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Over 180 Best Buys and Recommendations •Turntables•Tonearms •Cassette decks•Amplifiers •Loudspeakers•Headphomes •Compact Disc•Tuners• Cartridges

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1983

HIFI CHOICE



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Years ago Mission put forward ideas and products which have influenced this industry ever since. We suggested good measurements weren't enough. We said to design for low coloration wasn't enough. We insisted two-way speakers were inherently superior. We argued that loudspeakers had to reproduce the emotions and dynamics of live music. We claimed that good dynamic range needed higher sensitivity and power handling. We said our speakers had to be "hot wired." The unique combination of our own ideas with proven classical theories — accurate stereo imaging, smooth frequency response, low distortions, etc. — gave birth to a generation of products that made Mission an industry leader. Our courageous work with new materials influenced designers all over the world. 4 years ago the Mission 770 took the industry by storm and the competition has tried to out-perform it ever since. Our "upside down" 700 offered an entirely new standard of performance for inexpensive systems. In 1983 we advance once again. The new Baby 70 offers the real music lover an affordable high performance system, utilising carbon fibre come technology, dome, by each and the spheric triated filter petwork. It is

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HI-FI CHOICF From the thousands of hi-fi products on the market, this guide selects the best in performance and value. It includes full tests on all the current models rated as Best Buy or **Recommended by Hi-Fi Choice reviewers** How to use this book 7 Putting together a system by David Prakel 17 **Compact Disc and digital recording systems** 23 Turntables and tonearms: introduction 28 Turntables and tonearm reviews by Martin Colloms 30 Cartridges: introduction 72 76 Cartridge reviews by Martin Colloms 96 Amplifiers and receivers: introduction **Amplifiers:** summary reviews 98 100 **Amplifier reviews** by Paul Messenger, David Watson 105 Receiver (tuner/amplifier) reviews by Paul Messenger, David Watson 112 Loudspeakers: introduction 116 Loudspeaker reviews by Martin Colloms **Tuners:** introduction 152 155 **Tuners:** summary reviews 158 Cassette decks: introduction 162 Cassette deck reviews by Angus McKenzie 184 **Cassette tapes:** introduction 185 **Cassette tapes:** comparison chart 187 Headphones: introduction 190 Headphone reviews by Martin Colloms 201 **Glossary of technical terms** 207 **Product index** Published by Sportscene Editor: David G Prakel

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This is how records are made.

It's no coincidence that all records are cut on the linear tracking principle.

Experience has taught record companies there's no other way to ensure absolute fidelity and accuracy.

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We certainly think so.

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Which in turn means there's

Isn't this how they should be played?

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Naturally, making a linear tracking turntable demands a level of engineering skill rather above the norm.

But what else would you expect from the people who perfected direct-drive turntables? Even we can't improve on the

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New Memorex High Bias II is coated with micro-fine needle shaped particles.

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It's encased in our unique fumble-free storage album and guaranteed to last a lifetime. Literally.

Or we'll replace it free of charge. A promise that covers every one of our four amazing new cassettes.

MRXI, High Bias II, Chrome II and Metal IV.

MEMORE

Is it live, or is it Memorex?

HOW TOUSE THIS BOOK

The *Hi-Fi Choice* series has produced a fund of experience drawn from the detailed and rigorous examination of a wide cross-section of hi-fi equipment. Each issue involves a sophisticated measurement programme in the authors' labs which is coupled with extensive listening tests in order to produce the most accurate and comprehensive data that will help the hi-fi buyer choose wisely.

Bringing together the Best Buy and Recommended products together in one book offers a unique guide to hi-fi equipment which can help both with the purchase of individual items and the selection and setting up of complete systems. That one publication is the Hi-Fi Choice Best Buy Guide. To get the best out of the Guide it may be best to look first how the book is put together, the help it can offer and what it is not intended to do!

The chapter Putting a system together gives basic advice on how to approach the problem of buying hi-fi, how to work out a budget for a system, the compromises that may be involved, and most importantly where to buy from. Stress is put on the importance of personal audition and hints are given on how to get the best out of a shop demonstration. Further into the chapter detailed advice is given on how to choose and match turntables, arms and cartridges, amplifiers and speakers. It's hoped that you'll find the answer to the most frequently asked questions about systems in this chapter. There are some suggestions for ugrading and how to buy to avoid obsolesence.

The reprint reviews are grouped together with a newly written introduction which gives background to the product category under test and provides basic information on how to get the most out of the technical side of the individual reviews. These introductions offer advice on installation and alignment, of arms and cartridges for example, and on the maintenance of products like cartridges and cassette decks.

Hi-Fi Choice has not looked at tuners for some time now but a couple of pages of Recommended products have been put together from the *Tuner & Amplifier* issue and from the collective ideas of *Choice* contributors. This chapter also contains essential advice on getting the best from a tuner and how to set up an aerial for best FM stereo reception. To cover a greater range of amplifiers the same arrangement has been adopted for *Amplifiers*; additional models are covered in summary reviews after the chapter introduction.

Rather than reprint reviews of reelto-reel tape decks it was felt important to incorporate this material into summary reviews which weigh up the pros and cons of reel-to-reel versus cassette. This can be found as part of the introduction to the chapter on Cassette Decks. Recommendations for Cassette Tapes are made in a comparison chart taken from Angus McKenzie's most recent comprehensive review of cassette tape originally published as part of the Cassette Decks issue. There is an additional one-page summary of tape types which explains basic differences and the importance of choosing the right tape for your cassette player.

The chapter on *Turntable and Tone Arms* contains additional information this year on the important *Compact Disc* digital audio player launch and summarises Martin Colloms' authoritative findings from a special group review of CD players and software.

The Best Buy Guide concludes with a reprint section covering Headphones which has been enlarged this year to incorporate all Recommended and Best Buy models.

Naturally in reprinting reviews produced over a period longer than a year, and reprinting reassessment of older products, some information contained in the original reviews could be out of date. But every effort has been made to contact manufacturers and to publish details of even small design changes in Update paragraphs or as revisions to the reprinted reviews. When a price has gone up or come down, the price currentat the time of the review has been listed alongside the new price to enable you to put into perspective any value for money judgements con-tained in the original review text.

For those readers who already have one or more of the original *Hi-Fi*

Choice issues which contain reviews reprinted here, it is best to point out that some Best Buy and Recommended products are no longer available. Old favourites that have been dropped but may still be in the shops have been listed in the chapter introductions under the heading Other Models Worth Considering. Highly recommended products may now be found at new low prices in many dealers; bargain hunters should check out prices and likely products in the Worth Considering sections.

There were no Best Buy ratings made in the original issue of Turntables and Tone Arms. - we feel that it would be unjustly simplistic to award Best Buys in this category, as turntables and arms need to be carefully matched for best results, and so the emphasis must be on finding the best combinations or systems. Readers who want further information on any product category or who want to look at a wider range of product reviews before buying should turn to the original issues of *Hi-Fi Choice* from which the reprint material has been taken. Issues 19, 25, 26 and 28 through 30 are the relevant issues. These contain in-depth consumer and technical introductions explaining the background to the tests and products in full. Overall Comparison Charts and Conclusion sections can be found in the original issues which make straightforward comparisons and discuss the findings of the project in general terms. Useful Glossaries are there too which explain the necessary technical terms and descriptions.

The danger of relying solely on the simple inclusion of a product in this *Guide* cannot be stressed too strongly. Readers are advised to read back into the reviews rather than rely on the summaries. The review proper may contain important exceptions or points on the applicability, suitability and compatibility of certain products. The *Best Buy Guide* should be your first step to which you must add the help and advice of a good dealer, plus the all-important listening facilities he can put at your disposal.

David Prakel Steve Harris

Dear Sir, Sony have just announced sixty minutes of perfect sound that will last forever sthis a record?

Yes. And no.

It's not a record because it doesn't have any grooves, it's only $4\frac{3}{4}$ " across and it's silver.

Nor does it warp, hiss, crackle or wear out like ordinary LPs.

In fact it's almost indestructible.

Fingerprints, spilt coffee, even surface scratches don't affect it; just a wipe clean and it'll still play perfectly.

What you're looking at is the extraordinary new Compact Disc, the music format of the future. (March 1st 1983 to be exact.)

And the equally extraordinary Sony Compact Disc Player, which plugs in to any



stereo system and has about as much in common with a record deck as Concorde has with a Tiger Moth.

Instead of a stylus, for example, it has of all things, a laser.

It 'reads' the musical information encoded onto the disc by firing a beam of light at it, then unscrambling the pattern reflected back.



SONY COMPACT DISC PLAYER AND REMOTE CONTROL UNIT.

And because nothing touches the disc surface when it's playing, there's nothing to touch it for sound quality.

All you hear is music unaccompanied by clicks, pops or scratches.

More remarkable still, it'll sound just as perfect the twentieth, the two hundredth and the two thousandth time you play it.

Already there are around 200 LP titles to choose from in the Compact Disc catalogue, reflecting every musical taste from light classics to heavy metal, from Simon and Garfunkel to Beethoven.

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To see it, try it and above all hear it, ring us on 01-941 5717 for the name of your nearest Sony Compact Disc dealer.

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Paradox.

Quad products incorporate the same traditional values of engineering and craftsmanship which have made early Quad products collectors items.

Quad products incorporate innovative ideas which put them ahead of their time and set standards for the industry.

Paradoxical? Not if you think about it.

The Quad ESL 63 Electrostatic Loudspeaker – successor to the legendary Quad Electrostatic, uses concentric annular electrodes fed via a sequential delay line to produce a sound pressure pattern which approximates to that of an ideal point source. Quad is designed and manufactured by a company which for 45 years has been unremittingly devoted to the cause of excellence in music reproduction, a company in which respect for tradition and a quest for improvement go hand in hand to produce products which represent an investment in musical enjoyment.



Quad FM4 Tuner – superb ergonomics and a level of performance limited only by the quality of the incoming signal.





Quad 34 Preamplifier – provides everything that the serious music listener needs to obtain maximum enjoyment from disc, radio, tape and compact disc.

Music systems for thinking people.



For further details and the name and address of your nearest Quad dealer write or telephone The Acoustical Manufacturing Co. Ltd., Huntingdon, Cambs., PE18 7DB Telephone: (0480) 52561







LP12

turntable



Kans Sara Isobarik

speakers



LV.V Basik LV.X Basik LV.II Ittok

tonearms



DC-2100K Asak

cartridge

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Phone now for a demonstration





"A few additional functions are provided on the CD 63. Pause offers just that, and when released the music comes back right on the nose.

"I have been surprised by the quite audible difference between different CD players and have already stated a preference for the sound of the Marantz machine in terms of its handling of 'ambience' and its sheer unfatiguing listenability."

HI-FI ANSWERS March 1983

"Thus the Marantz players should offer improved pulse overshoot, but transients will be symmetrically reproduced in the time axis, apparently ringing in a fixed time delay between channels, this noted earlier. optional remote control unit, soon to be released.

"Utilising the programmed error test disc which carries an increasing dropout up to 2mm wide, the error corrections of Marantz machines was judged the best. By the 13th track, the full 2mm gap present, their output was only occasionally and momentarily muted."

HI-FI NEWS & RECORD REVIEW March 1983

"The Marantz player was put on the passenger seat of my Audi 100 SE and powered from the filtered output of an inverter, drawing current from the car battery. The player output was then fed into my normal cassette/amplifier system. In fact the Marantz worked well with no

A COMPACT DISCOGRAPHY.

"Insize the CD 63/CD 100 design is the most compact of the group and hints at even smaller models to come. Being a top loader, in this case access to the turntable hub is obtained via a small transparent lid. This model is relatively easy to make, and being simpler than the others mechanically, it could well prove more reliable. Many admired its non-technical, 'friendly' looking controls and appearance. The slimmest looking of the machines is the Marantz CD 73, which will slot into many existing rack systems. Visually impressive, with many LED indicators, the solid action of its front-loading, motorpowered drawer mechanism will appeal to the more technically minded buyer, and it also possesses some embellishments, these including rear connection for an

shock or vibration problems, in part due to the fact that the player mechanism floats on a suspension inside the case.

"By contrast the Marantz player produced a sound which was smoother, not quite so forward or bright, and infinitely more musically convincing. The sound stage had depth and the images were precise, stable and easy to place. Many recordings played on the Marantz exhibited that very important characteristic of a good reproducing system – the sound didn't obviously emanate from twoloudspeakers.

"Comparison made between the analogue and CD copies (played on the Marantz CD 63) showed that, given adequate software, the CD system was superior".

marani

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HI-FI FOR PLEASURE March 1983

To Marantz Audio (UK) Ltd, 15/16 Saxon Way Industrial Estate, Moor Lane, Harmondsworth, Middlesex UB7 0LW. Tel: 01-897 6633. Please send me details of Marantz Compact Disc Players CD 73 and CD 63 and other hi-fi equipment and my nearest Marantz Dealer's address. NAME

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Denmead Hi-Fi Centre HAMBLEDON ROAD DENMEAD, HANTS Tel: Waterlooville 50312



We are proud to be one of the foremost UK dealers stocking 'Digital Audio Disc' hardware and software. DAD makes conventional turntables look and sound outdated. At last the great breakthrough in front end technology. Come and hear these superb machines now. For the old fashioned we have turntables arms and cartridges from — STD Thorens Luxman Ariston ADC Audio Technica Grace FR Dynavector Mayware Koetsu Supex Zenn Ortofon etc. Also on demonstration the fabulous Ortofon SPU Gold. Free parking. Opening hours 9.00-7.00pm weekdays 2pm — 6pm Sundays

PUTTING TOGETHER A SYSTEM

Drawing up a product shortlist is essential. Set out a list of what you want hi-fi to do for you, what you want or don't want it to look like, and have some idea of how much you are willing to spend to achieve those ends. This information helps you cut down the market to a manageable size.

