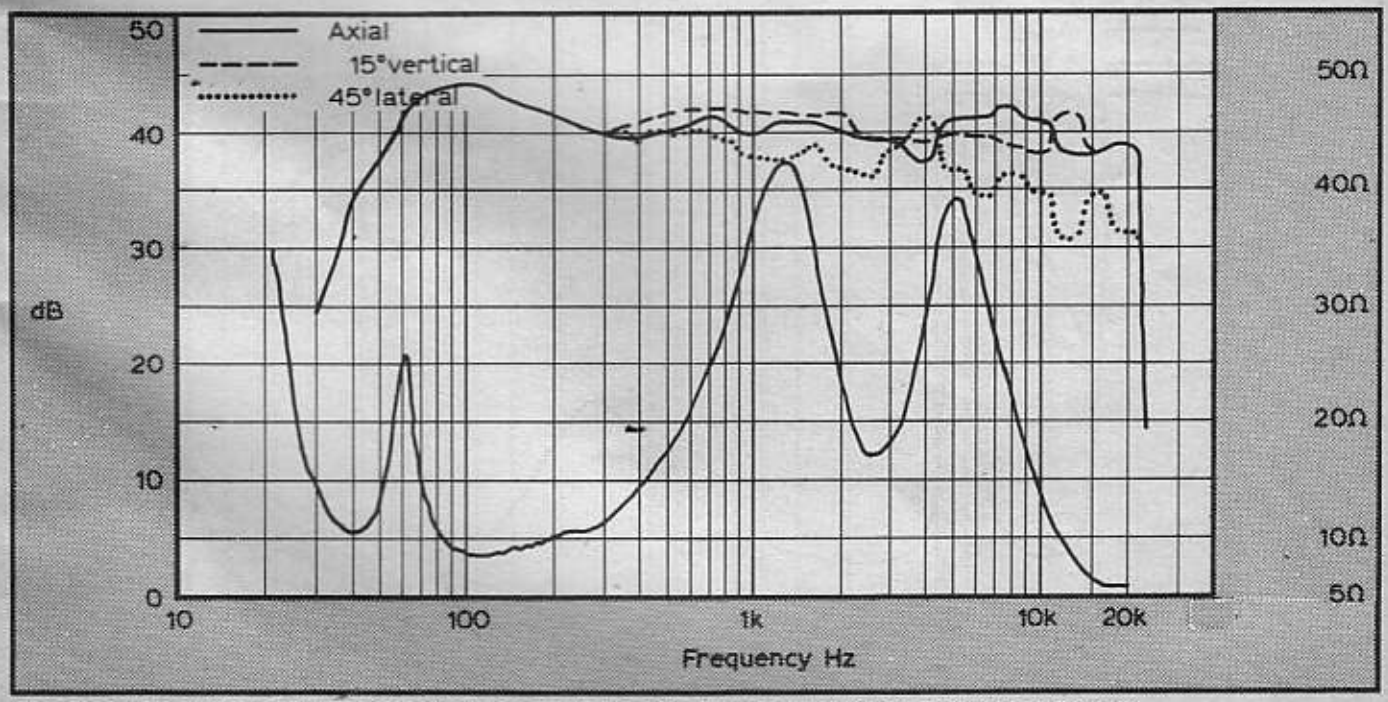
An upper bass hump was present which necessitated +4−6 dB limits to achieve a creditable 40Hz to >20kHz range. Narrow ±2·5dB limits were in fact sufficient for the range above 150Hz.

15° above axis produced a still smoother trace, although the 3kHz to 11kHz band was down 3dB, but the 15° below axis was less satisfactory, with an 8dB dip from 2·3kHz to 3·5kHz, and a −4dB droop from 3kHz to 15kHz.

Overall the BC1 showed a pretty even amplitude frequency response which was well dispersed and smooth. It was characterised by a 4dB bass hump between 60 and 120Hz and a slight presence band suckout.

Accuracy

Scoring 4·3 the BC1 ranked almost exactly at the mean for the group, but was judged slightly above average on speech, guitar, brush drum and musical box, but well down on pedal drum.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Sony SS5050

ON TEST 30 LOUDSPEAKERS

This fairly compact sealed box enclosure, 63cm H × 36·5cm W × 31·8cm D, weighs 20kg, and houses a full 300mm bass driver with a paper/carbon fibre cone and foam roll surround. A three way design, the other drivers comprise two dome units — a 35mm mid and 25mm treble, with crossovers placed at 900Hz and 9kHz. The amplifier rating is 80 watts with the impedance given as 8 ohms, and the DIN response stated as 40Hz to 20kHz. Mid and treble controls are provided.

LAB REPORT
Pair matching
Whilst the pair matched within 1dB on weighted sensitivity, areas of 2dB mismatch were noted from 1kHz to 2kHz, and around 15kHz.

Sensitivity
This was high at a measured 76dBA, corresponding to 97dBA for 10 watts or approximately 8 watts for the nominal 96dBA.

Impedance
A minimum value of 6 ohms was recorded placing the nominal value at over 7·5 — close enough to be specified at 8. Bass resonance came in at 55Hz with a harmless impedance rise to 38 ohms. Above 100Hz reactive effects were very low — generally below 16° — thus making this system very easy to drive.

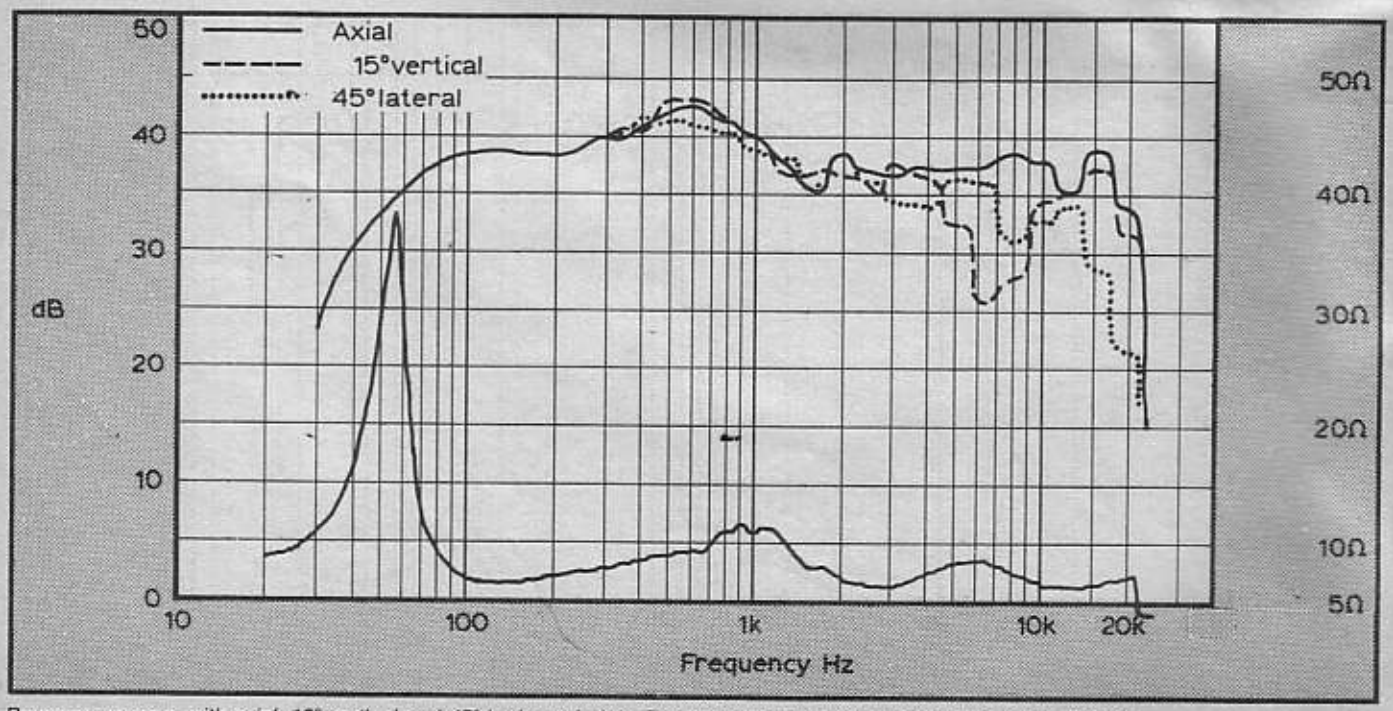
Responses
A broad hump was present around 600Hz, which dictated ±4dB amplitude limits for a 60Hz to 18kHz range. From 1kHz to 18kHz ±2dB was sufficient and an expanded +5−6dB tolerance brought in 45Hz to 20kHz.

The 15° vertical measurements revealed some loss in the extreme treble of −3dB at 10kHz and −4dB at 20kHz. 15° above resulted in a severe 9dB trough from 5kHz to 9kHz, and 15° below gave a similar suckout but this time over the 3·5 — 6kHz band. Clearly the mid axis of this loudspeaker must be on ear level for maximum evenness of response.

Laterally the system was symmetrical, with very little falloff until 7kHz. 8kHz showed a 6dB dip and beyond this the expected fall off occurred: −8dB at 16k and −10dB at 20kHz.

This system thus has a potential for an even response which is marred by the mid band hump. The lateral dispersion is quite good with an even symmetrical characteristic, but the vertical radiation axis is rather critical.

Accuracy
The Sony scored well below average, achieving 3·5. The marking on individual sounds confirmed this ranking bar on pedal drum where this system was judged to be average.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

SMC AS40

ON TEST 30 LOUDSPEAKERS

This new three way system comes from a small British Company who have been quietly making speakers for some years now. Measuring 63·5cm H × 32·4cm W × 35·6cm D, and weighing 18kg, this box is definitely a floor mounting system, and matching stands are specified for optimal performance. The bass driver is a 250mm dense pulp cone, with a 100mm Bextrene midrange unit and a 25mm fabric dome treble unit completing the vertical in line driver formation. The bass loading is sealed box.

A nominal impedance value of 8 ohms is specified together with a 100 watt maximum amplifier rating. The frequency response at 1 metre is stated as 50Hz to 20kHz, ±3dB.

LAB REPORT
Pair matching

Generally the pair match was good within 0·5dB, excepting a small area around the upper crossover at 2·5kHz where a minor 2dB mismatch was noted.

Sensitivity

68dBA was recorded which is low. The 10 watt 1 metre equivalent is 89dBA, corresponding to 50 watts for the standard 96dBA.

Impedance

A smooth impedance curve with low reactive components — a 20° maximum above bass resonance — was measured, making it an easy speaker to drive. The impedance minimum was 6 ohms, resulting in a nominal 7·5 value, which is near enough to the 8-ohm specification.

Responses

The axial response was both quite smooth and extended, covering 45Hz to 18kHz ±2·5dB. Extending the lower limit to give a +2·5−6·0dB amplitude range allowed a wide 38Hz to >20kHz response.

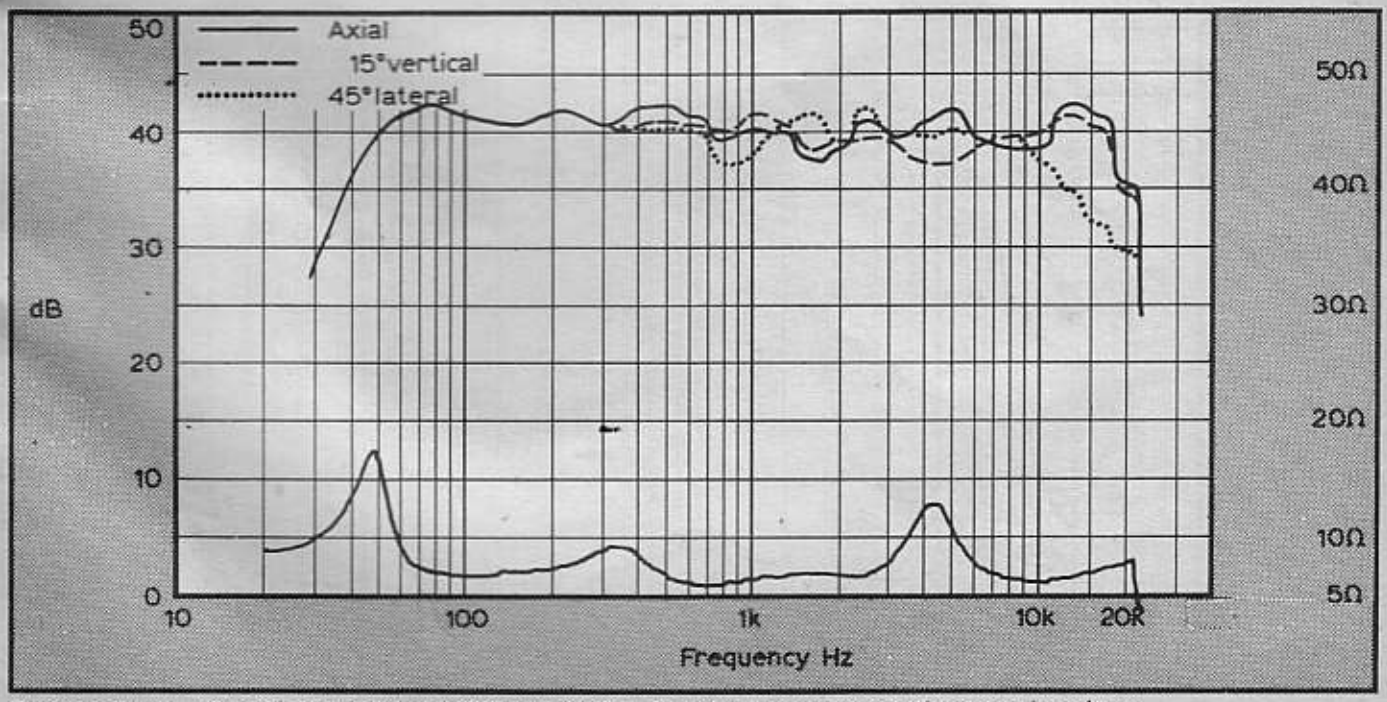
15° above axis the curve showed little change bar a small 5dB dip at 5kHz, whereas the 15° below response was less tidy, with some upper midrange suckout evident. On both curves the falloff in the upper treble was less than 2dB.

Measured on the broader 45° off-axis position, the response was maintained with a 2dB odd depression from 500Hz to 10kHz, and a fairly rapid rolloff above this to −16dB at 15kHz and 20kHz. The system is laterally symmetrical.

Overall the AS40 showed a wide flat characteristic which was well maintained over the forward radiation angles.

Accuracy

Highly ranked at equal second, the SMC scored a mean of 5·2. An examination of the individual sound scores proved interesting, as the AS40 did well on the musical box and all percussion instruments particularly the pedal drum, but was judged less accurate on speech and actually fell significantly below average on acoustic guitar.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Sansui LM330

ON TEST 30 LOUDSPEAKERS

Sansui LM330

This design is the top model in Sansui's 'LM' or 'Linear Motion' tweeter series. This rather misleading label refers to the unusual technique of channelling the rear radiation from the 60mm cone tweeter down three radial passages before allowing it to emerge at the cabinet sides, thus resulting in a delay of about ¼ of a millisecond. It is claimed that this delayed sound nullifies the unwanted crosstalk effects as perceived by the listener from the other system in a stereo pair. This theory aside, the remaining drive unit is a light 250mm paper cone, the combination crossing over at 1·5kHz, and fitted in a bass reflex enclosure of dimensions 71cmH × 31cmW × 30·4cmD weighing 18·7kg.

The amplifier rating is given as 60W, the impedance 8 ohms and the response as taken from the JIS curve is ±4dB from 45Hz to >20kHz, with an efficiency of 94dB/watt at 1 metre.

LAB REPORT

Pair matching

The pair matching was very good and was generally within 0·5dB with the exception of a small 2dB deviation, 10-16kHz.

Sensitivity

78dBA was recorded, which is high, and corresponds to either 99dBA for 10 watts at 1 metre, or 5 watts for the standard 96dBA.

Impedance

Sansui are optimistic in their impedance specification, as judged by the British standard. A minimum of 4·8 ohms was recorded at 5kHz, and another heavy loading effect was implied by the combination of a maximum 44° phase angle at an impedance of 9 ohms. On these measurements a 6 ohms nominal impedance is applicable, which will slightly devalue the recorded sensitivity.

Responses

The response on axis was essentially flat except for a 5dB high hump between 2 and 3·5kHz, but if that were tamed, the main response would fit narrow ±2·5dB limits, over the range 65Hz to 16kHz. Including this hump and expanding the lower limit gave +5-6dB 55Hz to 17kHz — not particularly extended.