There is a syndrome which afflicts many hi-fi buyers and which causes them to chop and change from one piece of equipment to another which costs much the same. This stems from having no strong appreciation of costs own expectations of demostic

How to apportion a budget

The one-third here, one-third there formulae simply spell disaster. At the end of your buying spree you want a good music reproduction system for your money.

The realism of any hi-fi system seems to be in its ability to excite the listeners. Musical excitement can be considered to be coded into wide and sudden dynamic contrasts and clean tr

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Record players — choice and installation

The turntable performs the essential task of isolating the stylus/disc interface. You should think how your surroundings are going to influence the way in which it does its job. If you like your music loud you will need a turntable that can cope with air-borne vibrations. If you live in a room with a wooden suspended floor then you will need a turntable with a suspension that can cope. The reviews printed later in the book can help with reviews give you all the need for this graph — the effective mass of the arm, the mass and compliance of the cartridge.

Once chosen, you can have your dealer deliver and install the turntable/arm/cartridge package, though you may prefer to install the cartridge yourself. Details of how alignment can minimise distortion due to tracking error is included in the introductions to the chapters on Turntables and Tonearms and Cartridges. The protractor printed here should be used to square the cartridge to a radius of the disc at two points. This means that the arc tracked by the arm cuts the imaginary radius along which the record was cut at two points, which minimises distortion across the whole disc surface. (This is often known as overhang adjustment, as to get the geometic alignment right the cartridge must be set forward in the arm to 'overhang' the spindle or centre of the turntable.) Rather than go for a single measure of overhang it is better to use a twopoint protractor (the one published here is produced for minimum distortion on records with minimum aroove radii up to 58mm, different zero points will be achieved using the 60mm IEC standard).

Full details of tracking weight, bias setting, etc, are included in the

go in your listening room. The 'wattage' of the amplifier doesn't tell you this.

There are three influences on the perceived loudness once a good signal from the turntable is assured. These are the amplifier power, the sensitivity of the loudspeakers and both the furnishings and size of the listening room. Big heavily furnished rooms need more energy pumping into them for the same perceived loudness as a small reflective (sparsely furnished) room. As explained in the introduction the chapter on Loudspeakers our reviews give a range of amplifier powers for each speaker giving the minimum requirement (which should suffice for average levels in smaller than average sparsely furnished rooms) to the maximum power handling which should represent the kind of amplifier power required in a larger than average room furnished with heavy drapes, thick carpets and plenty of furniture. (Average room=80cu metre.)

Many people are nervous about damaging loudspeakers by overdriving them with their amplifiers. As



explained in the chapter on *Loudspeakers* a big amplifier is unlikely to damage speakers even peaking well above their power handling for a short space of time. A small amplifier constantly running out of steam and clipping is more likely to damage loudspeakers. How well an amplifier performs as it approaches the limits of its power output is covered in the individual reviews.

How to make your amplifer sound twice as loud

An outrageous claim you'd think. But the answer is simply change your speakers for ones having 10dB higher sensitivity. The tailoring of ranges of amplifiers by the major Japanese manufacturers with models every ten watts from 30 watts to 70 watts implies that there is an important loudness difference coupling up a 40 watt amp after a 30 watt amp. I'm afraid not - the difference would be barely discernible. Changing from a speaker rated at about 82dB/1 w/1m sensitivity to one with a figure of just above average 92dB would produce a sound twice as loud. This is equivalent to going from a 50 watt to a 500 watt amp. The point worth making here is that chasing after those extra few watts when buying an amplifier is pointless as the difference would be wiped out many times over by even a slightly more bass output to be correctly balanced. Corner mounting doubles up bass output again over wall mounting.

A rough rule of thumb is that the speakers and listeners should be at the corners of an equilateral triangle with the speakers angled in to or across the listening position. There is nothing better than experimentation in the home, as in some instances the speakers can afford to be further apart or angled to have their axes cross well in front of the listening area. Use a simply-miked recording and adjust the speaker positions until you get a firm image extending right between them and existing in depth.

Be careful over where you position your loudspeakers in relation to your turntable as there is no point making its job harder by pointing a loudspeaker directly at it. While on the subject of turntables and speakers it is sometimes better to sacrific bass extension in a speaker system than to buy big bassy speakers and expect clean bass from the poor tuntable, which is now trying to work in an environment swamped with low frequency signals.

Receivers versus tuner and amp

It is better to buy separates or to save money by buying a receiver - a combined tuner and amplifier in one? If you can accept the level of facilities that are provided as a match on the tuner and amp sections by the receiver manufacturer then the receiver can offer a saving. If though, for example, you wanted the simplestto-use tuner with fair FM stereo performance yet wanted to use two tape decks and a cassette recorder with your amplifier, then you'd have to choose a cheap tuner and a facility laden amplifier; no receiver manufacturer offers that kind of package.

Receiver sales do seem to be falling off; even the much vaunted Nytech *CTA252XDII* receiver is now discontinued in favour of separate amp and a soon-to-be-launched tuner.

Upgrading

What ever you eventually choose and buy, you would do wise to thinkahead to the time when you want either to replace part of the system or to improve its performance. Some systems offer a hassle-free route to upgrading, particularly those active systems offered by one manufacturer. If you intend to upgrade in steps you need to follow a route which never compromises the system and which gives worthwhile improvements at each step.

Take as an instance of upgrading potential a good quality first-time system which could be recommended by many specialist dealers.

The system compriss a Linn Sondek LP12 turntable fitted with a Linn Basik LV-Varm and cartridge feeding an A&R A60 amplifier and ARC 101 Series II loudspeakers. The first upgrade move would be to replace the Basik cartridge for a slightly better model — a popular choice would be the A&R P77. A moving coil cartridge could be contemplated as the next upgrade move but a better arm would bring about fundamental improvements rather than cosmetic changes to the performance of the system. The Linn Basik mounting hole is designed to accept the *Linn Ittok* tonearm, and this partnering the P77 would be the next sensible move.

The next upgrade could be to a moving coil cartridge though if the owner didn't want the additional expense of obtaining a new mc input board for the A60 he could use a high output type mc cartridge (the Supex SD901 for example). The Linn Asak or Supex SD900EVSuper would be suitable low output mc types which would require the A60's input board to be changed.

The next upgrade could be to take the active option possible with the ARC loudspeakers which would dispense with the modular passive crossover (£18 refund for this item from the ARC dealer). An A&R SAX60 crossover-amp provides an electronic crossover and extra two channels of power for active operation. (Both A&R and Nytech make suitable electronics for active operation.)

This upgrading scheme shows the benefits of an integrated systems approach, which is becoming the norm among UK manufacturers. Some designers adopt similar compatible philosophies -Meridian. Linn, ARC, Nytech, A&R Cambridge and Naim have all agreed to use similar socketry, levels and impedances when it comes to active speakers. The modular approach to amp design adopted by Meridian, Crimson and Quantum allows for sensible upgrading in power or facility terms without changing the basic system. Bridging power amps as offered by NAD has similar benefits.

One popular and inexpensive way to upgrade is to fit a new stylus to an existing body. Buying a better stylus having a more sophisticated stylus profile can be a good idea if the arm in use is still compatible with any changed compliance. Shure cartridges, the A&R designs, ADC models and some of the Ortofons are ready for upgrading within the ranges.

Suggested systems

It's gratifying that Hi-Fi Choice's Best Buys feature prominently in the best selling under-£300 separate systems. One of the cheapest systems that could be put together using this Guide is already selling well in the dealers. The Dual CS-505 AM is one of the few recommendable budget turntables now available. in the absence of last year's Best Buy inexpensive amp, the JVC AX1 (now discontinued), the £69 Marantz PM310 comes into its own. This coupled with a pair of KEF Coda speakers at around £80 would provide a very capable system for the first time buyer. If a smoother cartridge than an absolute budget model were required then the Dual arm is quite capable of accepting the ADC Phase series designs and any magnetic design up to and including the A&R P77.

NAD's popular 3020 has moved slowly up the market in price and must now be less of an investment for the first time buyer than it was at its launch price three years ago. It can still be confidently recommended and last year made a very popular

package with the Dual and Mission 700 speakers. Sadly this design has been discontinued and its replacement and 700s and though selling well has not yet been reviewed in Hi-Fi Choice. At this level of equipment it wouldbeprudenttouseaturntableof the quality of the Rega Planar 3 or if feedback isolation was of great importance, the Systemdek II with a suitable arm, say the new Linn Basik LV-X. This arm would be a suitable partner for the Walker CJ55 or Heybrook TT2 and A&R P77, either of which would offer a strong front end in a medium price system that had good upgrading potential.

The next worthwhile step would be represented by the *Rega, Walker, Thorens TD160* or *Michell Focus* turntables while the *Basik* or *Rega* arm could take moving coils like the *Supex 901* or *Coral MC88.* The *A&R A60* amp seems almost alone in the £200 ampcategorythere being a particular shortage of Japanese designs competing at this price on sonic grounds.

The £1000 to £1500 bracket would be inhabited by systems based on front ends of the quality of the Linn Sondek LP12/Ittok/Asak, taking in designs like the Pink Triangle or Logic DM101 partnered with one of a new generation of UK designed and built super-rigid arms, starting with the Mission 774 and 774 SM designs. Speakers like the Rogers Studio 1, Spendor BC1 or SA2 as well as the Heybrook HB3 or Mordaunt Short Pageant 3 begins to benefit from the quality of the turntable in systems such as this. Amplifiers worthy of use in this context and price bracket would include the Marantz PM-5, the Meridian and Exposure designs. The potential for cartridges here would suggest the use of the Mission 773HC, the Dynavector DV23Ruby, ADC MC1.5, the FR MC201 or the Osawa Mirage 60. The SMEIIISB is best suited in this price bracket to modelslike the Goldring IGC range or the new Shure V15V.

Ultimate systems in the £3000 to £5000 category would be based around turntable/arm combinations like the Lux PD300, Linn LP12 or perhaps the Oracle using arms in the £350 to £800 bracket which would include the old favourites, Ittok and Sumiko would include the newer Helius Orion, Alphason or Zeta arms. The cartridge uniquely suited to this category of equipment is the Koetsu Black. Amplifiers like the Meridian, Exposure and Lentek would be obvious choices for use with speaker systems of the potential of the Quad ESL-63, Spendor SA3 or ProAc Studio 3. (Our turntable reviewer has questioned the use of the full Linn frontend in combination with the Quad loudspeakers, on the grounds of the Linn products' rather 'rich' or bottomheavy trequency balance see Choice: Turntables)

Do remember that these systems are examples only of disc systems that can be assembled from our recommended products in each price bracket. There is no recommendation we can make which can remove the need for personal audition, under suitable conditions, preferably in your own home.



ONCE YOU'VE ACQUIRED an Hitachi DA 1000 digital audio disc player, we have a feeling that you might like to tell your friends a little about it.

TELL THEM ABOUT THE LASER The DA 1000 is designed to play any compact disc on which audio signals have been converted into digital signals and recorded at high density.

These digital signals are read out using a semiconductor laser pick-up, without any direct physical contact, eliminating wear of both pick-up and discs.

And that means no more replacing worn styli, no more static crackle, no more scratches, no more surface noise at all. Ever. The disc you buy today will sound exactly the same in twenty, fifty, even a hundred years time. Even if it is played every day.

TELL THEM ABOUT THE SOUND QUALITY

Because there's none of the "scratch noise" associated with normal discs, and

none of the "hiss noise" associated with tapes, the signal to noise ratio of the DA 1000 is approximately 30dB more than conventional systems.

The distortion is less than 0.03%, the wow and flutter is below measurable limits, and the dynamic range is better

A comparison between the Hitachi DA 1000 and an ordinary LP disc player						
Items	DA 1000	LP disc player				
Frequency response	20 Hz- 20 kHz ± 0.5 db	30 Hz- 20 kHz ± 2 dB				
Dynamic range	More than 90dB	65dB				
S/N ratio	More than 90dB	60dB approx.				
Distortion	0.03%	3% approx.				
Channel separation	More than 60dB	25-30dB				
Wow and flutter	Crystal oscillator precision	0.03% approx.				



than 90 dB, producing an effect with added depth and dynamism.

Even vibration and howling are dispelled, as servo is applied to the pick-up during disc play.

Put simply, you'll never have heard anything like it.

TELL THEM ABOUT THE FUNCTIONS

<u>Random Memory Track Search.</u> With this function, you can program the DA 1000 to play only the tracks you want to hear on the disc, in any order you like.

<u>Self-Program Search System</u>. The SPSS searches for the start of each individual track in turn, forwards or backwards and then plays it. <u>Scanner Play Function</u>. This gives you a good idea of what is on a disc by playing one second of material out of every thirty seconds, continuously.

Something not worth risking on conventional systems.

<u>Servo-assisted Front Loading</u>. For stacking, and easier access and loading.

<u>Repeat Function</u>. Repeats the whole disc, or just the memory.

<u>Other Functions:</u> Pause – without the "Take up" of tape or the unreliability of tone arms. Headphone socket with level control – for ease of personal listening. LED's – for programme number and playing time displays, as well as elapsed time and pick up position indicator.

ONE THING YOU WON'T HAVE TO TELL THEM

Who makes the DA 1000? With sound this good, and this sort of accuracy and reliability, it could only be... Hitachi.

Hitachi have used only their own major components in their digital audio disc player (unlike some other manufacturers) and have created over 140 patents in its development.

The Hitachi DA 1000 digital audio disc player.

The Joneses aren't going to like it.



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COMPACT DISC AND DIGITAL RECORDING SYSTEMS

Digital technology has been used for a number of years now by the BBC in bringing you your radio programmes. Almost unsung the BBC pioneered the use of PCM (Pulse Code Modulation) techniques to transmit radio, to link studios and transmitters and to record material for later broadcast.

Analogue systems deal with analogies of the musical waverform, be they stored as a physical analogy in the case of the LP record groove or as a magnetic analogy in the orientated magnetic fields in a piece of recording tape. The problem with such systems is that they are prone to degradation and noise, furthermore they can become 'nasty' when pushed near their limits.