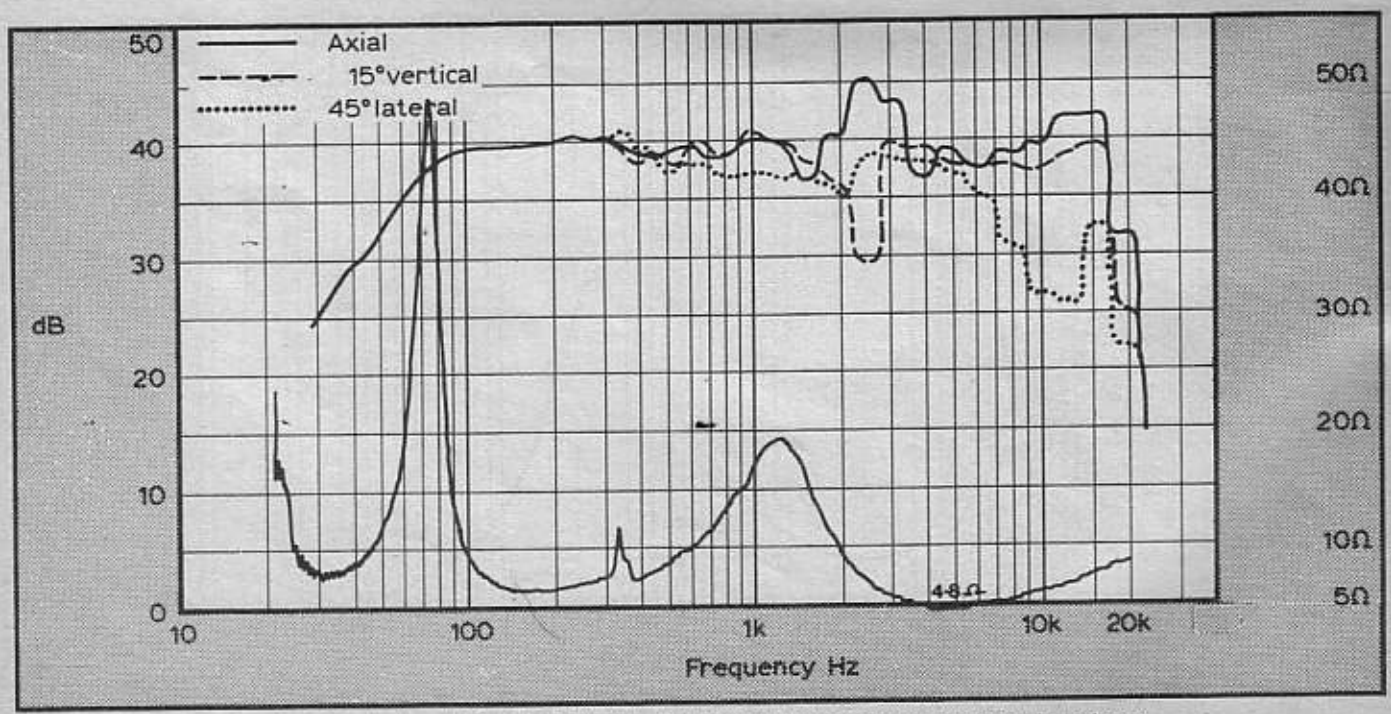
On the 15° vertical axes, the two curves were similar to each other and to the axial response, but with a gentle 2-3dB rolloff in the high treble.

At the 45° angles, the system was symmetrical, showing a smoothly falling response above 500Hz, averaging 4dB down at 7kHz and then accelerating to −15dB at 10kHz, and −18dB at 14kHz, with something of a subsequent recovery to −10dB at 20kHz.

Slightly marred by the axial presence hump, this system was otherwise smooth and well integrated over the forward plane. A wide response was clearly traded for higher efficiency — this being generally the case with the other sensitive systems in the survey.

Accuracy

Scoring just over 4·1, the LM330 was ranked a little below average. The results on individual sounds agreed with this marking except for pedal bass drum, where its performance places it just above average.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Jim Rogers JR 149

ON TEST 30 LOUDSPEAKERS

This unusually shaped compact, two way sealed box system is presented in the form of a cylinder 37cmH and 23cm in diameter, and weighing 5·5kg. The main vertical structure is damped aluminium alloy, with wooden end caps and a wrap round foam grille.

The design apparently owes something to the BBC LS35A and could be considered as a development of that system. The same 100mm Bextrene cone bass-mid range unit and 19mm melinex dome tweeter are employed, together with comparably complex crossovers.

The specification quotes a response ±3dB 75Hz to 20kHz; a nominal impedance of 15 ohms and a maximum amplifier rating of 30 watts.

The system is not intended for close wall mounting and open shelf, spaced wall brackets, or pillar stands are recommended.

LAB REPORT

Pair matching

As small 0·5dB mismatch was noted up to 7kHz, above which the treble outputs diverged by 2-3dB to 20kHz.

Sensitivity

67dBA was recorded which is low, and corresponds to 88dBA for 10 watts or a 60 watt input for the standard 96dBA.

Impedance

The 15 ohm nominal rating was not confirmed as a minimum of 5 ohms at 10kHz was noted, thus indicating a 6·5-7ohm result. Considerable reactive effects were present: 50° at 3kHz where the impedance was 13·5ohms and 40° at 5kHz, 8ohms, both these results further prejudicial to the specified 15-ohm rating. However if taken as an 8-ohm model, these reactive effects should not be harmful to an 8-ohm rated amplifier.

Responses

A 4dB spike in the response at 10kHz, possibly due to reflection from the edge of the top end cap (the HF unit is intrinsically flat) made the overall response less flat than it could be. +3-6dB limits gave 68Hz to 20kHz, and restricting the range to avoid the 10kHz effect allowed narrow ±2·5dB limits from 80Hz to 9kHz.

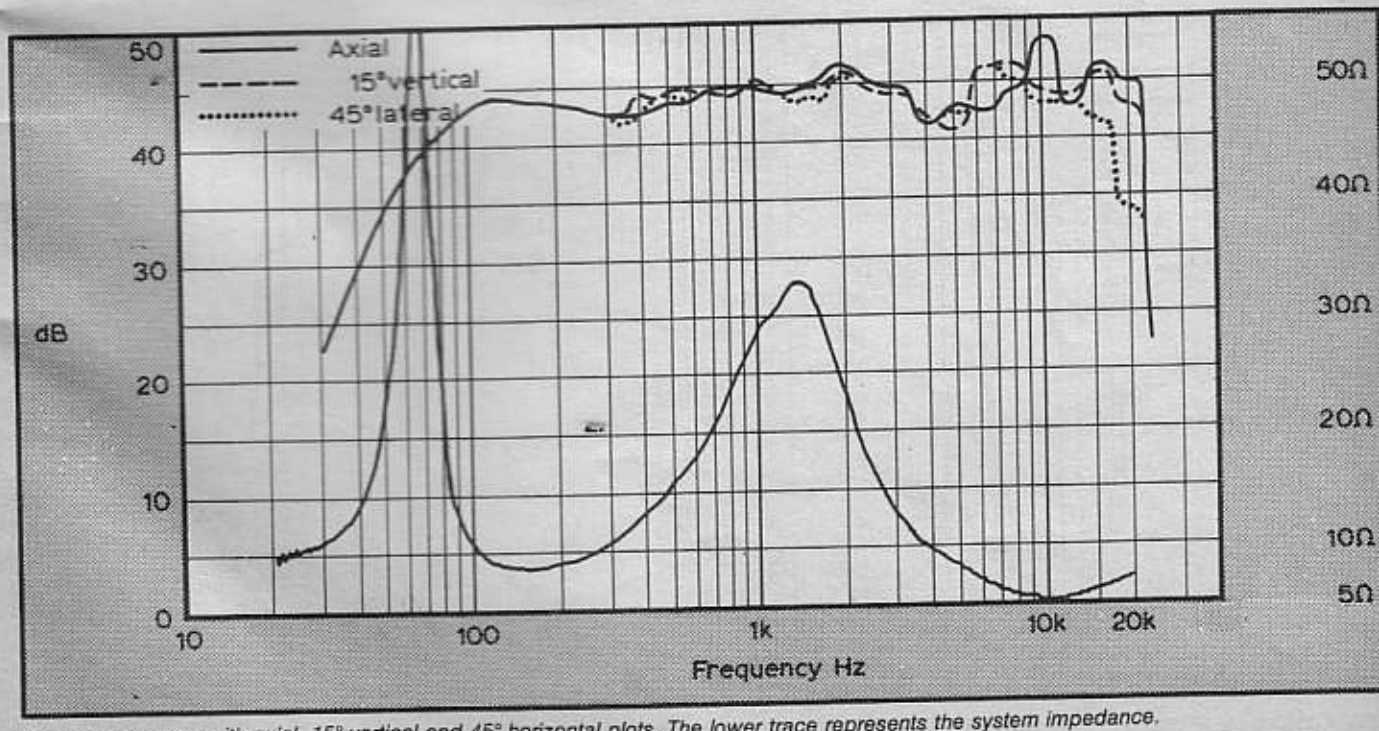
The ±15° responses were fairly flat except for a 10dB notch at 4kHz on the 'above' axis, and some irregularity between 4 and 12kHz 'below' — again these could be due to the end cap effect.

The 45° lateral dispersion was excellent — less than a 1dB droop to 14kHz and then a relatively mild rolloff to 20kHz, −7dB. Even at 45° the response still met ±2·6dB limits up to 16kHz.

An intrinsically even loudspeaker with an outstanding uniformity of response in the forward radiating region, the only penalty was in the form of the restricted bass response and a low efficiency, a problem common to most small enclosures.

Accuracy

To a 95% certainty this speaker attained an outright first placing, scoring 5·6. It was judged outstandingly lifelike of on speech, guitar, cymbal side drum, brush drum and musical box, but was slightly downgraded on pedal bass drum, where its restricted power handling proved its downfall.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Quasar QS2

ON TEST 30 LOUDSPEAKERS

Designed and manufactured in the UK, the weighty (18·15kg) QS2 measures 62·23cm × 33·02cm × 29·21cm. As a three-way bass reflex system, a 12in. plastic/paper cone bass unit with a 4in. midrange and a 2in. horn treble unit comprise the lineup, the crossover points placed at 600Hz and 4·5kHz.

The maximum amplifier rating is given as 50 watts and the impedance 8 ohms with the sensitivity at 3·1 watts for 95dB at 1 metre and the response 55Hz to 18kHz ±3dB.

LAB REPORT
Pair matching

Generally showing a good match, within 1dB odd, small regions of 3dB mismatch were noted at 2·5kHz and 7kHz.

Sensitivity

72dBA was recorded which corresponds to a fairly low 93dBA for 10 watts or 20 watts for the standard 96dBA at 1 metre. Even accounting for the linear mode of measurement, the specification is therefore a trifle optimistic.

Impedance

The measured impedance was also in disagreement with the specified 8ohms — a 4·5 minimum was noted at 2kHz, although fortunately reactive effects were fairly small at this point. At 1·2kHz a high maximum phase angle of 50° was measured, but the 10 ohms impedance recorded at that level rendered it fairly harmless. With the nominal impedance at actually just below 6 ohms, the sensitivity is thus degraded proportionately.

Responses

The axial response was pretty flat with narrow ±2·5dB limits sufficing for a 55Hz to 18kHz range, and increased +3·5-6dB limits allowed for a moderate extension of 42Hz to 20kHz. A slight lumpiness was evident in the midband.

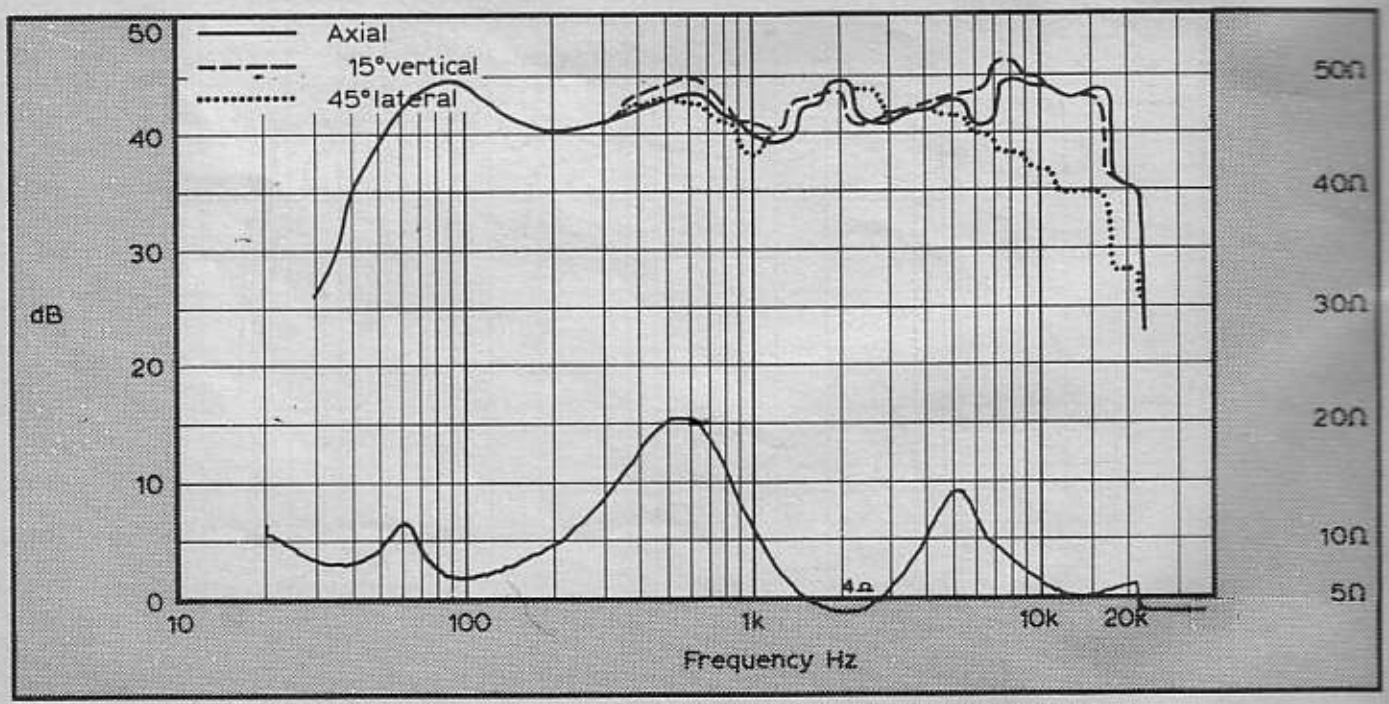
The +15° vertical curve was fine with very little deviation shown from the axial response. 15° below showed increased lumpiness and produced quite an irregular curve. The 'above' axis is clearly preferable — as would be favoured if a small stand were used.

The 45° lateral responses were symmetrical and showed little droop until 7kHz was reached, whereupon the whole treble range fell away to −8dB at 10kHz and −10dB at 15kHz.

Overall this system demonstrated a flat axial characteristic which was well maintained in the forward plane, thus indicating good unit integration at the non-standard measuring distance.

Accuracy

Placed a little above average at 4·5, the Quasar did well on speech and pedal bass drum but was judged poorer than average on guitar, side drum and musical box.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Quad Electrostatic

ON TEST 30 LOUDSPEAKERS

Barely in need of introduction this long established (1956) three way system exhibits an unusual format, basically that of a slightly curved simple baffle. Although only 10½in. deep its frontal dimensions are considerable at 31in. high by 34½in. wide. Owing to the rear radiation which is almost as strong as that from the front, it needs to be positioned at least 0·8m or so from a rear wall.

A 45Hz to 18kHz axial anechoic response is specified together with a nominal impedance of 30-15 ohms (40Hz-8kHz).

A point to note in connection with this enclosure as with other electrostatics is the need for an additional mains supply to each system, although the power consumption is minimal. In addition, the enclosure is practically a plane radiator at domestic distances, and will behave differently in rooms and under measurement by comparison with the normal box speakers, which are virtually point source hemispherical radiators.

LAB REPORT
Pair matching

The two systems supplied matched perfectly to within 0·25dB over the entire range.

Sensitivity

At the 2·5 metre test distance the Quad recorded an above average 74·5dBA, corresponding to almost 96dBA for a 10 watts input at 1 metre. For the reasons stated above this result cannot be compared with that for the other systems, and the practical sensitivity as judged in room conditions compares with the KEF R103, at about 50 watts for a standard 96dBA referred to 8 ohms, and taken at 1 metre. Although over most of the range 50Hz to 5kHz the Quad was well above 8 ohms impedance with almost no reactive component, there were two distinct problem areas.

One was at low frequencies where a 4·5-ohm minimum occurred which was, in addition, highly inductive at an 80° phase angle (due to the step up transformer). The maximum capacitance was less in magnitude but the measured 50° at 10kHz was still high where the impedance was low at 5 ohms. The impedance value continued to fall to a minimum of 2·27 ohms at 20kHz, above which frequency a rise began at last. The cruel nature of this load is clearly apparent, and its known incompatibility with certain amplifiers is understandable. With modern programme material containing full peak power beyond 10kHz, it would be wise to consider this as at best a 5-ohm speaker when choosing an amplifier.

Responses

The axial response at 2·5m was impressive at 55Hz to 16kHz, ±2·5dB, with an expansion to +2·5dB—−6·0dB limits extending the range to 48Hz-20kHz.

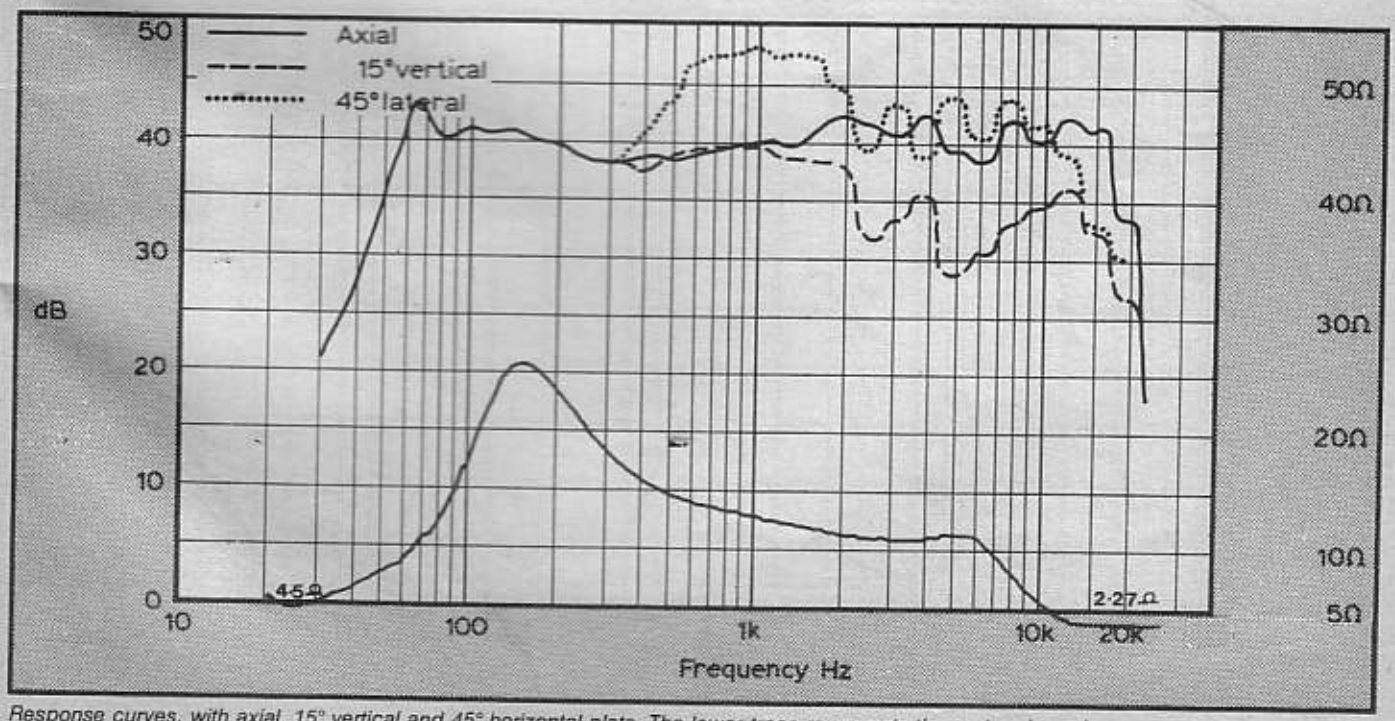
Symmetrical in both the horizontal and vertical planes the 15° vertical axis showed considerable loss compared with the group average. The 400Hz to 1kHz range was 3·5dB down with the rest of the range at −8dB.

At 45° on the lateral axis the 500Hz to 2kHz band was well maintained, but before and after this range considerable loss occurred. The entire 2 to 20kHz band was typically −12dB as was the range up to 200Hz.

In summary although the Quad was pretty flat and well extended on axis, severe loss even at moderate angles off axis was apparent. The forward energy was dominated by the mid range.

Accuracy

Ranked almost average at 4·3, the Quad did well on speech, guitar and cymbal, poorly on pedal drum and musical box, and about average on the side drum.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Mordaunt Short Pageant Series 2

ON TEST 30 LOUDSPEAKERS

This is one of the least costly systems in this report. It is a compact British loudspeaker, utilising an Isophon 25mm dome treble unit in conjunction with a 200mm doped paper cone bass-mid driver built by Mordaunt Short themselves. The crossover point is given as 3·5kHz. Reflex loading is employed for the bass with a resistive port tunnel, and switched level controls are incorporated for 2dB attenuation of mid and/or treble ranges. Stand or open wall mounting is recommended.

A 65Hz to 20kHz ±3dB response is specified together with an impedance of 8 ohms, and a maximum amplifier rating of 100 watts. The quoted sensitivity is above average at 5·3 watts for 96dB (linear) at 1 metre. Dimensions are 53·3cm H × 33cm W × 23cm D and weight 9·6kg.

LAB REPORT

Pair matching

The review pair showed good matching of better than 1dB overall, both in regard to sensitivity and responses.

Sensitivity

74dBA was recorded which corresponds to 95dBA for 10 watts or approximately 12 watts for a nominal 96dBA — an average rating for the survey group.

Impedance

The impedance never fell below 6·2 ohms, and hence the Pageant could be genuinely classed as an 8-ohm system. The phase angle of impedance was never large, typically 20° with a harmless maximum of 33° at 800Hz where the impedance magnitude was 10 ohms. This loudspeaker is therefore easy to drive and the recorded efficiency is confirmed.

Responses

The test response at 60Hz to 20kHz, ±2·5dB, bettered the specification. Proving that this was no fluke, the speaker recorded 65Hz to 20kHz, ±2dB at the 0·5 metre mic distance on sine wave excitation. Expanding the lower limits gave +2−6dB, 50Hz to > 20kHz.

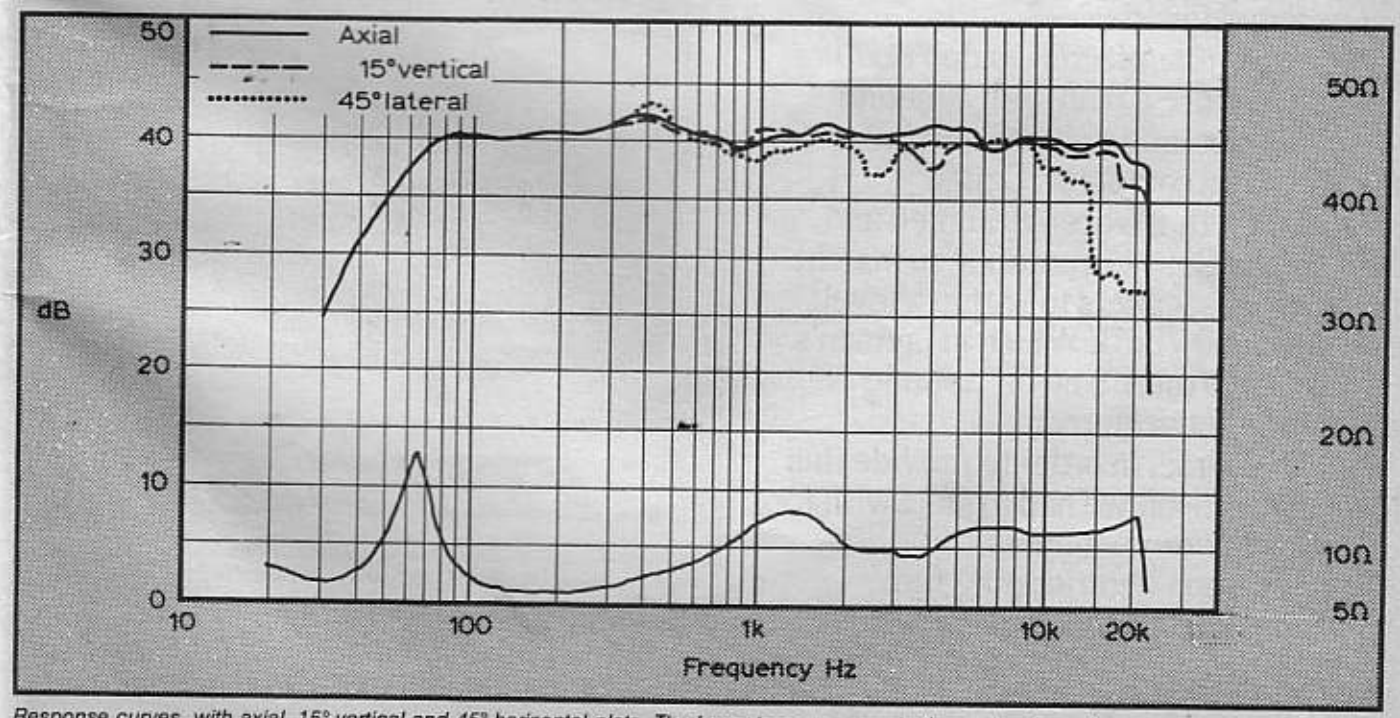
At 15° above very little change was recorded — a couple of dB dip at 4kHz was the major deviation. The 15kHz level was down less than 1dB, and at 20kHz, −2dB. 15° below showed some irregularity between 1kHz and 5kHz with an increased dip at 3·5kHz, but generally little change was noted.

The 45° lateral responses were symmetrical (symmetrical driver placement in the vertical plane) and showed a negligible loss up to 9kHz, with the exception of a small suckout of 2-3dB from 2kHz to 6kHz. Beyond 10kHz came the expected rolloff −12dB at 15kHz and 20kHz.

Overall then, we have a loudspeaker which measures very flat, with even, well maintained off axis responses. A listening position fractionally above the mean axis would seem ideal as would occur if mounted on a stand some 25cm high.

Accuracy

This model was highly ranked at equal third, achieving a rating of 5·0. It did particularly well on speech but poorly on pedal drum and was generally judged above average on all the other sounds.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

KLH CB10

ON TEST 30 LOUDSPEAKERS

This small, presumably bookshelf mounting speaker is a two way system comprising a 250mm paper pulp bass cone unit and a 55mm paper cone, treble driver. A very small port backed by a tube tunes the cabinet, and the fabric covered side panels are purely decorative and do not conceal any further drive units.

The minimum amplifier power is given as 10 watts, with the brochure declaring the CB10 'can be safely used with even the highest powered amplifier designed for home use'! The rated impedance is given as 8 ohms, and a ± treble control is provided on the rear panel.

LAB REPORT

Pair matching

Pair matching was fine over the bass and midrange, beyond which some areas of 4dB mismatch were evident. The agreement improved to 1-2dB higher up the frequency range.

Sensitivity

75·5dBA was recorded — a fairly high result corresponding to 96·5dBA for 10 watts input at 1 metre mic distance.

Impedance

Reactive effects were low with the maximum of 25° occuring at 4·5kHz. An impedance minimum of 5·5 ohms was recorded at 10kHz, making the system nominally 7 ohms — in other words not far from the specification.

Responses

A suckout between 3·5kHz and 5·5kHz dictated at best ±6dB amplitude limits allowing a 65Hz to 18kHz response. The restricted bass register was disappointing in a system with such a good size bass driver.

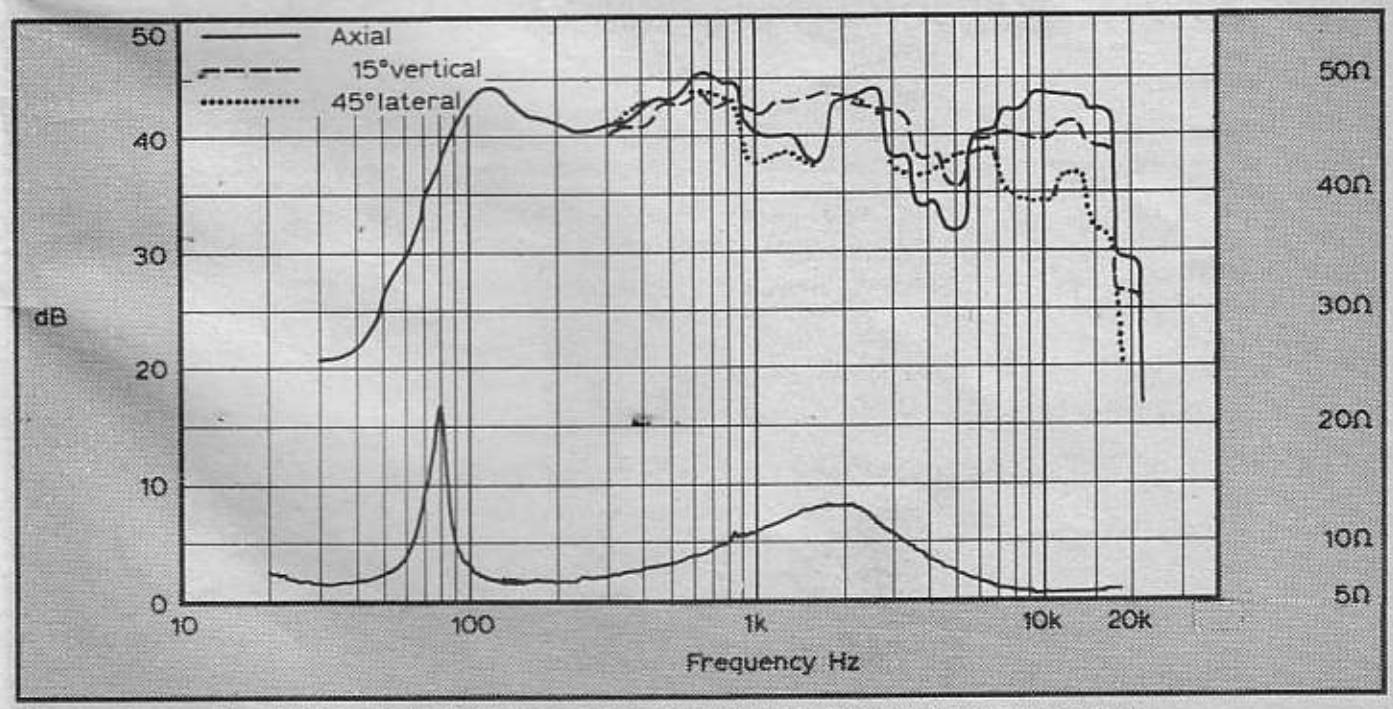
The 15° off axis responses below were irregular, and the 10kHz band fell by 3dB — a significant amount considering the small measuring angle. 15° above produced a smoother result, with the response now capable of meeting a ±4dB limit to 18kHz.

At a 45° measuring position, a small 2dB loss was shown over the 500Hz to 5kHz range, before the expected rolloff of −1dB at 10kHz and −14dB at 17kHz occured.

Overall the CB10 produced a rather uneven and restricted response which proved somewhat smoother 15° above the normal axis. The dispersion was not very wide at the higher frequencies.

Accuracy

Ranked well below average at 3·8, this marking was confirmed by the panel on all sounds bar musical box, where an average score was denoted.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

KEF R103

ON TEST 30 LOUDSPEAKERS

Recently introduced and joining KEF's new Reference series, the R103 is a compact sealed box enclosure measuring 58cm H x 33cm W x 22·5cm D. At 19kg its weight is certainly substantial for its size, and the cabinet has considerable internal treatment to control the usual panel and cavity resonances. It is a two way system with a 200mm doped, plastic-cone bass mid-range unit operating up to 3kHz, beyond which a shallow Melinex dome about 40mm in diameter continues the response up to 20kHz. The amplifier rating is given as 100 watts with the frequency response a tightly specified ±2dB 50Hz to 20kHz. The impedance is stated as 8 ohms, and the sensitivity '25 watts into 8 ohms for 96dB, 400Hz, 1 metre.'

A special feature is the rotatable front baffle which allows vertical alignment of the drive units whether the cabinet is placed in a horizontal or upright position.

LAB REPORT

Pair matching

The overall pair matching was very good — typically within 0·5dB, except about 15kHz where a 3dB divergence occured.

Sensitivity

68dBA was recorded — one of the lowest values for the group. At 1 metre the 10 watt equivalent is 89dBA, with 50 watts required to produce the standard 96dBA.

Impedance

It is fortunate in view of its low sensitivity that the R103 is easy to drive. Whilst considerable reactance occurs — 60° at 3kHz, — the impedance at this point is a harmless 27 ohms. It never fell below 9 ohms, thus allowing the speaker to be classed at a nominal 11-ohm rating. The bass resonance peaked at 64Hz, 25 ohms.

Responses

At the test 2·5 metre distance, the response met ±2dB limits from 125Hz to 20kHz. A slight bass hump was evident which may be accommodated within a +3dB excursion. With +3—6dB limits the R103 gave a wide 40Hz to <20kHz range.

15° above axis the response still held to the axial limits up to 15kHz, above which level a slight −2dB droop occurred at 20kHz.