Digital recording systems promise to overcome these problems by storing information about the music waveform in a robust mathematical code form. The code is created by a technique known as sampling. The digital encoder looks at or samples the music waveform very frequently, 44,100 times a second. At each sample point it looks at the level of the signal and ascribes a code to that level. This code is built up from binary digits ('on's and 'off's – or 'ones' and 'noughts') but to encode sufficient levels to capture the full dynamic range of music, codes built up out of 16 bit (binary digit) words are used. All the possible permutations and combinations of a string of 16 'one's or 'noughts' gives you 65,536 levels which in effect corresponds to a

dynamic range of around 100dB.

The binary code is robust because the only thing that needs storing is a difference between an 'on' stage and an 'off' state — unlike analogue systems which need to store a whole range of voltage levels, simply because they are not code systems but deal with analogues.

Because, in a digital system, the music is stored mathematically, any lost pieces of information can be mathematically recreated, or 'interpolated' by error correcting systems which act like very fast acting adding machines. This means that even gross defects in the storage medium, occurs on analogue, and even unacceptable noises such as clicks and pops, can be compensated for.

There are two types of digital equipment available to the UK consumer. Because of the high frequency sampling rate and the need to store 16 bits for the left channel, 16 bits for the right channel and a further 16 for error correction codes etc, the tape recorder needs to be able to handle roughly 2 million pieces of digital information every second - in other words it must have a bandwidth of greater than 2 MegaHertz. The video tape recorder is the only domestically available tape recorder with this kind of specification and it has been press-ganged into audio use by a number of manufacturers. There are two types of digital audio VCRs, those which have dedicated 'video' recorders useable only for recording

audio signals (like the Technics SV-P100) and those which use conventional VCRs (like Sony's PCM-F1 digital audio adaptor which can be used with any video recorder operating at the right video standard — PAL for UK and European use, NTSC for the rest of the world including the US and Japan).

Compact Disc

Both these digital tape systems allow the user to both record and replay digital material. As exciting is the launch (March 1983) of the play-only digital Compact Disc system. This system has been developed in Europe by Philips with a large R and D input from Sony over the error correction techniques and circuitry.

The Compact Disc itself measures only a little more than 4 inches across and carries its digital information in a spiral packed 40 times more closely than the grooves on an LP record. The digital information is carried as a series of 'pits' in an aluminium foil layer. This reflective layer is sandwiched safely inside a clear plastic disc. The benefit of this construction is that the laser pickup can focus past the surface marks and imperfections onto the digital track without let or hindrance. The error detection and correction systems can cope with any other problems.

For the UK, the launch catalogue included 195 Compact Disc titles, with CD players available from Philips, Sony, Marantz, Hitachi,



Sony CDP-101



Marantz CD-63



Hitachi DA-1000

Toshiba and other manufacturers. The CD catalogue will grow at a rate of at least six new titles a month thereafter. Player prices should be around £450 for a basic machine and over £500 for a remote control model with features like remote control and elapsed time readout; the discs will probably sell for £9.99 with rock material selling for a little less than classical. All CD machines feature automated track selection as this information is coded onto the disc for easy search and access — an important feature of the system.

The following material covers the digital tape recording systems available on the UK market in three reviews by Angus McKenzie. Compact Disc is given a preliminary user report by Martin Colloms who has also measured and auditioned a significant cross-section of the launch players and software for this new medium. The reviews reprinted here in abbreviated form can be found published in full in *Hi-Fi Choice* issues 29 and 30.

DIGITAL RECORDING SYSTEMS: REVIEWS by Angus McKenzie

HITACHI V300 digital audio recorder

Although the Hitachi V300 digital recorder is not their first one, it is the first to be released in the UK. It employs a VHS video transport in combination with 14 bit A to D and D to A processors for stereo record and playback. Phono line in/out sockets only are provided for audio interfacing, approximately 0.25V being required on the input to achieve maximum recording levels with the input rotary level control at maximum sensitivity. This record level control wasfriction locked. Peak output level is just over 1 V. from a very low source impedance, and a stereo 1/4 in headphone socket is provided with a headphone gain control, giving plenty of level into most headphones

The record level meters were very fast indicators with excellent discrimination, being of the horizontal fluorescent bargraph type. One point which seemed rather strange, though, was that the meters themselves appeared to be down somewhat at HF, although reading the signal after the point where preemphasis might be switched in on record, and before any de-emphasis switching on replay. An overload light for each channel showed when the recording volume reached absolute peak recording level.

The VHS transport incorporated the NTSC American video standard, rather than the European PAL one, and thus the total playing time was around 30% lower than that normally achieved in PAL-standard VHS video decks. Extensive facilities are provided, which include the possibility of marking points on the tape for subsequent reference, and whilst normal editing of course is not possible, editing by copying is fairly simple. Digital video inputs and outputs are available on phono sockets, allowing copying to and from a second video deck, but this had to be an NTSC one unfortunately.

It is possible to either record with a

completely flat power response from VLF to 20kHz, or to use pre-emphasis of 50/15 us to give effective HF noise reduction, although at extreme HF the maximum recording level is limited by pre-emphasis to around 9dB below that of the 1kHz peak level capability.

In addition to the normal tape transport controls, some additional ones are exposed when a cover is opened on the front panel. These include a data slice level control, which concerns the peak video level on the tape and the digital dynamic range, and a tracking control of optimise play-back of digital tapes recorded on other decks. Two dropout lights and the pre-emphasis switch are also behind encoded onto the tape as part of the bit sequence, so de-emphasis on replay is always automatically switched by the output of the tape.

A switch is provided to select external digital input or audio input to the record section. The 'digital out' phono socket gives the A-D digital output being recorded when in the record mode, but the digital replay bit stream when replaying a digital tape. The digital-in socket feeds the deck on record from an external bit stream when switched to digital dub but is inactive on replay. It is unfortunate that on this unit it is impossible, as far as we could ascertain, to obtain D to A de-processing from an external digital source. The frequency responses were phenomenally flat from 20Hz to 19kHz, the 20kHz response being 1.8dB, thus showing an incredibly steep anti-alias filter. At 24kHz, the filter response was -70dB! Responses with pre-emphasis in or out were virtually identical. We checked the aliasing performance which was thought excellent, 18kHz giving a 24kHz alias at -52dB, which should cause no problem.

At 1V in and out of the recorder (just below peak bit capability), 1kHz harmonic distortion was minimal at an astonishing 0.01% THD. At 40dB below peak, 3rd harmonic was dominant at just 0.3%. At -60dB distortion was 0.8% which can be ignored in the context of the level. We recorded tones at various levels, and managed to reconstitute them at very precise levels on playback using a spectrum analvser with 1 H 7 bandwidth down to 10dB below the noise floor, which was amazing, thus showing that reverbation could be accurately reproduced at the very lowest levels. Intermodulation distortions between high frequency audio tones were excellently low, even when the IM waveform peaked just below maximum recording level. Overall background noise was a mazingly low throughout, under all normal operating conditions.

For the subjective tests, we tried both live recording, and recording from other digital systems via analogue. The reproduction of a Royal Festival Hall concert, including Richard Strauss's 'Till Eulenspiegel' and Mahler's First Symphony, was absolutely stunning — we had no reservations whatsoever concerning the reproduced sound, no dropouts ever being apparent even after several replays.

I was a little bit concerned that the meter response indicated 4dB down at 18kHz, compared with the level that I suggest they should have been and this seems absurd. This seems a minor point though when everything else about this deck was so amazingly good. Its price will be very high at around £1800, but the state of the art quality produced makes purchase very worthwhile; consideration of this model is strongly recommended.

SONY PCM-F1/SL-F1 UB digital recording system

Sony's utterly remarkable new digital system can work off batteries or can be driven from mains power supply, including for example the one provided in the TV tuner module (this allows the video recorder to record and replay TV in the normal way.) The PCM F1 is a 14 or 16 bit (switchable) A to D and D to A processor. The unit is provided with phono sockets for stereo line in and out, and two mono ¼in jacks for mic inputs with adequate sensitivity even for speech recordings. The two separate miniature rotary record level controls we refound just a little awkward to bring up and down together. They are switchable between mic and line in.

Meters are horizontal bargraph types which read transients very accurately but which are rather difficult to see in bright sunlight. 'Over level' indicators are provided to show the user that peak recording level has been exceeded, these working on recording only. The UK model puts the digital code onto a PAL video waveform, but an NTSC record model is available in the US, the difference being very minor. Whereas 14 or 16 bit encoding is switchable, the unit will decode automatically either 14 or 16 bit inputs, and astonishingly either PAL or NTSC format, without any manual switching!

Front panel controls include a headphone gain switch with five positions, a ¹/₄ in stereo jack providing adequate volume into all normal types. Switchesselect replay muting on/off, copy facility on/off, and mic/line input. Push buttons select meter functions — peak hold (manual or auto-preset), battery check, and metering audio levels or tracking. A record mute button is provided.

The rear panel also includes external DC input, video out/in phono sockets, and a copy video output socket. the unit meaures 21.5x8x30.5cm and weighs 4 kg, incorporating a large shoulder strap which is most useful. The SL-F1UB battery operated video recorder again works off rechargeable Nicadswhich only take one hour to recharge, having a one hour running capability, as with the similar types used with the *PCM F1*. For portable recording the two units are interconnected with a multipin plug at the SL-F1 end and two phono plugs at the other end, the only other connection being required for recording literally being the two microphones! The video deck is very comprehensive, and in addition to the normal transport controls, allows scanning forwards or backwards at normal speed, double speed and single frame scan which can be used repeat the same words again and again (muting must be switched off to operate these unconventional modes). The tape counter reads in hours, minutes and seconds, which is superb. On the side panel is a multipin camera socketand a mono mic jack which can be used for recording (analogue) the syncoutput from a film camera. Sony recommended the use of their new Dynamicron HG low-dropout Betamax cassette for digital recording, L-750s giving up to three hours recording duration.

In all the subjective tests not even the slightest trace of digital problems were ever heard. For even when under-recording speech by some 50dB, requiring the playback to be interconnected with microphone inputs on my control desk, the reproduction was still completely clean, although hissy of course.

Measured frequency response was to all intents and purposes completely flat up to 19kHZ, and weighted overall noise, 16 bit being quite fantastic (-90dB), and 14 bit slightly bubbly when volume was increased considerably on playback. Distortion was 0.01% near peak levels, and only 0.22% at -60dB. (You won't hear distortion which is 113dB below peak recording level!)

Many professional engineers have commented that the set up actually gives a better overall sound quality than Sony's PCM 1610 £15,000 professional adaptor, for the circuits and microprocessors have been far more recently designed, thus giving dramatically lower distortion at low levels. The battery operation facility virtually means that this Sony combination will take over much professional work which in the past has been made on Nagra recorders, costing perhaps three times as much. Warmly recommended both for domestic home and in-the-field recordings, and even for professional use. With all things considered, these units are astonishing value for money, costing around £1500 the pair.

TECHNICS SV-P100 digital audio recorder

The long-awaited Technics digital recorder incorporates a VHS transport and is housed in a large metal case having a projection at the bottom of the front on which the main operating controls are mounted. Phono line input and output sockets are fitted on the rear panel whilst 1/4 in mono jacks are fitted on the front for mic inputs, a stereo ¼in headphone jack providing adequate volume into most types of headphones (volume control on replay by master gain control). The system records 14 bit coding at the usual sampling rate on to the Japanese standard NTSC video format. The 50/15us pre-emphasis is permanently switched in on record, but switchable on playback automatically. On the back panel there are also a pair of phono sockets for digital input and output with the same facilities basically as on the Hitachi V300. Rear panel switches include normal internal/external clock frequency edit on/off, timer 1 hour delay on/off.

Front panel controls include two separate left and right miniature

rotary record gain controls, together with a ganged master level having a calibrated gain scale around it, this master gain also becoming a replay gain and a digital muting control when copying digital tapes. The VHS transport controls include a swish tape loading/unloading button, and normal oerpating buttons including 'search'. Special facilities include record timer on/off (this operates with an external timer, and when the delay switch is on, the recording starts one hour after the preprogrammed timer switch switches on, which allows the mechanism to warm up and de-humidify). A light indicates if there is too much moisture present.

A data level button allows the actual recorded level of the pulses to be checked on replay, the tracking control allowing data levels to be peaked up. However this tracking adjustment is very awkward, requiring a rubber plug to be removed from the side panel and a screwdriver adjustment carried out to select the optimum replay tracking as indicated on the data metering.

Metering is with a liquid-crystal horizontal bargraph display having just 40dB displayed dynamic range, which can be switched to read audio or digital levels which is useful. Two buttons for memory operation allow memory on, off and recall memory location. A line/mic or digital input switch is fitted, the mic inputs being selected when jacks plugs are pushed home into the 1/4 in mono jacks select provided. Lever switches some fascinating functions, the first one being 'jump mark'. When this is selected on record or playback, a special tone is recorded which causes the tape to wind on at eight times normal speed for the duration of the jump tone, after which causes the tape to wind on at eight times normalspeedforthedurationofthejump tone, after which the decks reverts to normal playback. A spring-loaded 'search' lever records another type of tone, again on a separate track, which can be used to locate a given section of the recording, the search tone automatically coming on for 70 seconds, unless interupted, at the beginning of each new recording. A third lever clears all jump and search tones while playback is in progress

During high speed cueing (eight times normal speed, selected by holding down play and either forward wind or rewind) the headphone socket produces a speeded-up audio, while line outputs are muted. This facility is extremely useful and is rather amazing on a digital recorder, clearly involves some very advanced processor technology.

processor technology. The sensitivity of the muting control was clearly two low as tapes from the Hitachi V300 had peak data levels which were too low to open up the muting. So there might be some compatibility problems here, although the particular recording was clearly at fault in having too low a video level, which did, however, play back perfectly on the V300. Hitachi's own V300 demo tape did play back perfectly though. Recordings made up to peak recording level sounded excellent, but when we peaked at a very low level, some noise modulation was audible below the speech, which was a little odd. This effect virtually disappeared when we peaked at -40dB, but it was fascinating that the Sony system was better at low levels. The Technics recorder omits any indication of over-recording (in the bit sense) and no dropout lights are provided (the Sony omitted the latter

Input sensitivity was 150mV for full recording level, with maximum out-put level at 2.3V. Overall weighted noise measured extremely well, and unweighted noise measured the same at -84dB, which is amazing, hum levels being extremely low. At peak recording levels distortion was minimal, at around 0.02%, but at 60dB, which is amazing, hum levels being extremely low. At peak recording levels distortion was minimal, at around 0.02%, but at -60dB 2nd harmonic was around 1.3%, and 3rd harmonic 1%, which we regard as good but not outstanding at this very low level. Note that distortion products at this level are around -96dB total, ref max recording level, so you are hardly likely to hear them! Response was within 0.3dBfrom 10Hz to 20kHz. We all admired this system very much and as with the other new systems, we feel that it can be warmly recommended, but it should be noted that as with the V300, it is a dedicated deck for audio digital and cannot be used with PAL video recordings (Please note that the pros and cons of this arrangement are covered in the chapter Comparison: Cassette, Reelto-Reel and Digital in Issue 29). The size is rather large, measured 43x-27.8x34.6cm and weighing 21kg, and thus it requires rather more space than the other models do.