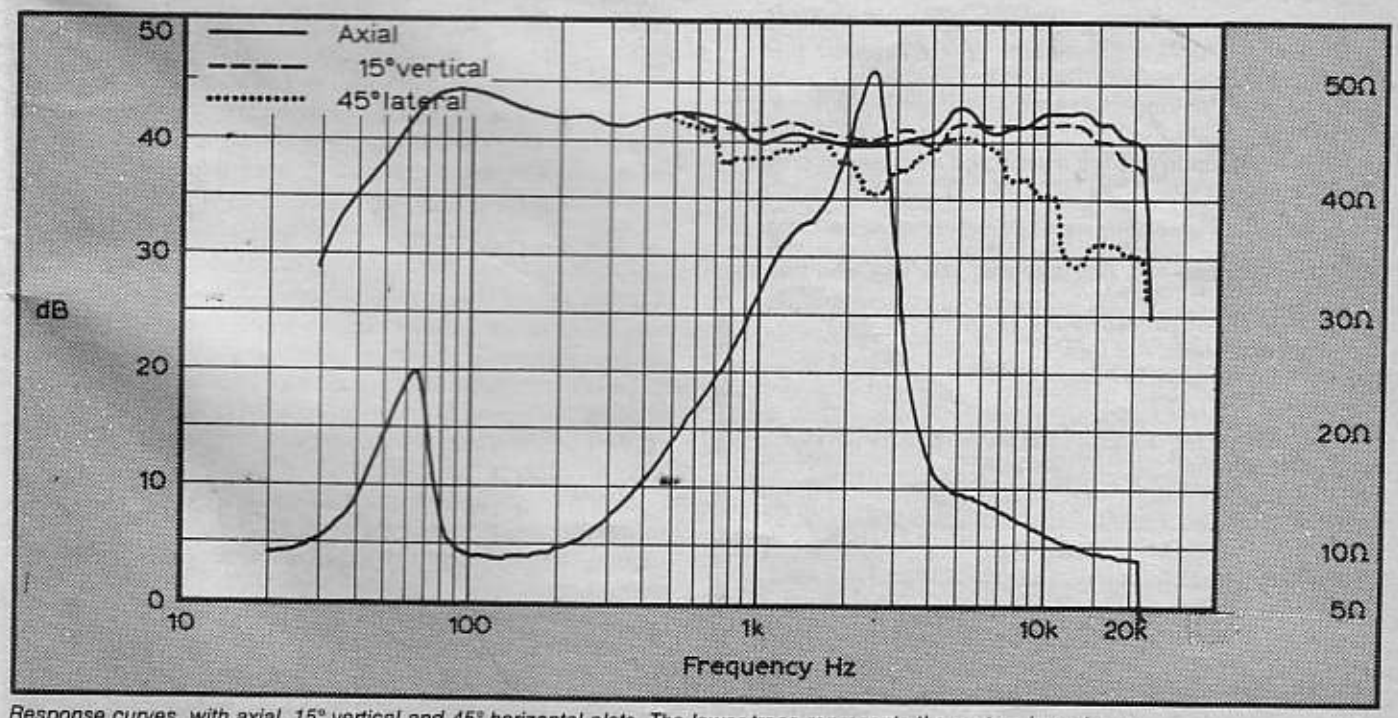
The curve 15° below showed an irregularity — namely a trough 9dB deep between 2·2kHz and 4·6kHz, presumably an interference effect around the crossover point.

The 45° lateral responses were good - typically 3dB of droop from 500Hz to 7kHz — with the expected increasing rolloff beyond, and falling to 15dB average from 12kHz to 20kHz.

Overall this model achieved a very flat, well controlled output in the forward plane with the optimal listening axis on or slightly above the treble unit. A small lift characterises the bass register.

Accuracy

Scoring an above average 4·6, the R103 was fairly highly ranked at equal fourth. It did well on speech but was judged below average on side drum; brush and sticks, and about average on the remaining material.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

JBL L36

ON TEST 30 LOUDSPEAKERS

An American 'bookshelf' loudspeaker, the L36 is the lowest priced three-way system in JBL's range. Measuring 61cm H × 34cm W × 35cm D, the L36 weighs 20kg. A 250mm rigid pulp cone bass unit plus 130mm paper cone mid range and a 3·6cm cone tweeter comprises the drive unit array. No frequency response is quoted but an 8-ohm impedance rating is given, together with a maximum amplifier power of 100 watts. The bass driver is reflex loaded and a fairly high sensitivity is predicted by the '1 watt for 76dB at 15 foot distance' specification. Mid and treble controls are provided.

LAB REPORT
Pair matching

Whilst the 'A' weighted sensitivities were close, a clear 3dB mismatch was apparent over the bass driver range. Over the remaining band from 1·5 to 20kHz, generally they agreed to better than 0·5dB, and thus bass mismatch was judged in this case to be an isolated fault confined to this particular sample.

Sensitivity

78dBA was recorded which corresponds to 99dBA for 10 watts at 1 metre or 5 watts for the standard 96dBA. This was a high sensitivity but there was a penalty incurred in terms of frequency range, and the true sensitivity was in fact somewhat less, owing to the lower measured-than-quoted impedance.

Impedance

A minimum impedance of 4·8 ohms was registered at 10kHz with the controls flat, which places the nominal impedance at 6 ohms. The rising treble response suggests that the treble control could be turned down to advantage, which would lift the impedance minimum. The maximum phase shift was 40° at a harmless high impedance point, and hence the system should not be difficult to drive.

Responses

This loudspeaker was disappointingly uneven — in fact so much so that the wide ±6dB limits occasionally used in this report proved insufficient and a ±8dB amplitude range was necessary to contain the mean axial response. At these limits a 50Hz to 18kHz range was possible.

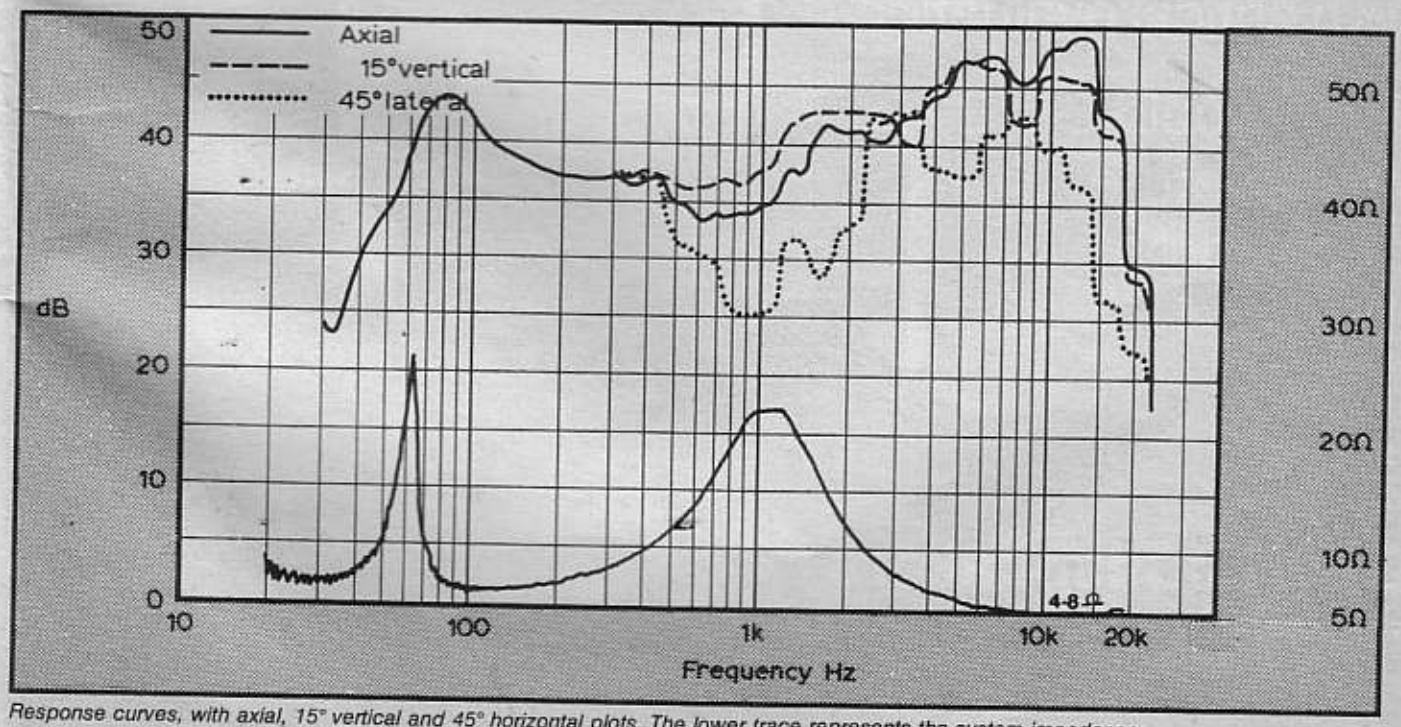
The 15° vertical curves were similar, and on average showed a satisfactory 2dB droop at frequencies of over 500Hz.

45° to the right gave an irregular curve with a broad trough of −8dB over the range 500Hz to 2kHz, and overall an 8dB droop. The left hand response was rather smoother with the 8dB roll-off only appearing at 3kHz. The lateral symmetry was considered fairly poor in the important mid band.

Overall the system showed a strong 'loudness' effect — a bass hump plus rising treble — both of which were quite severe. The frequency range was also restricted for a system carrying a purchase price of around £300.

Accuracy

Marked below the mean at 4·0, the L36 rose to the average on guitar but fell appreciably below this on the other sounds.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

IMF TLS50-II

ON TEST 30 LOUDSPEAKERS

The TLS50II represents IMF's latest version of their established transmission line or damped labyrinth bass loading system. Nevertheless, it is a full floor standing enclosure measuring 92cm H × 38cm W × 36cm D and weighs 27kg.

A four-way design, it combines an advanced 200mm Bextrene cone bass unit with a 100mm treated paper cone mid range, and a 25mm fabric dome tweeter, plus a 12mm (approx) plastic dome to handle the high range treble. Crossover points are nominally 375Hz, 3kHz and 15kHz. A vague 4-8-ohm impedance is quoted together with a low efficiency of 40 watts for 97dBA. The amplifier rating given is up to 70 watts, and the nominal frequency response as taken from the manufacturer's brochure measures ±4dB, 35Hz to 20kHz. A midrange level control is fitted and additionally the manufacturer's claim a wide dispersion.

LAB REPORT
Stereo matching

A very close match was shown overall, the greatest deviation being less than 1dB near 5kHz.

Sensitivity

71dBA was recorded, which is low but not the lowest for the survey group. The equivalent is 92dBA for 10 watts or 25 watts for 96dBA at 1 metre.

Impedance

On test the impedance proved rather nearer to 4 ohms than the 4-8 ohm rating would suggest. Minima of 3·8 ohms at 600Hz, 4·5ohms at 31kHz and a phase angle of 45° at 5 ohms, all suggest a 5-ohm nominal rating. The reactive component was considerable at some points — for example, 50° was recorded at impedance 8·5ohms. This finding places the recorded sensitivity in a poorer light.

Responses

The region 200Hz to 20kHz was relatively even and met ±3dB limits, with a dip at 140Hz dictating the LF cut off on this range. Expansion to +4dB—6dB allowed a 45Hz to 20kHz range. Noteworthy is the well maintained low octave 50Hz to 100Hz and the even mid-band — 200Hz to 2kHz, ±2dB.

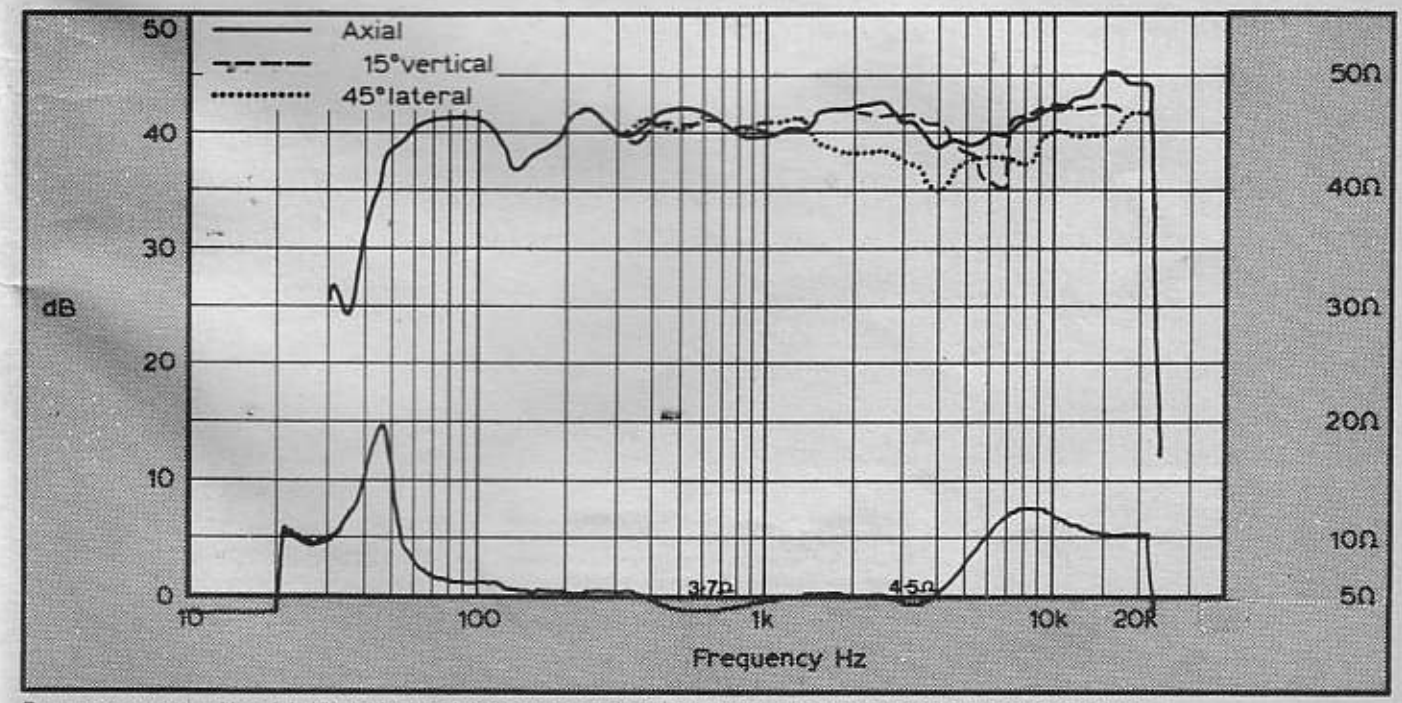
The 15° above response was practically identical to the axial characteristic. 15° below was similar but with a 10dB dip from 3-4kHz.

At 45° off axis, the lateral symmetry was pretty good, despite the unusual driver configuration. A ±4dB 50Hz to 20kHz response was still met, thus indicating a wide and even dispersion irrespective of the extreme angle.

Overall the curves revealed a wide range system with a very even mid band and good unit integration capable of providing good dispersion in the forward plane.

Accuracy

Ranked a little better than average, the IMF scored 4·5. It was rather above the mean as regards speech, guitar and cymbals, but was worse on bass and side drum.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Goodmans Achromat 400

ON TEST 30 LOUDSPEAKERS

The Achromat 400, a stand-mounted unit, has been available for a couple of years now. It is a sealed box enclosure, with three drivers: namely a 250mm paper/-plastic laminated bass cone, a 44mm fabric dome midrange and a 25mm fabric dome tweeter. Reasonably dimensioned at 67·7cmH × 32·7cmW × 29·2cmD, it weighs 16·5kg.

An ambiguous music power rating is quoted for the speaker, which is estimated to correspond with a maximum continuous amplifier rating of approximately 50 watts per channel. ±5dB limits are given for the axial response, which covers 40Hz to 22kHz limits. An 8-ohm impedance is specified and the crossover points are placed at 900Hz and 3·5Hz.

LAB REPORT
Pair matching

The agreement between the pair supplied was generally to a fine 1dB tolerance, except at 20kHz where a 5dB discrepancy was noted — high enough in the range to be inconsequential.

Sensitivity

70dBA was recorded which corresponds to a value of 91dBA for a nominal 10 watts input. To raise the standard 96dBA 32 watts are required, this representing a low sensitivity reading.

Impedance

The specification is a trifle optimistic if the British Standard is used as a basis for measurement, as a minimum of 5 ohms was recorded at 90Hz, placing the nominal value nearer to 6 than 8 ohms. This lower impedance implies that the sensitivity is poorer than that stated above, which was based on an 8-ohm reference.

Significant reactance was present in the impedance — for example a 43° shift at 230Hz — but the impedance value of 11 ohms at this point means that the effect will not be serious in terms of added amplifier loading.

Responses

The lower section of the axial response was promisingly even ±3·5dB over 45Hz to 9kHz, but above that the treble showed a uplift of 5dB. Expanding the limits to +7-6dB just allowed a 40Hz to 20kHz range — these margins are rather wide, and do not come very near those specified.