COMPACT DISC: USER REPORT — by Martin Colloms

LP versus CD

In tests, spectrum measurement shows CD material to have more peak treble energy, but often the subjective results indicated a 'brighter', more open sound from the conventional LP — not a function of its frequency response but simply the effect of the extra surface noise.

A full understanding of the mechanics of LP record replay would lead one to anticipate a deterioration in sound quality as the arm traverses the playing radius, due to the progressively reducing groove velocity gradually compacting the music modulation. This makes it harder for the stylus typ to trace accurately. In practice however this deterioration passes relatively unnoticed, as with continued listening to a given record, one tends to assimilate changes in clarity, treble energy, separation and distortion with the changing programme - unless a particularly trying end-of-side finale or massed choral section appears, where the record player's failure to cope is only too obvious.

With CD replay, the sound is consistently accurate from end to end, which makes comparison with LPs rather difficult. It quickly becomes apparent that the LP sound really is constantly changing, and that even with one of the finest analogue players combinations only the outer part of a mint LP is of much use. By the time that the last track has been reached, the difference is too obvious for any useful comparisons of fidelity to be made. Other problems also arise. Peak programme measurements suggest that even with wellcut records and top-flight cartridges, peak compression and distortion occurs on an analogue, and even when the noisy low level sections have been avoided, and the sound balanced for a fair comparison on middle sounds, analogue, is, brighter on transients.

If levels are not carefully judged it is all to easy to clip the monitoring amplifier and wrongly attribute the resulting hardness to the so-called 'digital sound'. This term is virtually meaningless, since good digital can be so transparent a recording medium as to be almost inaudible, a fundamental of performance sadly lacking in the current analogue systems whether tape or disc.

Subjective qualities

Some pundits, without actual experience of good digital equipment have nonetheless speculated on digital's subjective faults, such as 'grainy treble'. 'hard midrange', curtailed stereo depth and ambience, plus audible low level distortion. We however have experienced none of these with our machines; on the contrary we have discovered some unexpected virtues which I feel will assume increasing importance in the future. The most obvious and perhaps the least expected is the bass quality.

With CD replay of digitally mastered sources, the particularly good quality of the bass is immediately noticeable, the effect best described as an 'opening up' of that frequency range. The bass seems less obvious, less forward or boomy, and takes on a more natural perspective, showing greater depth, attack, damping and extension. The midrange also seems more clearly defined, the reduced bass confusion appearing to be a contributor factor here.

The potential of CD, yet to be realised in future recording productions of the right quality, will come as a revelation to the audio consumer. It will expose analogue LP weaknesses and will provide a stimulus to amplifier and speaker manufacturers alike to improve their product to match.

In absolute terms, the analogue LP chain has a tendency to soften, mask and compress the original pro-gramme in addition to applying a degree of audible frequency response filtering at both extremes. Strangely enough, on a considerable quantity of current programme this failure is actually an advantage. It would appear that much of the programme is doctored, hyped-up, equalised, or otherwise produced in such a manner as to give an enhanced 'larger' and 'closer than life' effect. Moderated by the analogue chain, the end result is more or less satisfactory, but the same programme replaying in all its exaggerated glory via CD can sound dire in many cases - a travesty of the musician's and composer's intentions.

Paradox

We therefore have an interesting paradox here — the LP can actually beat the CD player on modern programme material of typical commercial quality, when judged from a musical standpoint. Once again, there is scope for the pessimist to condemn digital reply. Conversely, given 'musically' produced and balanced programme free of emphases, CD affords the domestic user a very close approximation to a highly transparent, if delayed, link to the Studio mixing desk at the moment of programme production.

The results we have attained so far suggest that with accurate programme the CD system performs extremely well by analogue standards, and ruthlessly reveals recording excentricities. Assuming the CD players in the £450 price range are properly constructed — most of the pre-production models loaned us showed no signs of problems on that score — the reader can be assured that its replay fidelity will happily compare with or exceed that of a wellspecified analogue player complete with cartridge and costing overall from around £1,000 to as much as £3,000!

Features and facilities

From the players tried, a fair idea of CD operation and the general facilitiesthatwill be offered was gained. All were automatic in the sense of a conventional turntable tracks may be selected by pushbuttons on any order and the sequence stored for subsequent play.

When a CD Player starts up, the first thing it does is to seek the start point (running inwards to outwards) and reads the disc index. It then has all the necessary information to read out the number of tracks present and their individual as well a their total duration, on its disc play. If 'play' alone is pressed, the tracks are reproduced in their normal sequence without interruption, and some of the machines have fine forward and reverse controls for track seeking.

The 'pickup' position on the record can be 'seen' in some machines by observing a timer calibrated in minutes and seconds for each track; in others the pickup will jump complete tracks without the benefit of a fine access capability within each track.

Differences in the speed of operation when reading the discs and selecting tracks became apparent during our appraisal. Several machines seemed quite slow. However, the Aurex *XR-Z90* gave a hint as to what is actually possible. A preproduction prototype, it demonstrated a very desirable turn of speed as regards transport operation. Not only was it easy and logical to use, but it also appeared to respond with great agility.

A further facility we found convenient was the presence of a headphone socket in the front panel. As for example on the Hitachi DA1000. This was found to be very useful.

As regards loading method, we tried top loaders (Marantz and Philips) vertically orientated front-loaders

(Aurex and Hitachi) plus drawertype horizontal loaders (Sony and the upmarket Marantz). CD Players have the potential to be very small indeed, since the disc is under five inches in diameter, and the horizontal types (both top and drawer loaders) hold out the greatest potential for compactness. In physical terms the basic Philips/Marantz design is the smallest so far, this a top loading design.

Operation

Turning to their actual operation, the CD player produces a line or auxiliary signal level, with a flat-response audio signal, like a tuner or cassette recorder.

Measurements

In the absence of test dics, some other measurements were made on four of the machines.

Spectrum analysis of the Marantz (early sample) and the prototype Aurex showed a difference in signal to noise ratio from 200 Hz to 100 KHz. This was no great surprise since Toshiba had already informed us that their prototype sample machine would measure around -70dB, this referring to the signals visible at around 8kHz and 14kHz. Further spurii were charted at 44kHz - the main digital clock frequency - and at its second harmonic, 88kHz. Both these and the audio band signals were much lower with the Marantz. The Aurex noise was clearly audible as discrete whistles or tones on the softer music passages but the Marantz background proved undetectable with no recognisable tones.

Measured on a 50KHz bandwidth, the Hitachi was not entirely clearwith spurii at 11kHz and 16kHz in the audible range, as well as at the ubiquitous 44kHz at a similar level. Careful auditioning at very high volumes suggested that these spurious signals, approximately-90dB down, were just audible on quiet music passages, more so on headphones. The final version of the Philips player (results not shown) gave noise and spurious levels at around-96dB on peak signal level, and no odd signals could be heard under any conditions we tried.

Conclusions

The conclusious arising from this preliminary investigation into CD players and digital sound replay in general are pretty obvious. Already extremely good, digital is clearly here to stay. Limited measurement showed that the similarities between particular CD players seem much greater than their differences.

It will be some time before CD presents a serious alternative to analogue, though, because of the finite rate of expansion of the CD record catalogue. At first, only a few hundred titles will be available, and no-one with an established library of LPs is going to scrap these and their associated analogue equipment. Initially a secondary music source, CD is however expected to expand in the next few years to make serious inroads into the analogue and LP market, to an ultimate stage where the analogue equipment and source material will be rendered obsolete except for archive purposes.

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TURNTABLES AND TONEARMS

Strictly speaking *turntable* refers only to the revolving platter and its bearing; the term used throughout *Hi-Fi Choice* to describe a turntable unit without a fitted arm is *motor unit*. Such a unit will be complete with a motor, base (plinth) cover and arm mounting board. A *tonearm* or *pickup arm* must be chosen and fitted

The turntable unit most familiar to the consumer is the record deck, integrated player or turntable system, which combines the motor unit and pickup arm in a plinth, often offering automatic arm return at the end of an LP side or even full automation from record-size sensing to arm lowering and lift-off. The potential benefit of integration is that a well worked-out design package can be offered but only a few manufacturers seem to be able to get the design compromises well balanced.

What should a turntable do?

The turntable's basic job is to provide a stable unvarying platform for the interaction between the LP record and the cartridge, to enable the cartridge to derive as much of the best possible information it can from the disc. The turntable should do this without creating its own noise and it should help isolate the disc/stylus 'interface' from the vagaries of vibrations in both the air and the structure on which it sits.

The pivoted tonarm is part of this system; its design is the outcome of having to provide a relatively easily built and passive mechanism to track an LP record which was in the first place cut tangentially by a straight line cutter. Records are mouldings from metal-work stampers. These stampers are made by depositing metal onto an acetate blank which has been cut by a heated stylus itself driven by the audio signal. This lac quer as it is called was clamped onto the massive platter of the cutting lathe where it was cut by the cutting head driven along a screw thread lined up with the radius of the disc. As thecutteris driven along the screw, at aspeed which varies with signal level, its stylus cuts the signal modulated groove spiral.

To replay this groove you are faced with the problem that there is no way to clamp the replay stylus in a head mechanism and drive it across the surface of the disc — the pitch of the groove cut in the record varies with the level of the cut and the desired running time of the LP anyway. Not only that but mass produced records, even the best pressings, would be too off-centre and warped for such replay. The typical compromise is the common pivoted tone arm which is both free to move across the disc and up and down. The replay cartridge is fixed to the end of this arm, about 9 inches from the pivot, where it tracks the disc along an arc which through adjustment of the arm geometry aligns closely with the straight line track of the cutter.

Turntable assessment

We need to know how accurately the turntable is rotating, both how close to the correct speed it is and how it varies over a period of time from this speed. The vibrations generated by the motor and bearing need to be measured too, as does the turntable's effectiveness in cutting out or cutting down the vibrations reaching it through the air around it and through the surface on which it sits. The term microphony describes how some turntables pick up these vibrations and allow them to interfere with the cartridge where they are amplified and passed back to the system. Once at a high enough level at the speakers these vibrations are out in the real world to upset the turntable a second time. This is known as feedback when it happens again and again and we need to find out how good the turntable is at resisting this feedback.

Speed

The turntable must be able to rotate the disc for replay at the same constant speed at which the lacquer was cut. The problem for the turntable is that it is relatively easy to do only as long as the stylus isn't tracking the groove and causing drag which varies with the severity of the cut on the disc.

The speed of the turntable can drift over longer periods of time often caused by tolerances or cyclic changes in balance or even the electronics used to stabilise the speed. Shortertermchanges in speed cause wavering of the pitch of notes, which is very noticeable with records of piano music. This is known as wow, the effect heard when you slow the turntable down with your finger. Shorter term variations still are called *flutter*, often caused by motors imparting a jerkiness to the platter's rotation, or by a rough finish on the bearing.

The stylus drag mentioned earlier can cause similar problems to wow which are not commonly picked up in simple measurement tests. This is known as dynamic or transient wow. When the stylus hits a rough patch (a loud music signal) or has to cope with a big, quick excursion (a transient), the drag on the turntable increases, and the note may lose its attack and be 'smeared out'. This is then followed by a cycle of wows as the turntable attempts to stabilise. Servo systems are one attempt to solve the problem. A servo senses the speed change and acts to correct it, and that's where the problems with servos stem from an error has to exist before it is corrected. Poorly designed servo systems merely add their own frequency of operation to the wow and flutter problems already there.

The other way to overcome these problems is to have a platter of high enough inertia to 'flywheel' its way through the stylus drag changes. (High torque motors are a third solution but there are the associated problems of increased vibration levels and the inherent problems of motors 'pulsing around' rather than running smoothly.)

Rumble

Rumble is a very low frequency problem picked up by the cartridge through the record from the main bearing of the turntable or from hum or grumbles in the plinth from the motor system. Rumble, if fed into a hifi system, may not be heard but can sap the power of the amplifier by driving the speakers hard at very low frequencies. The interaction of rumble, recorded rumble off disc, turntable isolation (or lack of it) and a cartridge's low fequency performance is one of the areas covered in *Putting together a system*.

Do not disturb

The area of turntable performance that seems to receive the least attention from the major manufacturers is that of the turntable's resistance to outside disturbances; in other words its *isolation* character. One of the best approaches seems to be to hang the platter, arm and cartridge system from the plinth on a sprung subchassis. These systems may work well for filtering out certain frequencies of vibrtion, but they are often little help in dealing with shock.

Vibrations in the arm may come from passing traffic or from the loudspeakers, either way the turntable is susceptible to this air-borne vibration. Often moving the turntable to a different part of the room can help if the turntable itself isn't designed to cope. Martin Colloms has made some assessment in the following reviews of the capability of different systems to handle vibration and feedback of all kinds.

Tonearms

The tonearm should be part of the inert suspension system that enables the stylus alone to follow the modulations of the record groove, getting as close as possible to the path made by the cutter. The conventional way is to use a fixed pivoted arm some 9 inches long and to reduce the tracking error by offsetting the headshell end by some 25 degrees from the line of the arm. Further details on how tracking error is minimised are included in the introduction to the chapter on *Cartridges.*

Some arms aim to reduce the tracking error to zero by following the straight line cutter path, these are known by a variety of often misleading names, parallel tracking, straight line, radial tracking or tangential tracking arms. The practical problems are many-fold but some companies manage to overcome them to some extent though only the B80 8002 and Technics SL7/10 models did sufficiently well to merit recommendation and inclusion in this *Guide.*

The unfortunate fact of minimising tracking distortion by offsetting the headshell is that the stylus drag is now not in the line of the arm pivots and so causes a force to be generated which tends to pull the arm in to the centre of the record. As the drag changes with the modulations in the disc so does this force, but it seems sufficient to correct for it with a progressive bias force set to correct for the highest level signals. This bias compensation (often called sidethrust compensation or erroneously anti-skating) is built into the arm mechanism and can be effected by weights on cords, magnetic interaction or by calibrated springs. Choice reviews comment on the efficacy of the bias compensator fitted to every tonearm. Of course the straight-line tracking tone arms have no offset and so produce no sidethrust force and therefore need no bias force.

For assessment we need to know that the pickup arm bearings won't impede the cartridge's progress across the disc and that the geometry and alignment of the arm permits the adjustment of the cartridge for minimum distortion. Additionally a measure of the effective mass of the arm will help us to decide what type of cartridge will be compatible. We also need to know how the pickup arm will cope with vibrations put into it by needle chatter. The complete unit is then auditioned.

Tracking

The interactions between cartridge and arm mass and the compliance of a cartridge are covered in the chapter on *Cartridges* later in the book. The relationship between mass/ compliance and fundamental arm/ cartridge resonance is covered by a simple graph in the earlier chapter on *Putting together a system*.

Arm damping

Many cartridges contain some form of damping at the hinge or pivot of their cantilever system to help control the low frequency resonance. Some arms provide for pivot damping to help the cartridge cope with this low fequency resonance. Damping helps to reduce the sharpness and amplitude of the resonance but in doing so it spreads the range of frequencies that will excite it. Arm damping may therefore change the sound of a certain cartridge but not necessarily for the better. Over-damping can reduce the arm's ability to follow warps and so the cantilever system will be flexed over the warps instead of the arm and cartridge rising and riding over the hump. This will not only cause tracking problems and rota-tion of the stylus contact points causing distortion but it may well feed high energy subsonic signals to the amp and speakers, which again may cause havoc with feedback or may just drain the amp of the power it needs to drive the music signals. Comments are made in the tonearm reviews on the effectiveness of damping and in the cartridge reviews on the need for additional damping with certain cartridges.

Plattermats

The vogue turntable accesory is the plattermat but their action is only just beginning to be understood. Rather than provoke wholesale mat swapping it is suggested that with the more expensive designs the mat interaction is often taken into account in designing the turntable. With budget and mid-price record decks the mats are so often designed for visual appeal rather than record support and here is where the benefits from mat substitution will be found. Remember though that a £20 mat on a £70 turntable may not be a cost effective solution to improving the sound quality of your hi-fi.

The **Audio Ref** and **Avon** mats were found by Martin Colloms to be the best 'all rounders', while hard glass mats from **GA Audio** and **Michell** produced fine results on turntables with flimsy platters.

Other models worth considering

There were less than a dozen integrated record decks considered to be of above average performance but failed on grounds of cost or mild flaws in performance to gain full recommendation. The linear tracking **Aiwa LX100** model (£150 inc cartridge) sounded reasonably good for the price and was fitted with a compatible cartridge. The **Revox B791** (£420 inc cartridge) is now improved over the B795 model and is fitted with a better cartridge; it is worth considering especially for Revox system owners.

Three inexpensive turntables missed recommendation narrowly, these were the **JVC LA10** (£55 inc cartridge), the **Marantz TT120** (£54 inc cartridge) and the **Pioneer PL120** (£60 inc cartridge). All three models were considered to possess true hi-fi performance with reasonably good sound quality at low prices.

Sansui's classic budget turntable the SR222 has now resurfaced in MkIV guise. The **Sansui SR222 Mk IV** (£85) made quite a good impression and becomes worthy of consideration. The **Sony PSX600** was listed in this category in the last edition of *Hi-Fi Choice — Turntables and Tonearms* and it may now be available at a new low price (£180 or less). This model was found to be well made and to offer automatic facilities with good shock isolation.

Of the motor units seven models just missed full recommendation but when suitably set up and matched could offer fine results and are certainly worth considering. The **Ariston** Superieur (£350) was not entirely convincing as regards sound quality but the general standard was sufficient for inclusion here. The heavy version of the Dais (£480) produced top-ranking sound quality marred only by slight wow and motor breakthrough. The lighter platter version (£390) should sound comparably good and is well worth trying. No covers are provided for either model. The big Lux PD555 proved to be beyond any value recommendation because of its price in the last issue (£1700) but although the price has been much reduced (£999) it is still very high. This luxurious and massive vacuum platter turntable can be fitted with two arms. The Marantz TT1000, the Oracle, the Michell Gyrodec and the Thorens TD126IV £999, £747, £595 and £280 respectively) were all worthy of inclusion in this category. The TD126 is one of the few decks available with 78rpm speed and remains an ideal choice for the serious record collector with a collection spanning the years.

There were only half a dozen tonearms in the worth considering category this year. The Sumiko 'The Arm' (£795) was no longer alone in the super arm group though it con-tinues to offer fine performance but at a high price. Audio Technica's AT1100 was pushed into second place by the new AT1120 but it can still be considered a quality tonearm. The SME 3009 II (non-detachable) was considered long in the tooth but as the best value model in the 3009 II series at £75 it is still worth considering. The superb engineering and complete instruction book are a significant factor in its recommenda-tion here. The **ADC LMF1** and **ALT1** model (£74 and £44) still set good standards and were well calibrated offering good value though the ALT is still the better buy. Linn's original Basik LV-V (£45 inc cartridge) is now overshadowed by the LV-X model but is still worth considering especially when it comes factory fitted to one of the less expensive motor units. It is suited to medium to low compliance magnetic cartridges.

HR100S Alphason

Alphason, 31 Shawbrook Close, Euxton, near Chorley, Lancs Tel (02572) 76626 CURNER CONT



Since I was first asked to report privately on an year ago, production models have undergone early prototype of this UK-designed arm over a significant further development.

ity, the Alphason's main feature is the use of a substantial titanium beam tube with classic 'S' ioin to the headshell, itself ingeniously formed <u>0</u> A medium mass arm possessing high rigidfrom the front end of the tube; a transition considerable proportion of the beam upper surface continues down to the 'shell' or cartshape geometry. This has allowed a straight accomplished with minimal impairment interfacing of cartridge and arm. ridge mounting platform. good

∢

be dispensed with, offering much higher rigid-The concentric gimbal bearings are built of hardened tool steel for maximum strength and races. During the course of the review the the pivots are pre-loaded high precision ball bearing surfaces were updated using ultrahard carbide inserts — pre-loading could then ity with reduced friction levels.

approach rather than the superlative feel and Considerable care has been taken to maximise rigidity as well as to minimise reson-ances in the design by suitable choice of ance reflecting the mechanical engineering finish of the Japanese manufactured designs, materials and structure, the resulting performexpertise of the designer. Appearance and finish are undoubtedly to a good standard, but nonetheless this arm exhibits a 'craftsman' or example.

6mm rather than the required 4mm bolts are At present the arm is supplied with a pillar but we did not find this to actually be the case. and the tracking geometry is optimised compatible, com 58mm radius zero tracking-error point, used, g ē

2mm. However we understand that these disallows any desired overhang/offset angle to be obtained, and in this sense the geometry is The arm is slotted headplate of the Alphason of course also slightly longer than the Ittok by about crepancies will soon be overcome in production to make the arm fully compatible. The long rather than the accepted 64-65mm. already compatible.

sert with a locking socket-head screw, while മ The Alphason's fixed arm leads are reason-95pF. It is likley that two counterweights will be provided, these sliding on a hard nylon inđ downforce - 0.4g per revolution for the heavably compliant, aiding subchassis cable dressand are fitted with gold-plated plugs of quality. Cable capacitance was low at the weight carrier is stiffly engaged on threaded section allowing fine adjustment ier weight, which is suited to the Koetsu. good ing,

Lab report

at 10g inclusive of steel fixing bolts, and the and fine engineering. With the larger bias 8 0 ock was rather stiff - I would prefer a Effective mass was in the low to medium range rigid, with zero bearing play. The geometry was fine for a 2g downforce as well as being in particularly on the 'carbide' version now separate pillar rest. Resonance graphs were bearings and a small counterweight, and also for the second sample with 'carbide' bearings structure was highly 'dead' as well as mosi weight on the centre notch the compensation standard. The cue worked well though the arm plotted for the first sample which has steel Fhe latter showed improved rigidity, noticeable (optimised) was excellent with very good finish and larger stiffened counterweight assembly the right ratio, while friction was very

.⊆ ative of a very low-coloration design. Below the board is shown as a dotted line, demonstrating both cases behaviour was very good, indiccarbide' graph, the excitation on the Linn arm interactive relationship between arm and mounting. in the 'sharper' nature of the resonances but the substantial pillar coupling and clear

Sound quality

its excellent rendition of vocal lines while bass was firm, extended and detailed. Stereo was yet free of 'edge' or 'grain'. The mid-range gave exceptional with precise positioning and fine 'smoothness', transients were nevertheless Freble was detailed and precisely located and tonally balanced performance depth and ambience, and despite an apparent The HR100 impressed us strongly by reproduced with fine 'attack'. neutral and

Conclusion

performances are both undoubtedly worth the money. The HR100S confidently joins the ranks not quite commensurate with the cost, the echnical and more importantly the audible 'super' arms, its moderate mass giving While the price is high and the overall finish extra margin of tracking stability for mosi cartridges. of the an

GENERAL DATA

Lonearm

s, inc screws, excl cartridge10g	detachable	N/A	overhang/offset/height	good/excellent	Ip/usevery good/good/good	ical10mg/20mg	 thread, pulley and weight 	o 1.5g elliptical) 180mg/150mg	r, 1g/2g	ent	very good	very good	method95pF/none	e price	
Approximate effective mas	Type/mass of headshell	Geometric accuracy.	Adjustments provided	Finish and engineering.	Ease of assembly/setting-u	Friction, typical lateral/ver	Bias compensation method	Bias force, rim/centre (set t	Downforce calibration erro	Cue drift, 8mm ascent/desc	Arm resonances	Subjective sound quality.	Lead capacitance/damping	Estimated typical purchase	





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CUCKERS CONT

now machined to a slightly concave upper surface. Using the screw-down record clamp, standard with the unit, this allows reduction of hence the current designation RD80SL. As outlined by ments to the electrical insulation to meet Semco-Demco standards, while the platter is to-mat contact. Fine adjustment of the motor/ pulley/belt angle is now possible by a tilt frame and a nut-runner is supplied for this purpose Access is now provided underneath the tonearm without removing the base plate and in addition a new absorptive composition mat the has undergone some changes the manufacturer, changes comprise improvemost record warps as well as improved recordsuspension levelling. issue, last the intervening 18 months in the and for subchassis reviewed Ariston RD80 Favourably included over <u>s</u>

employs a weighty 2.5kg platter. The three-point spring suspension, and plinth and cover being Of slightly plain finish and appearance, the subchassis has a well-balanced substantial non-resonant items. ,80SL

-ab report

Fhough apparently undamaged externally our review sample suffered motor disintegration in ransit, but fortunately survived a rebuild. The supplied LVX arm fared less well as the counresult terweight had been left in position; the was 'notchy' bearings.

performance of the version was much the same as for the earlier model, both being to a respectable standard. Speed, wow and Lab

was generally neutral and the sound fairly transparent. The bass showed good depth and evenness, and pitch stability was also pretty ര substantial proportion of the required performstable and precise, while the overall balance Maintaining the standard set previously on ance parameters on a number of basic counts. The stereo soundfield seemed well focused, the 80SL provided sound quality grounds, Sound quality good.

tel: 021-459 4242

istic price. Its performance and sound quality, plus new additional features, have maintained its competitive quality, and accordingly the design continues to merit a *Choice* recom-While not a truly great turntable, the RD80SL is nonetheless a substantially good one at a real-Conclusion mendation.

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In the last issue a group of related Audio-Technica arms were assessed, including the 1010, the 1100 low-mass and high-mass versions. This year they are joined by a new low mass version of the 1100 called the 1120. The 1100 was characterised by its detach-

Tel (0532) 771441

Audio-Technica AT1120

Audio-Technica (UK) Ltd, Hunslet Trading Estate, Low Road, Leeds

able arm carrier fitted with a rigid low mass fixed headshell, the counterweight an elaborate affair with a lead-screw drive. With the 1120 Audio Technica have in essence simplified the design and taken some steps to improve certain areas, notably the bearings. These changes are in fact sufficient to result in a new arm model and justify a full review here.

The 1120 is a genuine low mass model in the 5g effective mass range. This makes it compatible with high-compliance cartridges that are unsuited to the more massy arms which are increasingly becoming available. As it is supplied with a fluid damping unit which may be used if required, this versatility is further extended. Low mass does of course mean that some sacrifice in rigidity is necessary, and this can mean a reduction in compatibility with lower compliance moving coil cartridges – not so much on grounds of subsonic resonance but more in the context of mutual resonances in the audible range.