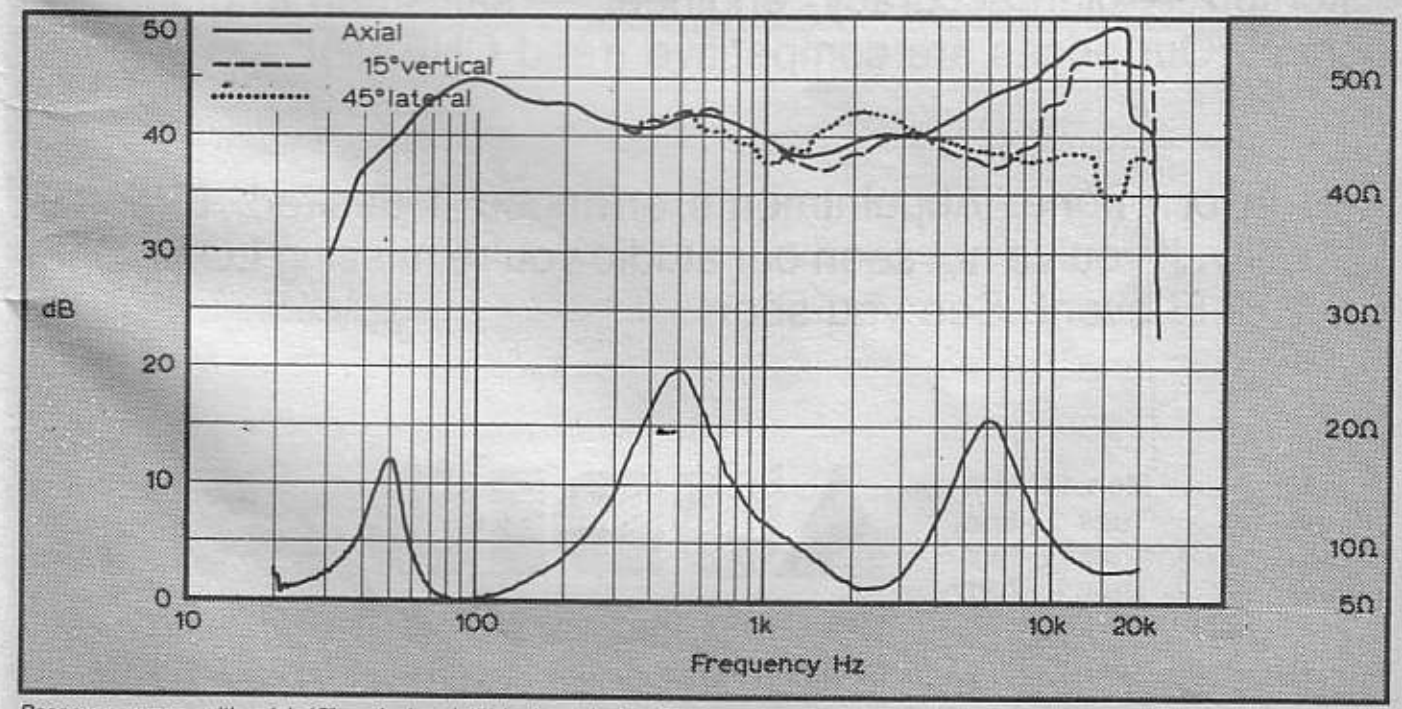
The vertical plane ±15° traces were very different. At +15° the axial characteristic was maintained to 5kHz, and from 5kHz to 10kHz a 5dB trough occurred. The response recovered above 10kHz but at 20kHz a strange reversal occurred with the response then +5dB (due to the short 'phase horn' on the tweeter). On 15° below axis, a major mid band suckout of typically −4dB was present, but reached a low of −12dB at 4kHz.

On the 45° lateral axis (symmetrical) the response fell off very little until 4kHz whereupon the output rolled off smoothly: −10dB at 10kHz, −15dB at 15kHz and −4dB at 20kHz.

The general characteristic was that of a system tailored to reproduce a flat energy response, the rising treble being typical of such a design. At present, available evidence suggests that a nominally flat axial response is preferable, but we must await the results of the final listening tests to confirm or deny this.

Accuracy

Scoring well below average at 3·7, the Goodmans being judged poor on speech, guitar and cymbal. By contrast on pedal drum and musical box it scored just above average, but fell again to just below the mean on side drum.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Exact Acoustics RH4

ON TEST 30 LOUDSPEAKERS

Weighing 10kg and measuring 62·2cm H × 25·4cm W × 25·4cm D, this new loud speaker released at Hi-Fidelity 76 is a four way bass reflex system, incorporating a 200mm bextrene bass driver, a 75mm paper cone mid range, with a 38mm plastic dome treble unit and a 19mm mylar super treble dome. Limits of ±4dB are quoted with respect to a nominal 70Hz to 15kHz amplitude frequency response. A matching maximum amplifier rating of 50 watts, an impedance of 8 ohms and an efficiency of 5 watts for 94dB at 1 metre are also specified, and the system comes complete with a floor stand.

LAB REPORT

Pair matching

The match was pretty good — generally within 1dB over the range.

Sensitivity

72dBA was recorded — a little below average. This corresponds to 93dBA for 10 watts or 20 watts for the standard 96dBA; rather different from the linear specification.

Impedance

Deviating noticeably from the specification, 4ohms was recorded at 2·7kHz, 6kHz and 12kHz. Reactive effects were fairly small, the maximum of 24° occurring at quite a low impedance 5 ohms at 2kHz. Overall a 5-ohm nominal rating would be fair, which downgrades the recorded sensitivity by nearly 3dB.

Responses

The specified axial response limits of 70Hz to 15kHz were met at ±3·5dB, and extended +4-6dB limits expanded the response to 55Hz-17kHz. A characteristic of the speaker was its gently rising treble response, which rolled off above 13 kHz.

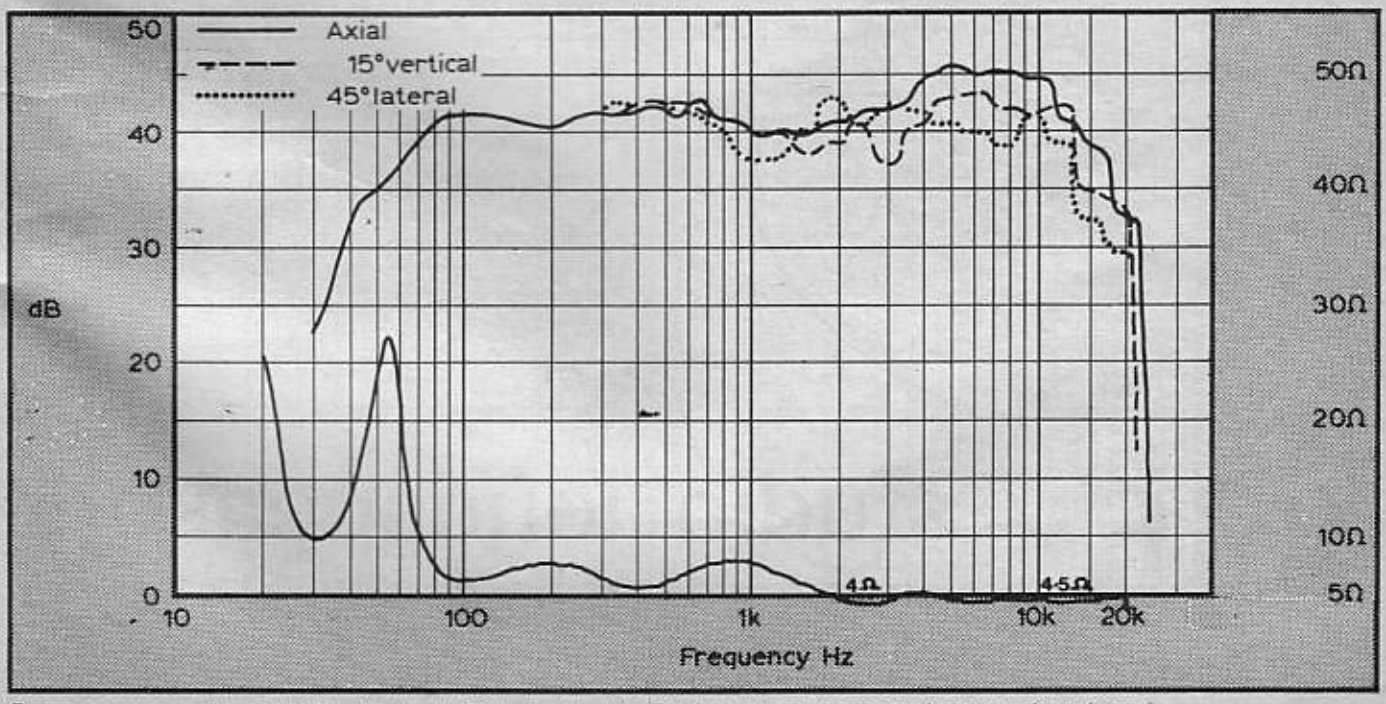
The '15° above' curve showed little change from the axial response, with the exception of a small loss above 2kHz and a dip at 3kHz, and the 15° below curve was also fairly close if generally less even.

At 45° off axis (a vertically symmetrical system) only a 2dB odd droop was noticeable at up to 4kHz, with −5dB typical above, much less than with many other systems in the survey group.

The RH4 thus illustrated a fairly flat response, with excellent dispersion and forward radiating uniformity.

Accuracy

The Exact was rated significantly below average at 3·9. Examination of the results for each sound showed a general agreement with this ranking except for the musical box where the rating was a little above average.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Celestion UL10

ON TEST 30 LOUDSPEAKERS

The UL range represents Rola Celestion's recent entry into the low efficiency, wide response field, these new compact enclosures all incorporating Bextrene cone units. A 250mm driver with a high power 33mm voice coil is fitted to the UL10, a sealed box system. To complete the line up of this three way design, a 37mm soft dome mid unit and a 19mm mylar dome tweeter are employed, with the crossovers placed at 700Hz and 5kHz. Measuring 67·3cm Hx 31·7cm W × 38cmD, this system weights in at 23·5kg.

Specified data includes a 4-8 ohm impedance, with a maximum amplifier rating of 100 watts, and a ±2dB response over 40Hz to 20kHz.

LAB REPORT
Pair matching

Both gave the same sensitivity within 0·25dB, and the response match was excellent over the entire range.

Sensitivity

68dBA was recorded on test which is undoubtedly low. This corresponds to 89dBA for 10 watts at 1 metre, or 50 watts for the standard 96dBA. No wonder the amplifier rating is so high.

Impedance

The impedance minimum was 4·5 ohms at 2kHz, which allowed for a nominal 6 ohm rating. In view of that figure, the significant maximum phase angle of impedance, namely 43° capacitive at 1kHz, 8 ohms, does not in fact represent a danger area. The 6 ohm impedance means that the true efficiency is rather lower than the 8 ohm based figure recorded under 'sensitivity'.

Responses

At 2·5 metres the response, even on pink noise, was not as smooth as the spec. would suggest. Within ±3·5dB, a 38Hz to 18kHz range was achieved, and by extending the amplitude limits to +2-6dB, 30Hz to 20kHz was recorded. Noteworthy is the extended bass response, unusual in this size of cabinet — but the obvious penalty for this bass extension is seen in the recorded low sensitivity.

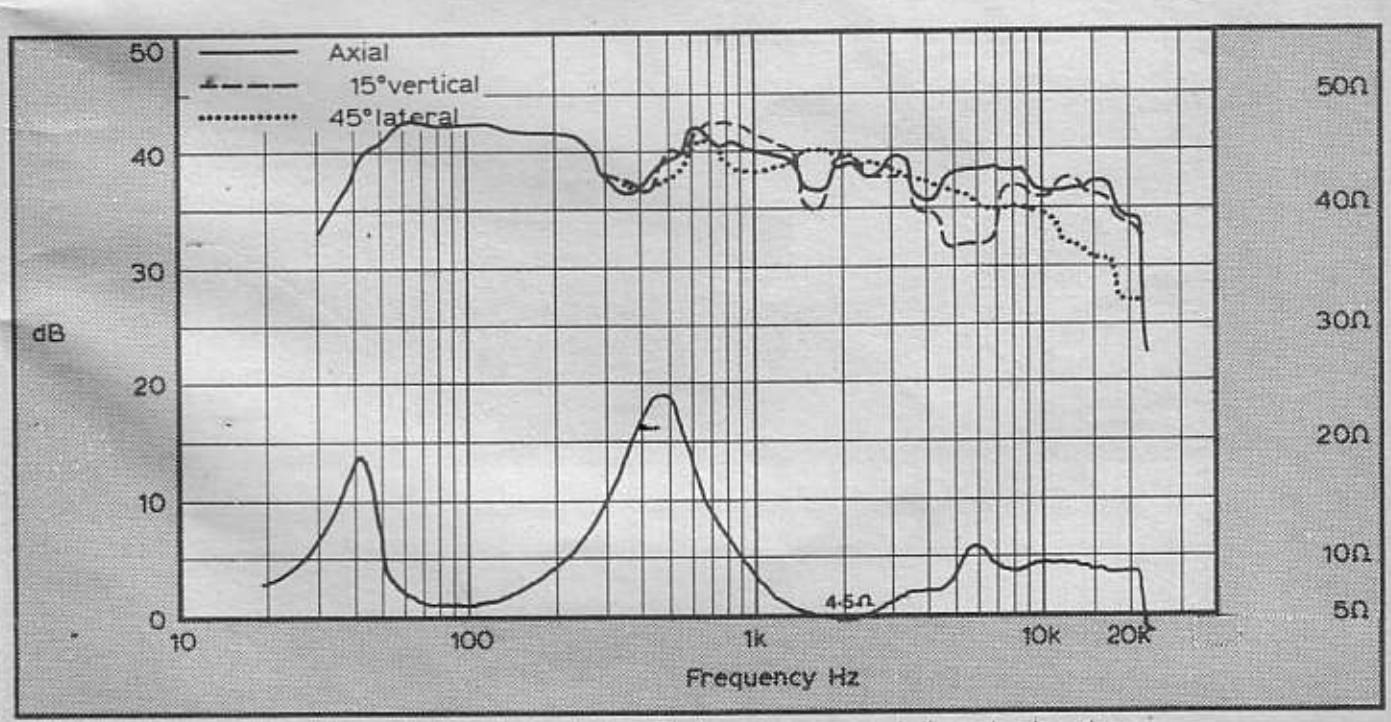
As would be expected from the drive unit types, the vertical plane, ±15° responses were generally close to the axial curves. The main irregularities consisted of a 5dB trough from 4·5-7kHz on the +15°, and a dip of 5dB around 400Hz at −15°, both effects being associated with the crossover frequencies. Otherwise the falloff was less than 2dB, and typically less than 1dB.

Plots taken at 45° on the horizontal axis showed perfect symmetry with a very smooth, even fall-off with increasing frequency. The loss held to −5dB at 10kHz, −6dB at 15kHz and −12dB at 20kHz.

Overall, the UL10 would seem to be pretty smooth in its response and well extended at the extremes, with very good dispersion in the forward planes. It is possible that some attention to the crossover could further improve the ±15° response, but as it stands, this aspect of its performance nonetheless rates highly.

Accuracy

Equally ranked with the IMF at 4·7, the UL10 is slightly above average as regards its 'truth to life' qualities. Confirmed by its individual ranking on most sounds, the UL10 was however significantly above average on pedal bass drum.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Celef Mini-Professional

ON TEST 30 LOUDSPEAKERS

Celef Audio Ltd is a relative newcomer to the British Loudspeaker field. The review system is intended for stand mounting away from walls, and measures 58·4cmH × 30·5cmD × 27·9cmW. Essentially a two unit design, the 200mm Bextrene coned bass mid-driver is loaded by a reflex enclosure with large twin ports backed by length-extending tubes. An array of smaller tubes or straws, arranged in the ports, is said to provide resistive damping, with reduced bass distortion. The crossover frequency is approximately 3kHz, above which a 25mm, doped fabric, dome tweeter takes over. The system is specified at 1 metre on pink noise as delivering a response of 70Hz to 20kHz ±2dB, with ±3dB limits applying to sine excitation. An 8 ohm impedance is quoted with a 6·5 minimum, and the suggested maximum amplifier rating is 80 watts.

LAB REPORT

Pair matching

Overall, the sensitivity match was within 1dB, and except for a small region of 4dB difference between 900 and 1500Hz, the general response agreement was within 0·5dB. One enclosure was 2dB up in this band and the other 2dB down, so the effect was not very serious.

Sensitivity

71·5dBA was recorded on test, which corresponds to 92·5dBA at 1 metre for 10 watts referred to 8 ohms. 22 watts were needed to raise the standard 96dBA level. These figures are quite low if not actually the lowest measured.

Impedance

From the curve the speaker is seen to be correctly specified at 8 ohms, with the minimum value at 7 ohms. The characteristic is smooth particularly at low frequencies, this latter effect no doubt due to the resistive bass port damping. The phase angle reached a significant maximum of 45° at a point where the modulus of impedance was 7 ohms. This is clearly the level at which the greatest load occurs, and at the highest volume levels some premature clipping of a highly protected amplifier might result from this reactive content. The relatively high impedance value is a helpful aspect and in practice is unlikely to prove a problem.