The arm tube and shell of the arm are fixed in the 1120, and the alloy shell of the 1100 has been replaced by a lighter but frailer carbonfibre-loaded plastic moulding. The new arm is clearly designed for use with low mass cartridges and will correctly counterbalance units as light as 2g. The upper cartridge weight limit is 9g, even with the use of an extra counterweight, so high-mass cartridges are ruled out. The counterweight is one of the ubiquitous rotating types with a sliding scale and it has a rubber decoupling insert in its mounting. Audio-Technica's 'DTS' system is incorporated, whereby the vertical pivot plane is located below the stylus tip, thereby reducing the tendency for a stylus to lift out of the groove under heavy modulation. In fact stylus drag tends to increase the short-term downforce with this system, giving an increase in trackability.

Lab report

With previous arms in this series the bearings have never seemed quite tight but in the case of the *1120*, judged by our sample at least, the pivots are free of detectable play. Bearing play and any other indeterminate looseness or incipient rattle in an arm can seriously detract from the sound, generally resulting in a muddling of detail and a failure to reproduce transients with good clarity.

Despite this absence of play the bearings provided low levels of friction, giving an excellent 5mg lateral measurement, and a fine 20mg vertical reading. Finish and engineering were both to an enviable standard, and the geometry was sound. The effective mass figure of 5g includes mounting bolts. The usual AT weighted lever bias compensation is used, and on this example gave lower values than usual as well as being in the inverse ratio to that needed for accurate compensation from beginning to end of a record side. Pillar angle adjustment can ameliorate this somewhat and the dialled settings need to be increased by 20-30% to attain the correct values.

Downforce calibration was accurate, while the cueing and fluid damping systems worked well. Leadout cable capacitane was low at 85pF. However the arm resonance behaviour was none to promising, with the 100Hz mode (redrawn) probably deriving from the counterweight while that at 400Hz was a shell/tube

Rarely seen in this country, the Audio-Technica 1500 series is designed for professional applications with a minimum of frills and inbuilt high durability. However Audio-Technica agreed to supply the latest *Mark III* version for review, and it was auditioned using the Lux *PD300* vacuum platter turntable – one of the very few decks large enough to take this substantial arm. Possessing a 10in nominal length, the overall dimensions are 330mm and the effective length (stylus tip to pivot) 257mm. Another similar version, the *AT 1501 III* is longer still at 285mm.

Effective mass is high at 20g, this including mounting hardware; the substantial cast metal headshell alone weighs 13.5g inclusive of screws. An array of blind threaded holes is provided on the headshell underside for cartridge fixing. Small overhang increments are thus possible but a change of offset angle is not. The shell has the universal SME-type collet fixing, this heavily reinforced with a clamping chuck to improve the arm/shell coupling.

Claimed to help in absorbing resonances in the main beam, the downforce adjuster is a sliding weight on the tube, and is equipped with a locking screw to prevent vibration. For what it's worth, the arm is wired with pure silver, teflon insulated as is usual for silver conductors. Bias compensation is of the thread-and-weight lever type, possessing low friction, and the arm height is easily adjusted via a lever-operated locking base arranged to provide high securing forces on the three point pillar locking system. The large rear counterweight is partially decoupled by a tensioned multilayer rubber damper, and large ball bearings are employed to provide firm control and adequately low friction.

Cartridges in the 1 to 20g mass range may

be accommodated and in the case of integralheadshell types up to 33g can be accepted. The 1503 may thus be seen as the antithesis of the AT1120! The geometry is slightly imperfect in that while a 1 deg 55 sec maximum tracking error is specified, the instructions suggest that an additional \pm 1mm overhang error is admissable, this due to the headshell fixing intervals – so in fact 1 deg of additional error can then result.

Lab report

With a 20g effective mass, low compliance cartridges are definitely the rule, particularly in view of the absence of a damper. Actually, in extreme cases the use of an accessory damper such as the Zerostat Z-Track would be a definite advantage in stabilising the cartridge to the record surface. Given the reservation noted above, geometry was otherwise very good, and the 'feel', finish and engineering were guite excellent. The arm proved easy to use despite the absence of a cue mechanism. Lateral friction was just satisfactory at 50mg while in the vertical plane it was fine at 10mg. Bias levels were appropriate for the setting and effective length; with the reduced offset angles on longer tonearms less bias is required. Downforce calibration was pretty accurate.

Arm resonance results were surprisingly good for a detachable head arm. Resonances were undoubtedly present, but the general energy trend was comparatively uniform and when the breaks did occur – notably at 300Hz, 600Hz and 3kHz – they were not too serious.

Sound quality

Judged a superior product on auditioning, some mild loss of definition was attributable

AT 1120: continued

mode. The slope is rather broken up and is severely dissected above 2kHz.

Sound quality

Auditioned on a good quality sub-chassis turntable, the sound quality was better than the resonance graph might suggest. Tonal balance was quite pleasant with the central image reasonably well defined, with some worthwhile depth rendition. The treble was not so well defined, yet remained inoffensive, and while the bass definition was below that of the 'super' arms, demonstrating some 'lumpiness', again this was not too serious. With a moving magnet cartridge (Shure V15 V) all these problems seemed reduced by an order of magnitude.

Conclusion

While less suited to the more intolerant moving coil models, the 1120 performed pretty well with others, such as the Dynavector 23R or the Denon 303 and 305. Moving magnet examples generally gave good results, and although in context the arm is rather expensive it is probably worthy of recommendation on the basis of its overall performance.

GENERAL DATA

Approximate effective mass, inc screws, excl cartridge 20g
Type/mass of headshellspecial detachable/13.5c
Geometric accuracy
Adjustments provided
Finish and engineeringexcellent/excellent
Ease of assembly/setting-up/usevery good/good/very good
Friction, typical lateral/vertical
Bias compensation method
Bias force, rim/centre (set to 1.5g elliptical) 150mg/150mg
Downforce calibration error, 10/20, 0.050/ - 0.10
Cue drift 8mm ascent/descent
Arm resonances
Subjective sound quality
Lead canacitance/damping method 95nE/none
Estimated typical purchase price



Structural arm resonances, audio band

Ease of assembly/setting-up/use

GENERAL DATA

AT 1503: continued

to the lowered subsonic resonance resulting from the 1503's high effective mass. Nonetheless the stereo performance was good with promising depth and detail. The sound was tight and punchy with good bass power and extension plus good tonal integration and balance over much of the frequency range. It gave a feeling of solidity and security. The upper treble showed a slight 'sheen' with a mild loss of detail.

Conclusion

This is one of the best high-mass detachable headshell arms so far reviewed, and while the price is high, it is by no means extortionate in view of the excellent constructional quality and finish. The arm is a product with professional durability and should give a long life. free of fuss or drama. As such, and bearing in mind the minor reservations expressed, the 1503 carries our recommendation although you will need a large turntable to accommodate it!





Tonearm Approximate effective mass, inc screws. excl cartridge 5g Type/mass of headshellnon-detachable Geometric accuracy.....excellent Adjustments provided.....overhang/offset/height Finish and engineering.....excellent/very good very good/very good/very good

Tonearm



Audio Technica AT 1100/1010 Audio Technica UK. Hunslett Trading Estate, Low Road, Leeds. Tel (0532) 771441





Features and design

This family of Audio Technica tonearms makes an interesting group, with the various members exhibiting distinct differences.

The AT1010 is an established seller reviewed before by Choice and here reassessed. Comprising a medium/high mass design, it effectively has an S-type main tube, with a universal detachable headshell. Audio Technica make a range of headshells as accessories with various mass and resonance damping properties, and in our case a magnesium die-cast version was supplied. The arm incorporates a variable counter-weight damping facility, adjustable via a clamping thumb-wheel at the arm pivot (see graphs).

Both the 1010 and the 1100 exhibit a refined geometry, whereby the vertical motion pivot axis is in line with the stylus tip, thereby minimising the effect of varying stylus drag upon instantaneous downforce. Both have an approximately 8cm back extension behind the pillar, and while the 1010 offers a dynamic balance weight called a 'gyrobalance', the 1100 has a fluid well damper pot rather like that fitted to SME models. The arms are interchangeable in their pillar mounts, which use three-point pillar contact locking, although the mounts themselves differ in detail between the two models.

The basic 1100 comes with a low mass straight arm tube, plus a complete interchangeable carrier, the latter locking by a thumbscrew into the upper bearing housing making the signal connections automatically.

1010, the 1100 offers a genuinely low 6g. An accessory S-tube carrier is also available which

accepts a universal headshell, together with a high mass counterweight - double interchangeability if you like - but this is probably best suited to integrated cartridges such as the Ortofon Concordes. Fitted with an 8g headshell the Stube effective mass came out at a medium 12.5q. and might effectively be lower of course if an integrated headshell/cartridge is used.

These arms were superbly finished in a matt chrome, and all moving parts worked smoothly and precisely, although a trace of looseness remained in the horizontal bearings of both. The counterweights could not be tightly fixed, but in fact this is intentional to allow for the convenient and accurate rotary downforce dials. The fit of the headshells etc, was exemplary, with well executed socket connections which could be tightly secured. A splined collet is a feature of the new AT shells, giving adjustment of vertical tilt and overhang, though the tilt facility is omitted from the low mass straight carrier tube.

Lab results

Taking the 1010 first, the effective mass was in the medium range suggesting the suitability of cartridges in the 18-8cu bracket, which are generally moving-coil models. Like the sample we tested previously the biasing was still rather high, and values of about half those suggested in the manual are about right. Other characteristics including low lead capacitance and accurate downforce calibration were satisfactory.

The variable damping control was initially investigated in terms of the subsonic arm/ In contrast to the 16g effective mass of the cartridge resonance. A cartridge which offered a +9dB resonance at 9Hz showed an amplitude change of only 0.5 dB over the whole range of the

damping settings. Conversely, when the audio range resonance graph was plotted the damper variation was significant, indicating that it should be experimented with on audition; in particular the behaviour in the 30Hz to 500Hz range was materially affected. In fact this arm was not especially clean in terms of its overall resonance behaviour, but its energy trend was guite uniform on average, indicating a neutral tonal balance (see graph).

The 1100 is characterised by its low effective mass with effective fluid damping (the latter adjustable via depth and viscosity). It is suitable for a wide range of cartridges from 12 to 40cu, showing excellent friction levels and bias compensation near the ideal, if a little on the high side. Downforce calibration was excellent and the audio resonance curve was promisingly uniform showing a well-controlled character, only marred by the counterweight mode at 90 Hz; the first tube mode at a quite high 550Hz indicates good rigidity.

The strong 'coupling' of this model is seen in a plot of the acceleration recorded in the rigid subchassis (Logic) on which the 1100 was mounted, taken at the same time as the arm resonance graph. This shows that the cartridge can 'read' the mounting chassis via the arm on this model.

The second 'S' tube resonance graph used the

detachable headshell and heavier counterweight. the latter's resonance mode now appears at 75Hz, with a headshell socket resonance at 190 Hz: the remainder was guite tidy and wellcontrolled.

Sound quality

Using a medium compliance cartridge (Technics EPC205 III), the low mass 1100 was the best of the three versions, offering a good standard of general clarity, frequency balance, stereo precision and ambient depth, plus good bass definition. The 'S' 1100 was quite well suited to moving-coil models of lower compliance, but had a hint of a less even tonal character in comparison, proving more forward in the lower midrange and restrained in the treble. The sound of the 1010 was a touch firmer in the bass than the 'S' 1100, but it sounded somewhat hard and even slightly ringing in the midrange, where a loss of depth and stereo focus occurred with even the best cartridges. The tonal balance was a trifle 'dulled' overall.

Conclusion

The 1100 is the best of the three, and provides a well balanced standard of performance at the price. The low mass, straight version gave fine results with the more delicate moving-coils, including Dynavector Karats and Denon models. while the 'S' tube is an accessory possessing


considerable merit, allowing the use of headshell cartridges as well as models of lower compliance.

Compared to the 1100 'S', the 1010 would seem to be inferior in several respects. Nevertheless, the standard of performance is reasonable for the price

1048

20

20

20

20

GENERAL DATA Tonearm Approximate effective mass inc screws, excl cartridge....12.5g Type/mass of headshell

rypo, made or neadenen	
universal detachable on acce Geometric accuracy. Adjustments provided. Finish and engineering. Ease of assembly/setting up/use excellent/ver Firction: twical lateral/vertical	essory 'S' tube/9g excellent overhang, height cellent/very good ery good/very good o/less than 10mg
Bias compensation method	weighted lever
GENERAL DATA	AT 1010

GENERAL DATA	AT 1010
Approximate effective mass inc screws,	excl cartridge, 16g
Type/mass of headshellu	niversal detachable/11g
Geometric accuracy	excellent
Adjustments provided	overhang, tilt, height
Finish and engineering	excellent/very good
Ease of assembly/setting up/use excel	lent/very good/very good
Friction: typical lateral/vertical	. 30 mg/less than 10 mg
Bias compensation	weighted lever
Bias force: rim/centre (set to 1.5g ellipti	cal) 380 mg/320 mg
Downforce calibration error: 1g/2g	
Cue drift/8mm ascent/descent	slight/0.5sec/2.3secs
Arm resonances	fairly good
Subjective sound quality	good+
Lead capacitance/damping method	
95pF/some variable co	ounterweight decoupling

Estimated typical purchase price.....£160





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Beogram 1700

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



Features and design

Briefly mentioned in the last issue, the 1700 has now been in full production for some time, sporting an impossibly thin looking tonearm plus B&O plug-in cartridge. In many respects it represents a development from the established 2200/1500 models which were strongly recommended in previous editions, using the same ultra-light alloy platter (0.45kg) with support patches of sprayed *nextel* suede paint, but no mat proper.

This automatic deck offers two speeds *via* push button controls. Manual track selection is also possible by pushing the cued-up tonearm, but as the sequences are otherwise 'hands free' no finger lift is provided. The cartridge from the 20 series is fitted with a non-detachable spherical tipped diamond stylus, and comes complete with a calibration certificate.