Responses

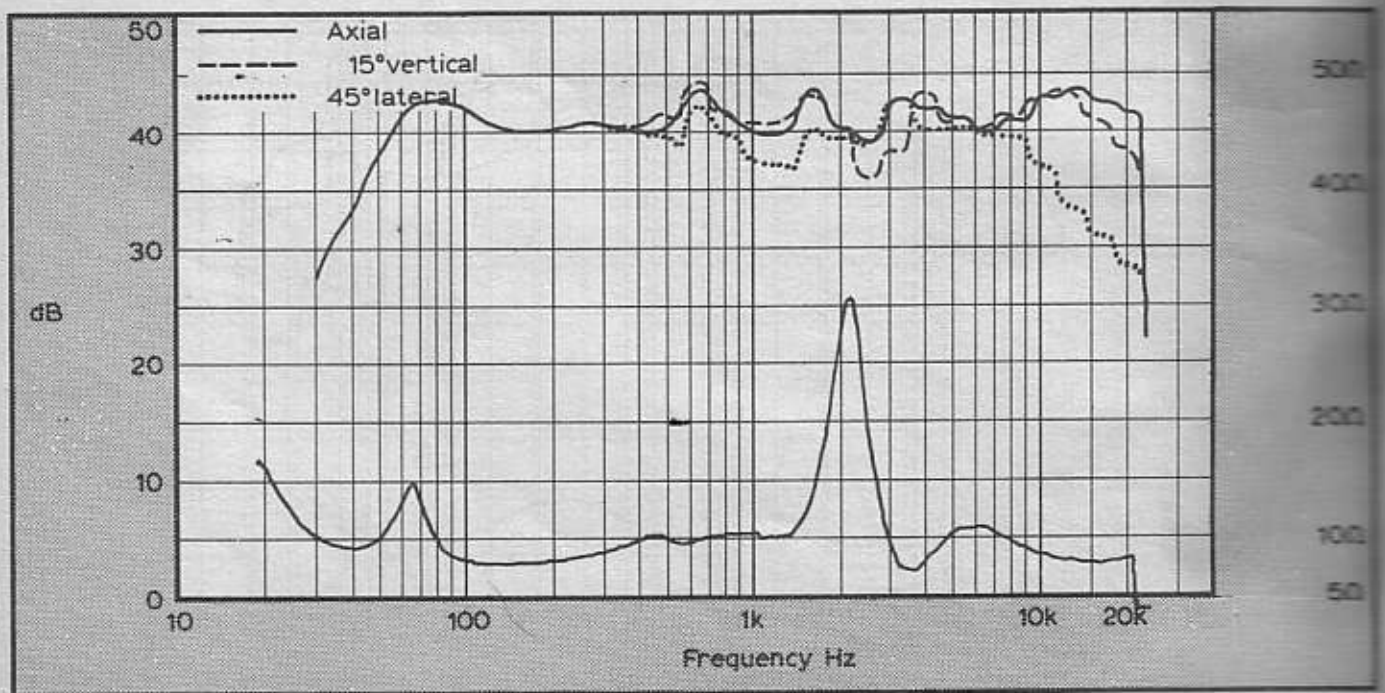
At the 2·5 metre measuring distance, the Celef achieved a very creditable 50Hz to 20kHz axial response within ±2·5dB limits. With an expanded +2-6dB excursion, 45Hz to >20kHz was recorded, with both boxes in the pair meeting these limits. The ±15° vertical responses were also very good, particularly the +15° one, which showed less than a 1dB droop all the way to 10kHz, with 20kHz coming at only 2dB down. 15° below axis, a −6dB dip appeared over a narrow 2·5kHz — 3kHz band and was not considered to be serious.

On the lateral axis the design showed perfect symmetry due to the balanced, vertical-in-line driver placement, and exhibited very little loss at 45°. A 3dB droop between 800 and 2kHz was present, with a full recovery until beyond 6kHz where the inevitable treble roll-off occurred, although this was pretty good as judged by the group standard: −6dB at 10kHz and −12dB at 20kHz.

Overall a well integrated and uniform response was demonstrated over the all important forward planes.

Accuracy

Scoring above average at just over 4·6, the Celef falls in the top 9. It was judged to be particularly good on cymbals and also did well on all the drum sounds and the musical box. It was less successful on speech and was poorer still on guitar.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Bose 501

ON TEST 30 LOUDSPEAKERS

This floor standing system intended for placement against a room rear wall, is a two way enclosure employs a forward facing paper cone bass-mid driver, with two treble units positioned on the left and right hand sides of the cabinet, intended to provide a wide lateral dispersion coupled with wall reflections. Due to this unconventional layout the measurements are not strictly comparable with other systems — particularly those relating to frequency responses.

Measuring 60·96 cmH × 36·83 cmW × 36·83 cmD, the system needs no stand. The specified impedance is 4 ohms, the power handling 100 watts, but no frequency range is quoted.

LAB REPORT

Pair matching

Generally to within ±1dB in the bass and mid range, a clear 2-3dB mis match was noted in the treble register.

Sensitivity

Measured anechoically on the frontal axis 73dBA was recorded but as this did not account for much of the treble response I would estimate the realistic figure to be of the order of 76dB, when side radiation is accounted for. This would translate into 97dBA output for 10 watts or 8 watts for the normal 96dBA — quite a sensitive system.

Impedance

A minimum of 4·5 was recorded resulting in a nominal impedance of 5·5 ohms. The bass resonance at 53Hz was highly damped rising to only 10·5 ohms and the reactive effects were small, never exceeding a 30° phase angle. If the true efficiency is thus considered, this lower than specified impedance degrades the recorded sensitivity by about 2dB.

Responses

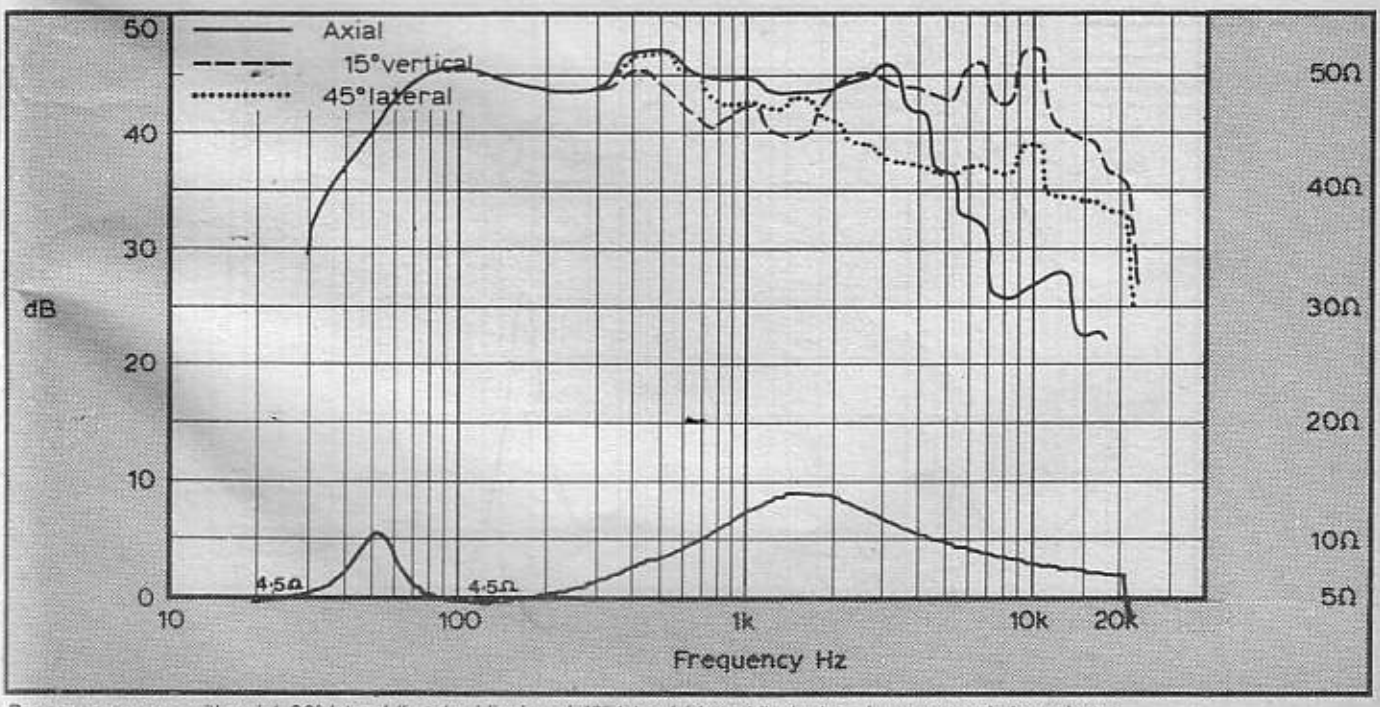
Sections of the Bose's response were surprisingly flat — ±2·5dB for the range 60Hz to 3·5kHz on axis but as the speaker was rotated through 15°, 45° and finally 90° to present the tweeter axis to the microphone, the mid-band became somewhat depressed. At 90° the addition of tweeter resulted in a fairly flat curve with ±4dB, 50Hz to 16kHz with the −6dB point at 40Hz.

The subjective room tests in stage two should act as a check on these frequency response results.

Accuracy

The Bose was placed well below average attaining 3·6 under the test conditions which may have proved a trifle unfair to this type of dispersive radiating system.

On the individual sounds this low ranking was maintained, with the exception of voice where the rating was equal to that for the group average.



Response curves, with axial, 90° lateral (hatched line) and 45° lateral (dotted line) plots. Lower trace is impedance.

B&W DM5

ON TEST 30 LOUDSPEAKERS

The DM5 is a small, two way, sealed box system ideally bracket mounted in a vertical position, and employs a 170mm Bextrene bass-midrange driver together with B&W's own 19mm fabric dome tweeter, the crossover point set at 4·5kHz. Cabinet panel damping pads partly account for its 9·5kg weight, the overall dimensions being 45·5cm H × 22·7cm W × 24·1cm D.

The frequency response is quoted at ±5dB 100Hz to 20kHz, the maximum amplifier rating at 25 watts and the nominal impedance 8 ohms. The efficiency is stated as 6·8 watts for 95dB at 1 metre (referred to 8 ohms) and a two amp fuse is fitted for protection against gross amplifier overload.

LAB REPORT
Pair matching

The frequency responses from the two review systems agreed to within 1dB, indicating a fine match.

Sensitivity

73·5dBA was recorded, which corresponds to 94·5dBA for 10 watts at 1 metre, or about 15 watts for the standard 96dBA, which is a fairly low reading. (See impedance.)

Impedance

The small rise to 17 ohms showed good damping of the main 60Hz bass resonance, but above this range the impedance characteristic was pretty wicked. Several danger points were present — a vicious 2·9ohm minimum at 12kHz; a 4·3-ohm minimum at 200Hz and an awkward combination of considerable reactance, namely 64° at 4·5kHz where the impedance was 7·5 ohms. The phase angle was still 45° at 6·8kHz, where the impedance had dipped to 3·4 ohms.

This overall characteristic implied a nominal value of no higher than 4 ohms, and this should be borne in mind when choosing a matching amplifier. It also degraded the recorded sensitivity by 3dB, implying a true, rather low value of 30 watts for 96dBA at 1 metre, 4 ohms.

Responses

While the axial characteristic was a trifle lumpy it virtually bettered the spec by a factor of 2, meeting ±2·5dB limits over the range 125Hz to 20kHz. With extended +4—6dB limits a 65Hz to >20kHz range could be accommodated.

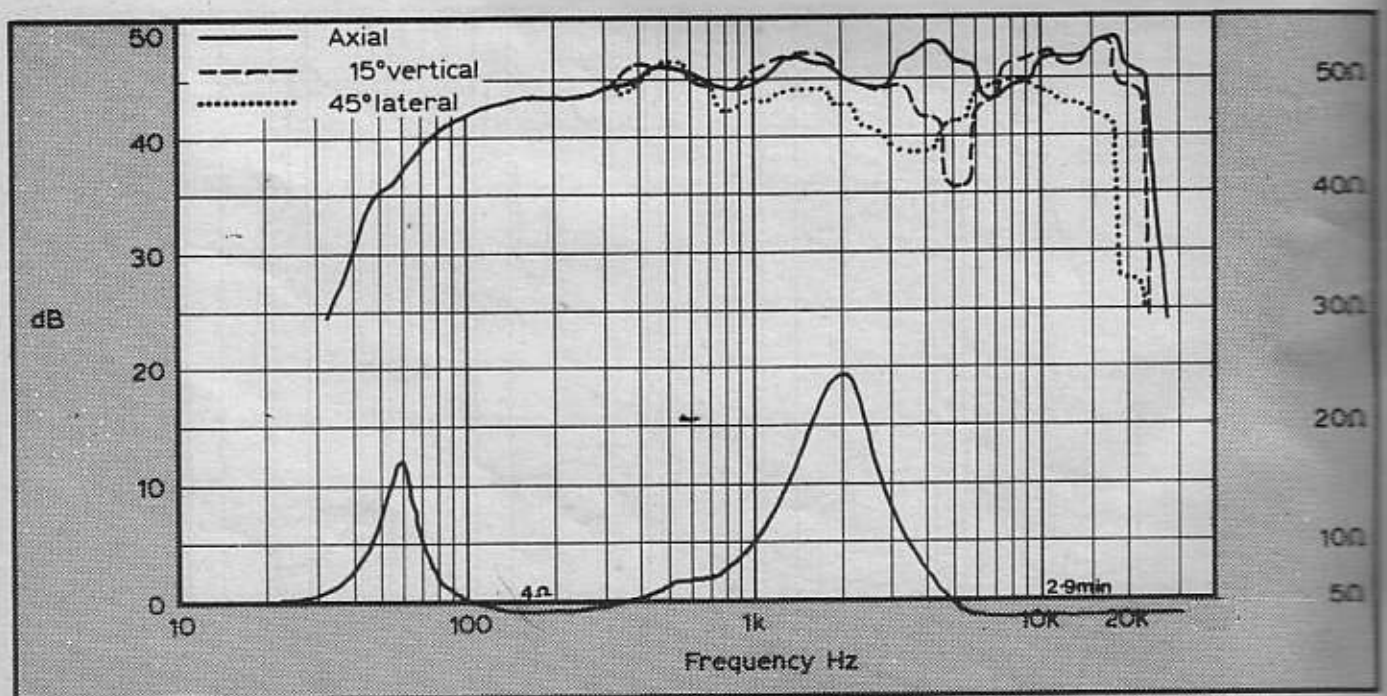
The two 15° responses were similar and showed a small dip of 5dB at 5kHz, but otherwise very little deviation — the high treble drooped only 2·5 dB above 15kHz.

Intrinsically symmetrical, the DM5 at 45° off axis revealed a mild 3dB odd loss above 500Hz, recovering in the treble band before finally quickly rolling off to −3dB at 10kHz, −8dB at 15kHz and −20dB at 20kHz. Another characteristic of the 45° response was the deepening and widening of the 5kHz dip which reached a maximum of −9dB.

Overall the curves revealed a pretty flat axial response with a fairly well integrated and well dispersed radiation off axis, the basic trend being that of gently rising amplitude response with frequency.

Accuracy

Highly ranked at equal second, the DM5 scored 5·2. Essentially it did equally well on all sounds — a surprising result for such a small system.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

BIC Venturi Formula 4W

ON TEST 30 LOUDSPEAKERS

This US designed speaker manufactured in Spain comes from a series of enclosures employing a novel bass reflex loading said to be based on the Venturi effect. Internally, a horn of sorts is connected to the reflex port, flaring into the enclosure volume, and the manufacturers suggest that this system is capable of producing an exceptional bass performance.

Measuring 63·5cm H × 33·5cm D and 33·0cm W, it weighs about 23kg and is a three way design, incorporating a 250mm paper cone bass mid driver plus a 40mm paper cone treble unit and a small treble horn.

The specified response of 35Hz to 20kHz is meaningless as it is given without limits. A maximum 100 watt amplifier rating is suggested with the nominal impedance given as 8 ohms, and a treble control is also included.

LAB REPORT

Pair matching

A very poor match was shown above 1kHz with imbalances of up to 5dB at several points. (Control set flat).

Sensitivity

A high 77dBA was recorded, which corresponds to 98dBA for 10 watts or 6 watts for the standard 96dBA.

Impedance

With a minimum recorded value of 6 ohms and low reactive effects, namely a phase angle of 28° maximum, a 7·5 ohm nominal impedance is in order — close enough to the specification.