The 1700 is belt-driven from a small DC motor, and an effective gravity/leaf spring suspension based on a light steel sheet subchassis is used. Physical examination showed that the arm was a very light structure, with vertical knife edge bearings, the whole almost loosely fitted by gravity in its mounting pillar assembly. In representing the antithesis of the usual strength and rigidity expected of a tonearm, it was particularly interesting to investigate its sonic performance.

Lab results

While the light platter offered little potential for either support or damping, requiring the 'X1' scale to illustrate its 'transient response', it was rather better behaved than that of the much more costly 8000, presumably because the *nextel* patches did contact at least some of the disc surface area. The turntable started up rapidly, and the automatic cycle was very quick to engage the leading grooves. Wow and flutter was low in DIN peak-weighted form, but was not so clean unweighted, suggesting that it might have been optimised for the specification. Speed slowing under load was a trifle high at 0.5%, but the torque was more than sufficient for the cartridge supplied. Rumble was fine, and better than for previous designs.

The arm proved to be well adjusted with respect to friction and bias, and suited to tracking in the 1.5 to 2.0g range. Effective mass was very low at an estimated 6.5g *including* the cartridge, endowing the combination with a stable subsonic resonance in the preferred range (12.5Hz) well clear of the subchassis modes at approximately 5Hz.

Plotted using its own 20S cartridge strictly speaking the arm resonance curve is not comparable with the others; but it does nevertheless give some idea of the arm's behaviour. The potential problem area between 200 and 600Hz defined by the low arm rigidity has been skilfully suppressed, and in terms of termination and damping as well as resonance the graph looks good, offering an improvement over the 8000 in fact.

The graphs also show that this model is much better than average on grounds of acoustic and vibration isolation, confirming the quality of the simple subchassis design.

Sound quality

Exhibiting excellent shock resistance and acoustic feedback behaviour, the 1700 was a little above average for its price class overall. The subjective character was softer and less well-

focused than the 8000, and although free of unpleasant coloration or emphasis, it seemed somewhat muddled, complex material not being well separated in the stereo stage. Impact and ambience were also lacking.

Conclusion

This trim automatic player has taken the goal of component lightness too far, and despite control of resonance and fine isolation the sound did not cohere to the extent which is possible with more substantial and rigidly constructed systems. It is however worth recommendation at its modest price, especially for a B&O matching system. It will survive adverse environments and the included cartridge is also to its advantage.





Arm resonances, B&O 20S cartridge.



Disc impulse transmission, standard X1.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0–500Hz lin): above, acoustic; below, vibration.

Beogram 8002

Bang and Olufsen (UK) Ltd, Eastbrook Road, Gloucester GL4 7DE Tel (0452) 21591



Replacing the previously-reviewed 8000, the 8002 incorporates a number of significant improvements. There is a 'remote control' terminal at the rear which, via a single cable, links both audio signals and control facilities to a matching B&O receiver, and a neat infra red remote control supplied with the receiver allows complete command of the turntable. The deck of course complements the elegant and unified Scandinavian styling of the other B&O components.

The 8002 is an automatic player with photoelectric sensing of record presence and size – hence, on the remote, functions of start, stop and pause/cue lift, are all that is required. The central control interface in the receiver will also accept data from the turntable when operated manually. With the remote disconnected, the turntable may be operated in a conventional manner with a DIN to phono audio adaptor lead.

Other salient features include microprocessor control via B&O's versatile and ergonomically angled touch-button panel. Two speeds are available, with incremental pitch variation monitored by a large three digit LED display. Repeat playing may also be selected up to a maximum of nine times, while the arm wis servo controlled with touch-button cueing

and proportional arm traverse. Most important perhaps is the superbly executed sub-chassis system, based on a near-perfect pendulum suspension with adjustable leaf springs. A heavy steel sub-chassis plate provides the foundation for the drive and also the complex arm assemblies.

The direct-drive motor system applies power via magnetic eddy currents induced in an aluminium drum located beneath the platter, speed being under full servo control. The platter has been considerably revised by comparison with earlier models and the oftcriticised hard plastic ribs have been supplanted by a platter with thin film Nextel pads for support and photo electric detection. These are just 0.15mm high and provide a good non-scratch interface with the disc, resulting in much improved record contact and damping. B&O claim the platter is deliberately light (0.6kg) so that the record damps the platter, and *vice-versa*.

The tonearm is an ultra low mass design of integrated concept and matches B&O's new range of quality lightweight cartridges. The model fitted in fact weighs just 1.6g – it is a detachable cartridge, to be replaced entirely when the stylus is worn or damaged. Total effective mass with cartridge is a little under

7g. This integration results in foolproof installation, correct geometry and proper stylus compliance-tonearm compatibility, with the subsonic resonance placed in the ideal 12-14Hz range providing excellent warp immunity. The tonearm is a linear or parallel tracking design, traverse provided by a nearsilent servo controlled leadscrew. Photoelectric detection of tracking angle holds errors to a miniscule ±0.04 deg or less, and bias compensation is not required. The boxbeam arm tube is constructed of hard drawn brass which gives satisfactory rigidity despite is pencil-like thinness.

The cartridge must be assessed in the context of its inclusion in the integrated turntable package. The 8002 is fitted with the topline MMC2 (the MMC1 is only a selected version of this), a brand new B&O design with a hollow sapphire cantilever. It uses a semi-line-contact, grain-orientated naked stylus tip of very low tip mass, tracking confidently at just 1g downforce. 20Hz to 20kHz is specified within ± 1.5 dB, with a reduced sensitivity to load and temperature, by comparison with earlier versions. Separation is quoted as 25dB minimum at 1kHz and better than 20dB from 50Hz to 15kHz.

Lab report

The 8002 proved to have an excellent motor section with textbook levels of wow and flutter, and unweighted wow. Speed was accurate and freedom from speed variation under load was fine. Start-up time was, inconsequentially, average at 2.5 seconds. DIN B rumble was low at -77dB, with no motor harmonics visible and just a trace of 200Hz mains supply breakthrough. As testified by the impulse photo, disc damping was effective, a result vastly better than previously attained. The arm collected a list of 'excellents' for geometric accuracy, finish, engineering, ease of assembly, setting up and use. Cue rate was safe and rapid, minimising record damage.

However, most arm parameters could not be measured due to the servo control although they could be inferred from the excellent tracking performance of the cartridge at a 1g downforce. An insensitive arm would not allow this high standard. Arm resonances were plotted with the supplied cartridges, the behaviour indicated being above average in view of the main energy continuity through the spectrum. It was not free of breakup, this beginning as low as 200Hz with further modes at 350Hz, 800Hz, 1kHz and 2.5kHz, and these were just sufficient to impose small blips on the steady state frequency response of the cartridge.





Rumble, electrical (above) and total (below)



Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

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301 Kilburn Lane, London W9 Tel 01-969 1770 Olufsen

System as a whole Ease of use.....excellent Typical acoustic breakthrough and resonances.....very good Hum level/acoustic feedback.....very good/excellent Vibration sensivity/shock resistance.....excellent/very good Estimated typical purchase price.....

Integrated turntable (inc. cartridge)

less than 0.06%/0.05%

excellent/excellent/excellent

. excellent

. N/A

Type.....fully automatic, linear-tracking, direct drive

Platter mass/damping.....0.6kg/good

Finish and engineering.....excellent/excellent Type of mains/connecting leads......2-core/5-pin DIN

Speed options.....variable, 33/45 rpm Wow and flutter (DIN peak wtd, sigma 2).....0.05%

Absolute speed error.....less than 0.05% – 0.05% Speed drift, 1 hour/load variation....less than 0.05% – 0.1% Start-up time to audible stabilisation.....25 secs

Rumble, DIN B wtd L/R average (see spectrum)..... - 77 dB

Approximate effective mass, inc screws, excl cartridge...5.2g Type/mass of headshell......special, non-detachable

Adjustments provided.....none

Finish and engineering.....excellent/excellent

Friction, typical lateral/vertical.....N/A

Bias compensation method.....N/A

Bias force, rim/centre (set to 1.5g elliptical).....N/A

Cue drift, 4mm ascent/descent....none, 0.3 secs/0.8 secs

Arm resonances.....above average

Downforce calibration error, 1g/2g.

Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)

Geometric accuracy......

Ease of assembly/setting-up/use



Frequency response and separation, cartridge



Structural arm resonances, audio band

GENERAL DATA

Motor Section

Arm Section

Proving very good on acoustic breakthrough, and excellent as regards vibration resistance and feedback margin, the deck also demonstrated outstanding shock immunity. The cartridge delivered a good performance on this abbreviated evaluation (it will be reviewed fully in a future Hi-Fi Choice) with the response meeting ± 1.5 dB limits as specified from 35Hz to 20kHz, having an impressively uniform treble range. Mid-band separation reached 34dB but, on this test at least, was curtailed somewhat at high frequencies.

Sound quality

Auditioned complete with cartridge, the 8002 attained a substantially good standard even by comparison with audiophile exotica using costly moving coil cartridges. First impressions were of a confident and firm presentation with good timing and pitch, plus a tuneful articulate bass line. Surfaces were guieter than usual, while the midrange was well projected with good detail and stable stereo focusing. Slight mid 'horniness' or hardness was noted, but the treble did not draw attention to itself, and was slightly depressed or 'laid back' - not a bad thing with some records! Stereo stages were well rendered with promising depth and ambience.

Conclusion

After years of personal campaigning for B&O to refine their tangential player particularly with respect to the platter, I am pleased to say the 8002 has finally done the trick. A high quality, foolproof automatic player, it deserves serious attention. Viewed as a package the price is realistic, the sound quality good overall and particularly acceptable as regards pitch, timing and bass quality. B&O afficionados and indeed others can confidently consider this elegant creation, as the 8002 wins a recommendation this year.

Note: Our sample 8002 was supplied well head of first production in order to meet deadlines for this issue. We have since learned that the main resonance modes in the tonearm have responded to the application of damping. A very similar belt-drive version is soon to be released - the 6002 at £295 and the nonremote control TX which gives the user the choice of any B&O cartridge, being supplied without cartridge at £ . On the basis of our previous experience with B&O belt drives, these models should also be worthy of recommendation.

BEOGRAM 8002 continued

Dual CS505-1AM

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Gerrards Cross, Bucks Tel (02813) 88447



First impressions of this revised stalwart were none too promising and little hope was held out for its success in our competitive context. But as testing proceeded it gained ground, and after the listening sessions virtues were no longer in doubt.

A classic spring-suspended turntable using a flanged steel deckplate/chassis, the 505 is an inexpensive design which now comes fitted with a promising Ortofon *LM10* cartridge. For the latest version the arm counterweight has been simplified to reduce spurious resonances, while the suspension spring compliance had also been lowered, and a superior flat type of mat fitted.

Belt-driven from a 16 pole synchronous motor the 505 is fitted with vari-pitch speed control. The motor pulley is multilobed and may be expanded or contracted by mild degrees to provide fine pitch variation.

Since it came fitted with a worthwhile cartridge, reaping the benefits of the low-mass integration of the cartridge and special arm fixing, the player was assessed as a complete unit. Used in this way, the arm effective mass is a low 5g, complementing the *Concorde*-style cartridge. Dual have always produced arms with higher than average sensitivity and they have not skimped on this one. Although of rather light construction, the design is rigid, with low friction and excellent bearing adjustment free of play, while both downforce and biasing are well executed.

Lab report

Platter mass has been slightly reduced for this latest 505 but the improved mat has resulted in

better record damping and termination; all transients decay more quickly. Wow and flutter was fine on this sample, with balanced results for the separate components. Speed error was negligible and slowing under load small at 0.2%, with start-up average at 2.3 seconds.

Rumble was however just satisfactory and I feel it could and should have been improved — the 505 has been borderline on rumble for some years now. The platter bearing alone measured -78dB, the poorer result entirely the fault of the motor vibration breakthrough.

The arm's basic parameters measured very well, with low friction, sensible biasing and reasonably accurate downforce calibration. As noted previously the resonance graph illustrates a fairly wild behaviour, the plot taken this year with the cartridge supplied. The 300Hz mode easily imposes itself on both the frequency response and the crosstalk curve of the attached cartridge, which is shown with two loading combinations, 200pF and the preferable 450pF. The Dual arm supplied 180pF of lead capacitance, to which the amplifier's contribution is added in practice.

Ease of use was highly rated on grounds of its semi-automatic operation. Vibration isolation was certainly improved and attained a good standard, while acoustic breakthrough was fairly good, feedback low, and shock immunity good.

Sound quality

Within moments of starting the listening tests it was clear that the 505 sound had improved despite the marginal rumble measurements, and the end result was well above average. The stereo image was stable and quite well focused with surprising depth for a deck at this price. The overall tonal balance was quite neutral and detail was present at both extremes of the musical spectrum without serious exaggeration. Some mild coloration was noted, associated with the arm, and by comparison with far more costly systems it would appear that the 505 is a trifle 'loud' and 'brash'.

Conclusion

Selling at under £80 inclusive of cartridge, in its improved form the 505 is an impressive, easy to use and fuss-free turntable system with a number of useful facilities. With a slight reservation concerning motor breakthrough, the unit nonetheless scores a full recommendation.

GENERAL DATA Integrated turntable (inc. cartridge) Motor Section

Rumble, DIN B wtd L/R average (see spectrum)..... - 67 dB

Arm Section

Approximate effective mass, inc screws, excl cartridge*5g
Type/mass of headshelldetachable, special bracket/N/A
Geometric accuracyvery good
Adjustments providedoverhang/offset
Finish and engineeringvery good/very good
Ease of assembly/setting-up/usevery good/very good/good
Friction, typical lateral/vertical
Bias compensation methodinternal spring
Bias force, rim/centre (set to 1.5g elliptical)250mg/260mg
Downforce calibration error, 1g/2g+0.1g/+0.1g
Cue drift, 8mm ascent/descentnone, 1.5 secs/1.7 secs
Arm resonancesbelow average
Subjective sound qualityaverage +
Lead capacitance/damping method

180pF/decoupled counterweight

System as a whole





Structural arm resonances, audio band



Disc impulse transmission showing damping





Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

Dunlop Systemdek II

Dunlop System Transcription Ltd, PO Box 9, Troon, Scotland Tel (0563) 29777



Dunlop have devoted considerable effort to the design of a low-cost true subchassis turntable, benefitting from the experience with their original Systemdek model. Built in an unusual cylindrical form and lacking a dustcover, it superficially resembles a small version of the Dais. The deck is belt driven by the usual synchronous motor, the two-part platter consisting of a reinforced plastic centre drum on which a plate glass platter is located. A felt mat is used, the disc clamped if so desired by the ingenious and secure spindle clamp provided. Two speeds are available, changeover on the double crown pulley being effected by hand with the platter removed.