Responses

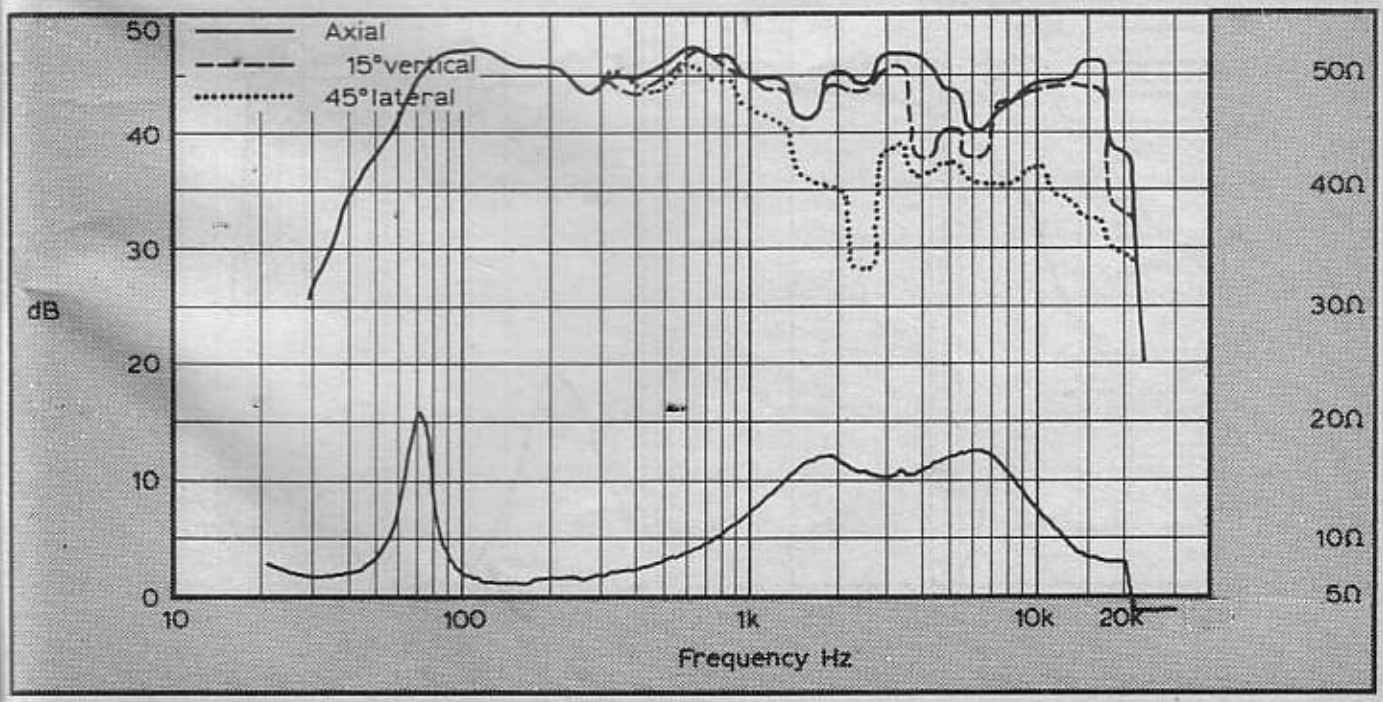
The better of the two enclosures achieved a creditable ±3dB, 60Hz to 18kHz and allowing wider +3-6dB limits gave 55Hz to 20kHz. Despite the manufacturer's claim, the interesting point here is that no real bass is present below 50Hz.

The ±15° vertical responses were quite good with little change occuring until above 10kHz, where −4dB at 13kHz and −6dB at 20kHz were recorded — a significant loss at this small angle.

At 45° the lateral symmetry was only fair. On the left hand a 15dB dip appeared between 2 and 5kHz, and the whole lower treble, 3kHz to 10kHz drooped by 5dB, the loss then increasing to −15dB at 13kHz. The right hand axis was smoother, suggesting that mirror pairs might be advantageous.

Accuracy

One model had to come last. The BIC ranked (to a 95% certainty) significantly below the other 29 systems, at 3·0. It was unfortunately inaccurate on all live sounds including pedal drum, with the exception of the musical box where it scored marginally higher, but was still held to be below group average. (This does not mean that no-one could live with this speaker — just that it does not faithfully reproduce live sound) under the test conditions. There are indications that the manufacturer's recommendation of shelf mounting is incorrect and that stand mounting improves this model's subjective quality significantly. Shelf mounting was employed for the true-to-life test.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Audiomaster BBC LS3/5A

ON TEST 30 LOUDSPEAKERS

This tiny 30·8cm H × 19·3cm W × 16cm D enclosure has an excellent pedigree, and carries a guaranteed BBC design specification. (Incidentally, the other versions from Rogers and Chartwell should be identical.) At 5·3kg, it is certainly weighty for its size, and it contains two well engineered (selected) KEF drive units, namely an 11cm Bextrene cone midrange and a 19mm hard plastic treble dome.

A nominally flat free field response of 80Hz to 20kHz ±3dB is claimed, which for an enclosure of this size, carries both a low efficiency and also a reduced power handling penalty. Specified at 15 ohms, a 25 watt 8 ohm based amplifier is suggested with 50 watts as a sensible upper limit.

LAB REPORT

Pair matching

An excellent match was shown by this pair, which correlated to within 0·5dB throughout the range.

Sensitivity

66·5dBA was recorded, which corresponds to either 87·5dB for 10 watts (8 ohms based) or some 75 watts to raise 96dBA — this latter level in fact being just beyond its capacity, although cautious music programme use at this power would be unlikely to cause damage. The true sensitivity is augmented a couple of dB by the higher than average impedance, although not unduly so.

Impedance

Measurement showed a minimum value of 9·2 ohms which strictly speaking puts the system at around 12 ohms. While some 37° of phase shift was noted at 1·3kHz, the impedance value of 20 ohms was high enough to render its effects harmless. This speaker should match happily with any amplifier up to its full rating.

Responses

A tight ±2dB limit covered the entire specified responses 80 Hz to 20k Hz, with a +2·6 dB expanded tolerance allowing a bass extension to 66Hz — a very creditable performance for so small an enclosure.

In the vertical ±15° axes the average response showed little falloff throughout the range — less than a dB loss up to 10kHz — with the 20kHz figure well maintained at −2·5dB. At 15° above axis it showed a small 5dB dip at the crossover region of 3·4·5kHz, which deepened to 10dB down 15° below axis.

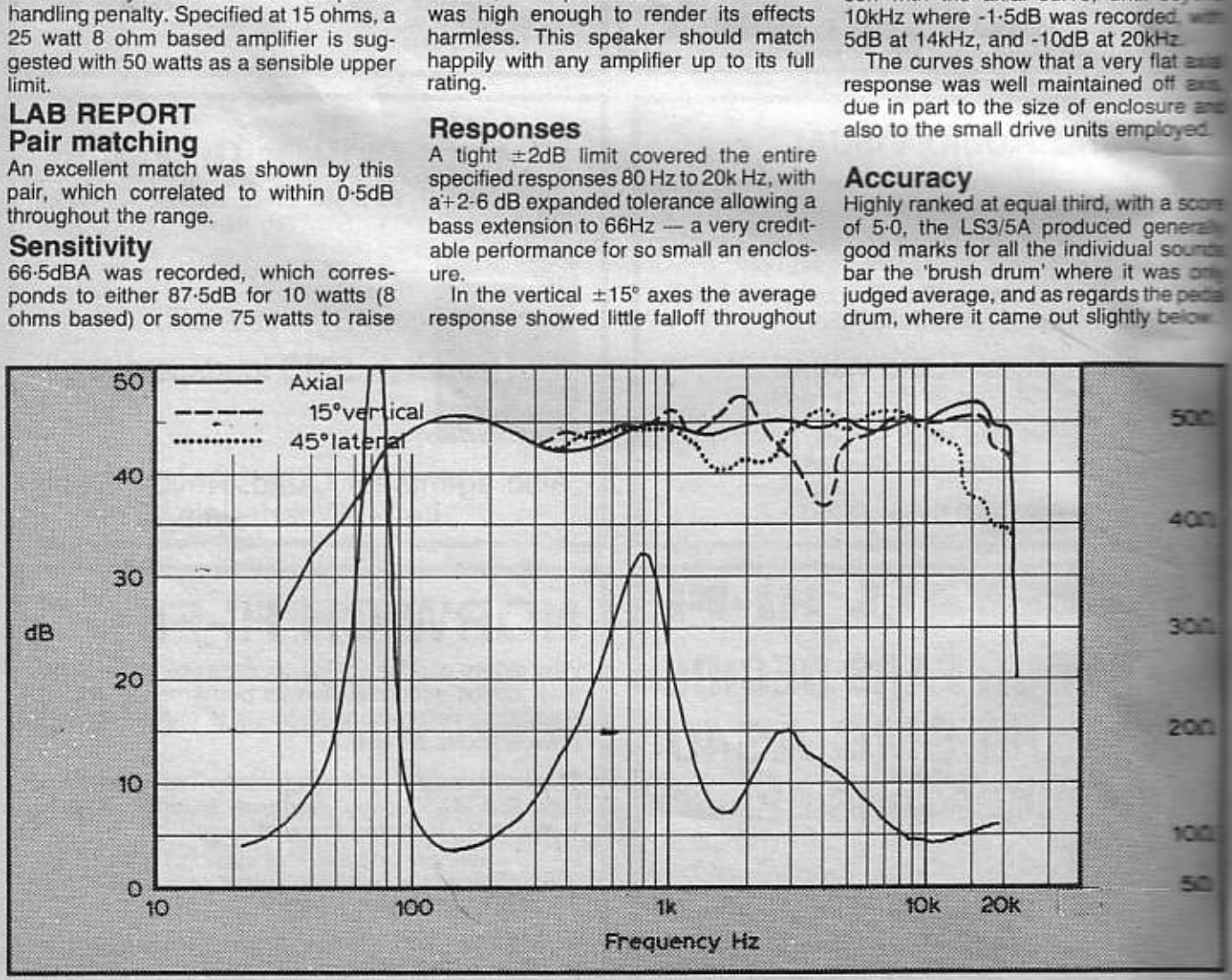
In the lateral plane at 45°, the vertical drive unit positions produced a symmetrical response shape in the left and right directions.

The 5dB dip near the crossover region was still present at 45°, but otherwise little response change was noted by comparison with the axial curve, until beyond 10kHz where -1·5dB was recorded, with 5dB at 14kHz, and -10dB at 20kHz.

The curves show that a very flat axial response was well maintained off axis, due in part to the size of enclosure and also to the small drive units employed.

Accuracy

Highly ranked at equal third, with a score of 5·0, the LS3/5A produced generally good marks for all the individual sounds bar the 'brush drum' where it was only judged average, and as regards the pedal drum, where it came out slightly below



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

Acoustic Research AR12

ON TEST 30 LOUDSPEAKERS

A recent introduction, this bookcase system employs three drivers: namely a 250mm heavy cone bass, a 65mm paper cone midrange with magnetic fluid coil damping and suspension, and finally a 19mm fabric dome HF unit. Crossover frequencies are placed at 700Hz and 4kHz, and the nominal impedance is stated as 8 ohms. Mid and treble may be adjusted via three position switches.

Dimensions are 63·5cm H × 35·4cm W × 27·5cm D and the weight some 16kg. The published frequency responses relate to the system as flush mounted in the wall of a 2π anechoic chamber, and for the purposes of our tests, all speakers were measured 4π or open space.

LAB REPORT

Pair matching

The review pair showed a good correspondance of typically 0·5dB.

Sensitivity

72·5dBA was recorded which corresponds to 93·5dBA for 10 watts. The standard 96dBA at 1 metre would require about 18 watts, so the system was not very efficient.

Impedance

AR are optimistic concerning their quoted nominal impedance of 8 ohms. Three trouble areas were noted — a 3·9-ohm minimum at 8kHz; a 5-ohm minimum at 1·5kHz and a combination of 30° phase angle and a 6·5-ohm impedance at 850Hz. This puts the nominal value at 5 rather than 8 ohms, and places the recorded sensitivity in a poorer light. If AR's value is accepted than the speaker could well prove difficult to drive, but if the lower nominal impedance is accounted for then the speaker should present no problems. The maximum impedance of 22·5ohms occurred at 50Hz, the bass resonance.

Responses

A narrow dip of 4·5dB was observed on almost all traces at around 700Hz, which could be a phase discrepancy between the bass and mid drivers. If this problem is temporarily ignored, we can use narrow ±2dB limits to cover a 66Hz to 20kHz response, which is flat indeed. The choice of wider limits (+2−6dB) extends the range and gives 50Hz to >20kHz.

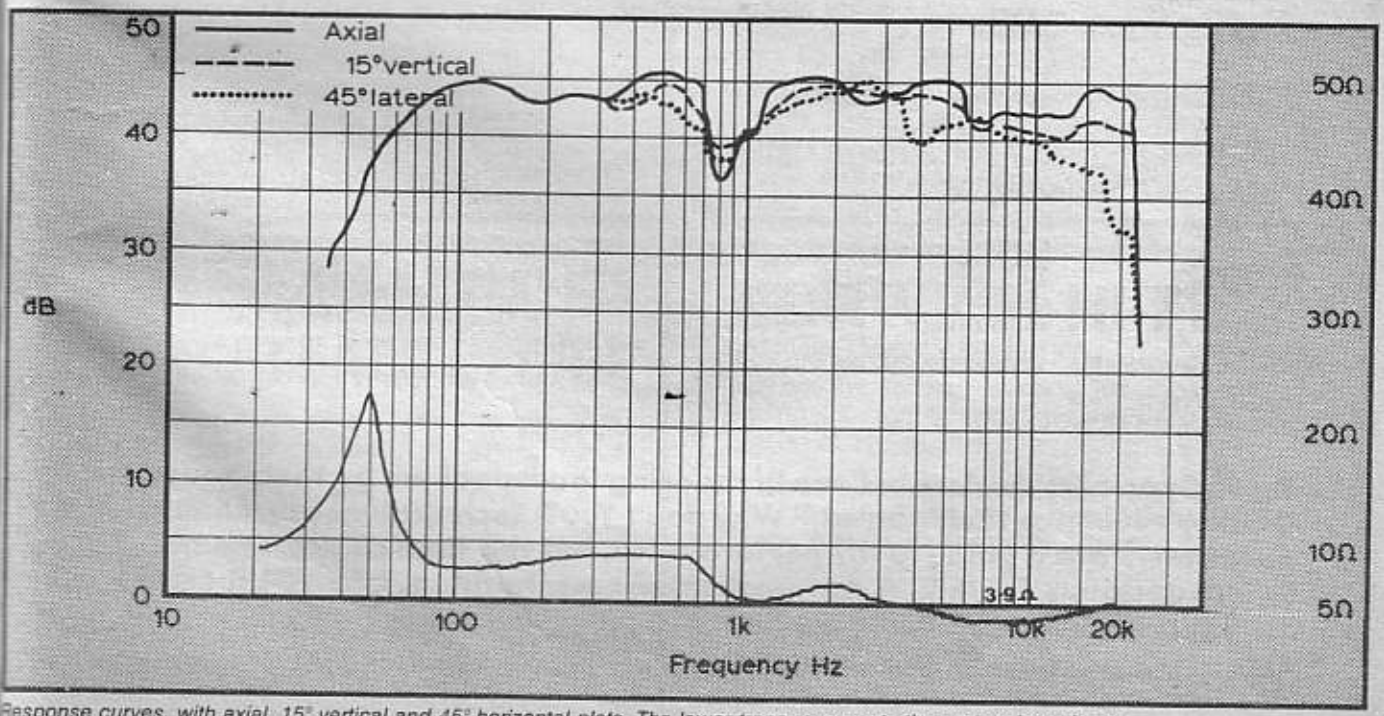
The measurements taken at 15° below (box vertically positioned) agreed closely with the axial curve as did the 15° above axis, with the exception of a mild 2dB droop towards 20kHz.

The 45° lateral curves showed some assymetry of a minor nature mainly due to mild ripples between 800Hz and 4kHz. The falloff was small up to 10kHz (−1dB), beyond which a smooth rolloff occurred — −8dB at 15kHz and −12dB at 20kHz.

Thus apart from the minor phase notch at 700Hz, the AR12 demonstrated smooth even responses over the whole forward radiating region, with a very good dispersion even at a 45° off-axis.

Accuracy

Overall the AR12 scored just above average at 4·6. It did quite well on guitar, brush drum and musical box, but fell below the mean on speech.



Response curves, with axial, 15° vertical and 45° horizontal plots. The lower trace represents the system impedance.

line length, this corresponding to a 95% statistical certainty. In other words, in order to be 95% certain that one system is higher ranked than another, the lines must not overlap. It is not valid, for example, to discriminate between models in the grouping and separate them on neutrality grounds, as here the line overlap is considerable, indicating substantial common ground. Nevertheless, the table clearly shows the J. Rogers to be the outright leader closely followed by the Yamaha, SMC and B & W. The next three models are still close — the KJ LS3/5A, Mordaunt Short and Pioneer but these are succeeded by a third sequence of overlapping positions which are clearly below the standard set by the first four ranking models. This section is headed by the KEF, and followed by the Celef, Ortofon and Acoustic Research. The fourth group, clearly below the first seven, is headed by the Celestion and IMF, with the Quasar Studiocraft, Tandberg, Tannoy, Spendor, Quad, Toshiba and Sansui all following in a tight bunch. This central group constitutes the main average placing and contains the largest number of models. Falling behind of the first eleven are the Chartwell, JBL, Exact, KLH and Wharfedale, and clearly below are placed the Goodmans, Bose, Sony and BIC.

The ranking order as achieved by each speaker on the various programme sources shows certain expected deviations. In general the highly ranked systems did equally well on almost all sounds. Clearly some models did better or worse than average on certain material. Thus if one aspect of reproduced sound is considered especially important, a system could be chosen on the basis of its rating on that score alone. The pedal drum produced the greatest order shuffling, as it proved very demanding, and only the systems which could tolerate powerful upper bass and which were well controlled performed satisfactorily on this test.

Statistical Notes

The averaged results of six control tests made during the session indicates that the panel as a group was highly consistent in its judgements. Indeed five of the six control averages agreed with 1% — a highly satisfactory result. To further improve the reliability of the data some corrections were applied before analysis. These included one known interaction of programme with certain specific speaker types, the latter identified by using the panel's comments on frequency balance and colouration. The data for both the panelists and the various sounds was also normalised, so that each lent equal influence to the overall ranking, and a further correction concerned a slight upwards trend in marking noted from the control which came as the end of the session was approached.

Lab Test Notes

The test sensitivity readings were non-standard and are scaled in this report to give two relevant figures — firstly the loudness, 'A' weighted on pink noise under anechoic conditions and taken at 1 metre for an 8.9 volt input; ie 10 watts into 8 ohms; and secondly the 8 ohm based power required to generate the standard 96dBA at 1 metre (also pink noise).

However, with two of the loudspeakers, this scaling was found to be invalid due to their special radiating properties. The Quad Electrostic is large enough to be almost a plane radiator at these distances, and the Bose 501 is also included due to its side radiating treble units. These defy the inverse square power law which sensibly governs the remaining systems. For example when measured on axis at 2.5m, the result indicates that Quad is actually more sensitive than might be expected. This anomaly is accounted for by its narrow radiation properties, which mean that the total forward radiated power is in fact in keeping with its known practical low efficiency (very similar to the KEF R103).

Impedance

Because the sensitivity ratings are based on voltage as would be provided by an audio amplifier rather than on true power (volts and current), the true efficiency is related to the impedance and its reactive magnitude. A lower nominal impedance than 8 ohms implies a lower efficiency that was actually measured, and conversely, a higher impedance indicates a higher efficiency. A lower impedance is more taxing for an amplifier especially if a significant reactive phase angle is present, which may result in restriction in the maximum power delivery as well as increased distortion. Conversely the higher impedances are easier to drive and hence the accompanying amplifier may be taken to its full limits without distress.

Stereo matching

The stereo image quality is dependent on the uniformity of the foward radiation of a given pair of enclosures. This applies to both phase and amplitude responses, which are in any case related. It is fair to say that a matched, well balanced and symmetrical forward response is a distinct advantage (this includes mirror pairs where the placing instructions are followed).

Response

At present the concensus of opinion is that an essentially flat forward frequency response is an all important element in good speaker performance, but it is by no means the dominant one. Designs with visually only reasonable responses can do well, and conversely excellently smooth traces occasionally partner indifferent sounding models. Good drive unit integration and an even dispersion off axis are nonetheless promising signs.

with the live sound replacing the silent gaps on the tape. The live/recorded sound levels were matched as closely as possible.

The panel of seven listeners were all aged under 40 (average around 30) and comprised a professional quality monitor engineer; a young woman; two loudspeaker designers, two hi-fi enthusiasts whose ears were known to be reliable; and finally, myself. The seating was in a fairly open arrangement about 4 — 6 metres from the sound source and almost on the loudspeaker axis. As far as was possible the loudspeaker placement was that recommended by the manufacturer — thus average sized systems were stand mounted about 40cm clear of the floor, and where wall mounting was specified the rear wall of the hall was employed, although the systems were not flush mounted as it was felt that few users would achieve this in their own homes. If floor mounting was recommended, this was also carried out. One model, namely the Quad Electrostatic, was known to have specifically difficult directional characteristics. An effort was made to prevent these from influencing the results unduly by positioning the system about 0.7m off the ground on open backed chairs and tilted forward so that its axis was directed at ear level.

The panel listened to these sounds through an acoustically transparent curtain which effectively concealed each system's identity and thus no panel member knew which speaker was playing at any one time. My editor also retained the order in which the systems were presented until the computation of results was complete to ensure a total lack of bias in their compilation on my part.

After a couple of practice runs to educate the panel in the procedure and the proposed scale of judgement, the session began. It lasted an entire day, and during the tests two 'control' speakers were repeated for a total of six times in order to check the marking trends and panel consistency. For each comparison of sounds, the panel was required to evaluate the basic aspects of the speaker reproduction as compared with reality — in other words the live source. The most important of these parameters was a straight numerical judgement of accuracy, neutrality, and true-to-life quality, this measured from 0 — 10, with 10 representing a perfectly accurate reproduced sound. In addition judgement of a parameter denoted 'frequency balance' was required, where the qualification consisted of the area or areas of frequency variation as subjectively perceived — for example, 'upper-treble loss; moderate'. Finally, colouration was to be assessed and its description was to be taken from a specified vocabulary which included such terms as 'boxy', 'chesty' and 'boomy'.

The overall result was a remarkably consistent stack of judgement forms, concerning the true-to-life quality of the various loudspeakers tested, this data subject to the restriction that only single boxes were evaluated under the specially controlled conditions described. Their deviation from reality was noted by the subjective comments in the second and third categories, namely the characteristics of colouration and frequency balance.

A statistical analysis of the data was carried out by a computer to provide mean and standard deviations, scaling, reliability and other relevant factors. More importantly an overall ranking order was established for the speakers, which could form the basis of the subsequent group listening tests mentioned earlier. As a degree of uncertainty exists regarding the absolute position of each model, an overlap in placing for those systems closely judged subjectively is inevitable. This is shown in the accompanying ranking table, where the position of a system is represented by a line whose length gives a reasonable estimate of its ranking error (95% statistical certainty). The finer separation of loudspeaker placing will be covered in the second section, where direct A/B comparisons will be undertaken.

It was decided that a ranking order for each test sound could also prove useful and this was also duly computed, and presented in the same way as the absolute ranking.

A point to bear in mind concerning these rankings is that they only cover one aspect of the review, namely 'true-to-life' accuracy, and clearly cannot account for other important aspects such as price, size, living room performance, sensitivity and compatibility with amplifier models.

Lab Tests

As loudspeakers are used at a listening distance of typically 2-3 metres, a break was made with the standard 1 metre measuring distance commonly employed. In the 180 cubic metre anechoic chamber used for these tests, 2.5m proved to be the maximum useable distance for sufficiently accurate and repeatable ⅓ octave analysed pink noise responses taken above 300Hz. At this distance the axial responses for both speakers in the pair were taken, in order to ascertain the sensitivity, and also to allow comparison to be made between the two speakers as regards consistency and matching — an important area for stereo. For the single speaker used in the listening tests, off axis plots were also made in the vertical plane at ±15° and in the lateral plane at ±45° to assess the uniformity of output over the range in the forward radiating region. These off axis curves can pick up interference effects which may or may not be serious, and will in addition show how well the drive units are matched in their radiation angle; also how well they integrate in the forward plane. One of the hallmarks of quality design is good overall integration, and several of the models in fact failed dismally in this respect, even though they may have been aligned to produce a flat axial response.

To overcome chamber irregularities below 300Hz, and to side-step the low frequency irregularity inherent in pink noise measurement, the response below 300Hz was plotted in sine wave exitation at a close measuring distance of 0.5m, with the mic. placed central to the loudspeaker axis. In fact the curves here printed for each speaker represent a marriage of close sine wave below 300Hz, and ⅓ octave pink noise analysis above.

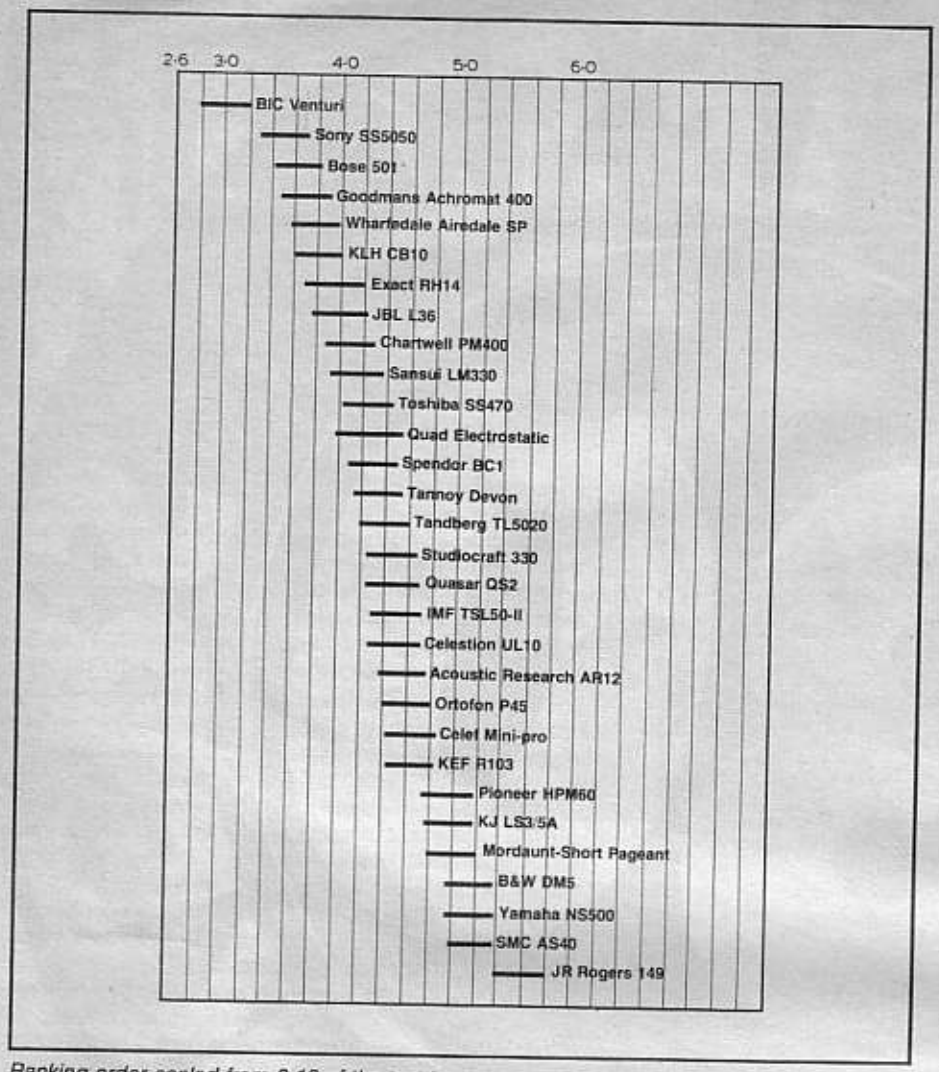
The normal impedance curve was measured, but in this instance with the addition of phase readings which serve to reveal how reactive the impedance value is over the entire frequency range. The more reactive a loudspeaker impedance, the heavier the loading presented to the accompanying amplifier. A high reactive content combined with a high impedance generally presents no problems, the higher demand placed by a low impedance on an amplifier will increase in severity when appreciable reactive components are present, as denoted by a high phase angle. (This is the phase angle between volts and current entering the load — not the phase of the loudspeaker output.) From the two a fair estimate may be made of the severity of amplifier loading as presented by a given loudspeaker.

Discussion of 'true-to-life' comments

As individual opinions concerning loudspeakers are in general particularly subject to prejudice, one of the most fascinating aspects of a truly objective panel test is the degree of unpredictability inherent in the results. In truth, all speakers are sufficiently imperfect to attract extremes of criticism — one will be condemned for an obvious but possibly unimportant failing, while another may be praised for an isolated virtue while in general its performance is well below par.

The 'blind' test conducted here removes all possible prejudice — the smallest system can take on the largest — and the procedure adopted can never be made more accurate than by taking a direct comparison between a reproduced sound and its live source. With competent panelists and using a wide range of material, the 'true-to-life' capabilities of each speaker may be ranked against an absolute scale.

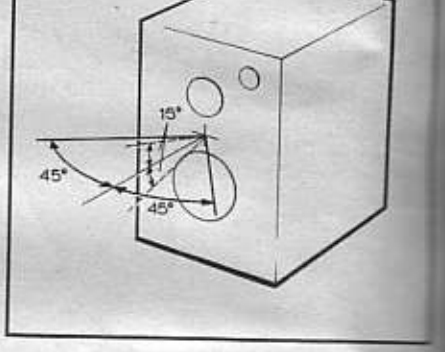
The results of such tests are invariably controversial as they frequently go against both preconceived opinion and past experience. The accompanying table shows the averaged marks achieved by each loudspeaker for all the test sounds. The degree of possible error in their ranking position is indicated by the



Ranking order scaled from 0-10 of the test loudspeaker into mono (one only from each pair) subjectively judged in comparison with seven live sounds.

ON TEST 30 LOUDSPEAKERS

Angles of measurement with mic. position relative to speaker.



This loudspeaker report is divided between two issues of the magazine, and although all 30 models will be covered in both sections, the separate presentation was dictated by the sheer size of the project.

In consequence the final appraisal and summary for each loudspeaker can only be presented when the second section is complete. This first issue does, however, present both important subjective and objective material, the aim of subjective tests being to evaluate the absolute accuracy and neutrality of the test loudspeaker when compared with reality. The objective tests comprised laboratory measurements and covered the frequency response, sensitivity, and impedance of each system involved.

The next issue will consist primarily of further subjective evaluations, namely a comparison of small groups of closely ranked systems conducted in stereo and under normal listening conditions — in other words, in a domestic living room. In addition, observations concerning the results of further lab tests such as transient analysis will be printed, and one of the project's main aims will be to investigate the correlation between this transient data and the objective characterisations of colouration in loudspeakers. Subjective panel testing is a particularly laborious method of analysis and unless very carefully established, can prove unreliable: the more frequently that an accurate laboratory measurement can be traded for a subjective observation, the better for all concerned. Finally, a summary for each system containing important comments on its overall performance will conclude the second stage of the report.

Studio Recording

To provide the listening panel with accurate material for the live versus recorded comparisons an EMI studio was hired, and ½-track 38cm/sec recorders were used (Studer B62 & TEAC A3300S machines in mono with no processing or extra equalisation) in an attempt to record an accurate a recording as possible of a number of sounds. The choice of microphone depended on the source material, but generally Neumann U87 or AKG C451s were used. A screened area of deliberately short reverberation time and as 'dead' an acoustic as possible was set up, with care taken to place the microphones at distances where the sound sources were reasonably even and well integrated — typically 60-80cm distant. This technique was employed in preference to anechoic conditions, as in the latter instance, performers tend to produce unpredictable results due to the unfamiliar and disorientating lack of acoustics. Work carried out at the BBC indicates that this is acceptable if the listening room where the live versus recorded comparison is made has a reasonably long and even reverberant characteristic. During recording care was taken to ensure that no limiting or clipping of the transient content of the programme occurred.

The sounds recorded and used for the first subjective panel test were as follows: Male speech (using test phrases used by the BBC for this purpose); acoustic guitar; hi-hat cymbal (played to bring out the range of different tonal qualities); bass pedal drum (single skin, damped with a pad of wool cloth resting against the skin and played fairly softly); side drum, including rim shots and brush sounds; and finally, a musical box.

The best available room for the listening tests turned out to be a small hall in a modern hotel, which in the event proved quite satisfactory (120m high × 9m wide × 16m long). While the acoustic was more 'live' than would have been ideally the case, its general character was pleasant and unobtrusive, and the long reverberation time allowed the panel to assess the loudspeakers on test without any great difficulty.

The recordings made of each sound were between 1 and 3 minutes in total duration, and consisted of short passages lasting around 10-20 seconds, interspersed with similarly timed but silent sections of tape. For the purposes of the panel test, the recordings were reproduced by each loudspeaker type in mono

ON TEST 30 LOUDSPEAKERS

BY F. M. HUGHES

Loudspeakers are frightening animals. They are responsible for the greatest deviations from pure sound, they are bulky, and above all are incredibly difficult to assess. In other words they represent a reviewer's nightmare. In no way, however, can we bury our heads in the ground and repeat the old quotation 'well, go and listen to a few speakers and use your own ears to judge which to buy'. A sincere attempt at reviewing loudspeakers is something we just cannot ignore.

Taking the bull by the horns, we decided to tackle some 30 pairs of loudspeakers in the £100 to £300 per pair approx price range. One-off reviews of a subjective nature are almost completely without value to readers — you all need to know how one behaves with respect to another. Such a project is an enormous task — not only due to complex listening tests and statistical analysis, but also the sheer weight and bulk of speakers costs a fortune to transport around the countryside. Your Editor remains cowering in a corner awaiting a rap over the knuckles from his finance-conscious directors!

The test procedures were formulated after lengthy discussions with technical representatives of many British loudspeaker manufacturers. In general the conclusions bore remarkable resemblance to our own ideas for optimum practical reviewing procedures, and thus the project was born. Credit for almost the entire co-ordination of this project is due to F.M. Hughes, who we suspect by now sees loudspeakers in his sleep.

The presentation of results is explained in detail on the following pages.