A lightweight reinforced subchassis is employed, with the arm mounting arranged as an outrigger, providing easy access for cable dressing and mounting. The subchassis is suspended on three compliant springs and levelling may be done from above - more convenient than with those models requiring the removal of the base plate. Furthermore, three external plastic feet allow easy levelling of the whole unit, which is important in view of the soft suspension with its low resonant frequency — estimated at 2-3Hz in the dominant vertical mode. Rotational freedom is well controlled if the arm leads are well dressed. though the unit does take rather a long time to settie down after a shock impulse.

Lab report

Despite the large size of the initial disc impulse transient with its secondary reflec-

tion, the pulse died down quickly after 30 milliseconds with little low frequency ringing thereafter. The platter has a reasonable mass of 2.1kg, and the general finish and engineering were considered very good. Wow and flutter, DIN peak weighted, was fine, though with the linear wow figure a touch on the high side. It also ran a little slow, -0.43% (beware slower tempo on A/B comparisons!), although in use this will not matter a great deal. Torque was fine under load, and rumble was also good at - 74dB, this mainly attributable to motorframe vibration breakthrough at 100Hz and 200Hz as shown on the spectrogram. Vibration resistance was excellent and acoustic breakthrough very good.

Sound quality

We were most impressed by the sound quality of this model. It was felt to offer a neutral and open sound with good transparency and stereo depth plus fine bass, good 'drive', attack and depth. In this respect it approached the performance of far more costly models, and the feedback immunity was also impressive. Only the slightest reservation was expressed concerning subjective pitch stability, possibly due to the very soft suspension.

Conclusion

While devoid of a cover this turntable offers a remarkably high sound quality for the price and would do justice to a number of quality tonearms. We obtained good results using the Linn Basik LVX and Audio Technica AT11200 for example. If you like the look of the Systemdek II, we can back your preference with a strong recommendation.

(Note: Dunlop have indicated that they intend to revise the suspension stiffness to give a higher resonant frequency.)

GENERAL DATA	Motor unit
Typemanual, belt-drive, synchronous mot	or, subchassis
Platter mass/damping	. 2.15kg/good
Finish and engineeringvery of	lood/verv aood
Type of mains/connecting leads	
Speed options.	
Wow and flutter (DIN peak wtd. sigma 2)	
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz).	.0.15%/0.06%
Absolute speed error	0.43%
Speed drift, 1 hour/load variationsynchro	nous -0.18%
Start-up time to audible stabilisation	3.5 secs
Rumble, DIN B wtd L/R average (see spectrum).	– 74 dB
Size/clearance for lid rear	x 13.5(h)/none
Ease of use.	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback very	nood/excellent
Vibration sensivity/shock resistance	excellent/good
Estimated typical purchase price	£115



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques



REASSESSED

Since its introduction the *Systemdek* has begun to establish itself firmly in the quality category. The early minor teething problems have long ago been sorted out, and a number of detail refinements have been made to improve the performance and the ease of alignment/setting up

Dunlop Systemdek III

Dunlop System Transcription Ltd. PO Box 9, Troon, Scotland

Founded on a steel plate, the Systemdek subchassis has an aluminium extrusion reinforcement which runs beneath the main bearing through to the arm base. The original models were very softly sprung indeed, with an estimated 3.8Hz vertical and 3Hz lateral subchassis resonance, and gave rise to alignment problems. With the high 4.8 kg platter mass, this gave the unit a tendency to rock or sway from side to side, resulting in slightly high pure wow readings and some handling sensitivity.

In the later version, this situation has been improved – by the substitution of even more compliant springs! At first sight this might be expected to worsen matters, but in fact when properly adjusted the springs lie in a state of greater compression and are physically shorter. This considerably improved lateral stability, confirmed by the low wow figures in the last *HFC*. Alignment is made easier by the use of surface mounted crosshead screws, located beneath the top platter. The fabricated plinth is a well damped wood composite steel structure, with open access for arm lead dressing beneath a detachable arm board, which is secured by two socket head bolts. Improved feet have been fitted and can be adjusted for levelling, while the low resonance lid is retained. The plinth is finished in a *Nextel* suede type coating.

The outer platter has benefited from the addition of a so called 'wave termination' ring: a high density absorbent rubber insert fitted into the rim. The dense lambswool felt mat bonded into position has been retained, but in practice it is easily enough removed if alternative mat types are desired. Two speeds are provided, using a simple manual belt change, which requires the (annoying) removal of the outer platter.

With the *III* designation, the *Systemdek* acquires a concave platter which in conjunction with the clamp supplied gives some reduction in record warps and also improves disc/platter contact.

Lab results

The drive exhibited good torque, with only 0.1% slowing under load, and a fair start up time in view of the heavy platter. Wow and flutter was very satisfactory and better than

for earlier samples: likewise the rumble level, which is now at the threshold of measurement. A 100Hz component was noted on the spectrogram at -70 dB, but this proved to be inaudible as a specific effect when auditioned.

The results for vibration isolation and acoustic breakthrough, reprinted here from the last issues, were both very good, the slight lumpiness on the acoustic trace attributable to the disc and its supports. Two disc impulse responses were taken. First on X1 scaling and using the mat as supplied, the initial transient was large, but was guickly damped, and the longer term low frequency performance was fine. For comparative purposes the Audio Ref mat was also tried, and this reduced the impulse magnitude by almost a factor of 10. allowing X10 scaling for the superimposed (white) presentation - a very fine system response. Use of the record clamp on the new concave platter should equal or improve on these results.

Sound quality

When reviewed in previous issues, the Systemdek has been considered as setting a top class standard as a motor unit, with a firm and stable quality to the stereo image. The bass register was open, deep but slightly 'heavy' in balance, while coloration was very good, only showing a mild 'thickening' in the lower midrange (eg tenor), which also affected bass transients slightly. Though the Systemdek has always tolerant of arms, we nevertheless obtained the best results using the Ittok. The felt mat suited most moving coil cartridges (Asak, Supex and the like), but with 'flatter' models such as the Karat and the Technics EPC205, the Audio Ref mat gave a more relaxed perspective, with greater midband depth and ambience.

For this issue, the *III* was auditioned using an Ittok tonearm. The listening results were very good, and yet slightly disappointing in that the smaller *Systemdek II* was felt to be marginally 'clearer' with more musical 'attack'. The *III* set a high standard, but this time just failed to get the top rating by virtue of a shade of vagueness in the stereo presentation and stereo focus.

Conclusion

The Systemdek III remains a very fine turntable whose competitive pricing has been maintained, and consequently it continues to be recommended. It sets a high standard on all major parameters, is relatively easy to set up and possesses a well finished exterior, as well as proving largely uncritical of the choice of accompanying arm.



Disc impulse: black, felt X1; white, Audio Ref X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0–500Hz lin): above, acoustic: below, vibration.

Helius Helius Designs, 11 Falstaff Way, Hartford, Huntingdon, Cambs Tel (0480) 59037



Reviewed in its provisional form in the last issue, the Helius arm is now in full production. Two distinct versions are available, one with the established sliding/detachable headshell (no plug system however for the leads) and a second called the Aurum, where the shell is permanently bonded to the arm. We did not test the latter, but the Helius designer had indicated that it shows improved audio band resonance control and consequently a 'smoother' sound.

avoid any injurious decoupling between the ment if the arm sensitivity is not to be firm, large-area cartridge mounting platform, and the arm mounting base. The full-circle nested gimbal bearing is finely adjusted for moderate friction and zero detectable play, a condition critical to sound quality. The arm should therefore be carefully handled if this condition is to be maintained. An unusual ball race is employed with only three balls per race aligned to maintain mutual contact as well as firm contact with the bearing needle and of course the race itself.

The sliding headshell does confer certain practical benefits, allowing for easy adjustment of both overhang and vertical tilt. In practice the fixing is quite strong, a vertical bolt firmly clamping the splined main tube onto the headshell stub. The main tube is anodised alloy with cross section and thickness varying along its length, the intention being to break up symmetrical vibrational modes.

The rear section comprises a threaded brass rod on which the counterweights are screwed.

Two weights are used in various combinations and when the appropriate downforce has been set — a downforce gauge is required — the weights are contra-tightened to lock them firmly on the arm. A thread and weight lever bias compensator is fitted, this also uncalibrated

While the overall finish and constructional standard was very good, the wiring around the bearings was exposed and somewhat untidy particularly the single strand third earth. A medium mass design, the arm tries to Wires must be kept in a good state of adjustimpaired.

Lab report

At 12g effective mass including hardware the arm was well suited to cartridges in the 10-25cu compliance range. The bearings were well adjusted with a satisfactory 50mg lateral friction and fine vertical friction figures.

Set half way, the lever weight provided bias appropriate for a 1.5g-downforce elliptical stylus, measuring 160mg rim and 220mg centre. On our sample, cue descent was rather slow at 4.2 seconds.

The arm resonance graph illustrated some anomalies though the general trend put it in the 'good' category. The 100Hz mode was guite energetic, probably due to the rigid counterweight mounting, a point noted also in our earlier Helius review. Those clustered around 600Hz were likely to be main beam modes, their complexity relating to the distributed structure. Above 1kHz the unit remains well behaved.

Sound quality

Loosely ranked in the 'good +' category, the Helius sound was found to be lively with good transient attack, while the bass lines were well portraved with substantial weight. A good first impression was gained, but prolonged listening suggested some mid colouration on vocal sections, and although the standard of stereo was high, with promising depth, the treble register did not perfectly integrate with the mid, the whole sounding a trifle uneven. These results were confirmed when moving onto the more costly and superior Orion.

Conclusion

The second time around we were less enthusiastic about the Helius although it undoubtedly achieves a high technical and subjective standard. Possessing its own particular character it is recommended.

	TUllealli
Approximate effective mass, inc screws,	excl cartridge120
Type/mass of headshells	pecial detachable/7
Geometric accuracy	excellen
Adjustments providedov	erhang/height/latera
Finish and engineering	very good/very good
Ease of assembly/setting-up/usegoo	od/difficult/very good
Friction, typical lateral/vertical	50mg/10mg
Bias compensation method	thread and leve
Bias force, rim/centre (set to minimum).	N/A
Downforce calibration error	uncalibrated
Cue drift, 8mm ascent/descentmodera	ate, 0.9 secs/4.2 secs
Arm resonances	fairly good
Subjective sound quality	
_ead capacitance/damping method	
stimated typical purchase price	£150



Structural arm resonances, audio band



Helius Orion Helius Designs, 11 Falstaff Way, Hartford, Huntingdon, Cambs Tel (0480) 59037



Since the introduction of their first arm, Helius have continued development of an advanced model, taking some of their concepts to a further level of refinement. The result is the *Orion*, supplied to us at short notice in an early form, and soon to be updated in some minor respects.

The most obvious feature of the Orion is the massive bearing assembly milled from substantial aluminium block, and as with Audio-Technica models, the pivot plane has been placed below the stylus tip to aid tracking stability. The bearing is an unusual design whereby the horizontal and vertical components are effectively concentrated on a single point, use being made of the Helius 'tri-ball' system, which when correctly set provides zero play and no secondary rattles. Inertial masses may be designed to balance around this unified pivot (not to be confused with a 'unipivot' since this one is rigid except in the two desired planes), conferring benefits as regards the wider distribution of structural resonances.

A large section threaded rod provides the rear counterweight extension, the multiple weights screwed on and contra-locked for final setting. Synthetic inserts in the counterweights damp the interface between the rod and counterweight mass.

The main arm beam, in alloy tube, has an extended larger diameter first section to distribute vibrational modes. At the front the standard Helius right-angled alloy cartridge platform is fitted, here rigidly bonded in place. A revision to the shell, which is in hand at the time of writing, includes a curved section to reinforce the right angle and marginally

increase the mass — probably by 2-3 grams

Both the arm base, which has an improved pillar lock, and the cue device are made of solid metal, possessing minimum self-resonance. Thread-and-weight level bias compensation is fitted and, as with downforce, this is uncalibrated.

Lab report

only.

Approximate effective mass was 11g, increasing to 13-14g with the production headshell revision, and the arm is therefore classed as medium.

Geometric accuracy was excellent, the slotted headshell providing ready adjustment of offset angle and overhang. Although no slack whatsoever was detectable in the bearings, the friction levels in both planes were exemplary. The arm was however not so easy to set up, and for final clamping of vertical height it needed to be removed from the turntable to gain access to the socket head bolts below the baseplate - this arrangement may be improved.

Set to 'minimum' the bias was found to be appropriate for a 1.5g downforce, and little extra will be required for the usual 1.8-2.0g downforce moving coil cartridge. Cue descent was however too slow at 8 seconds, this encouraging groove damage as the stylus slides slowly into record contact. Overall engineering and finish was very good, but the gold plating on the counterweights was suspect and not adhering well on the review samples.

The resonance graph portrayed well ordered behaviour, showing a highly-favourable energy trend. It did however demonstrate some res-

onances, with that at 200Hz probably a bear- GENERAL DATA ing/counter counterweight mode, and that at 800Hz the main tube – a worthwhile high value. The remainder were more difficult to pin down as to exact origins. Low in capacitance, the leads were usefully flexible and carried good quality plugs.

Sound quality

On audition there was no doubt whatsoever concerning the high calibre of this tonearm. The bass was particularly good, showing depth, weight, eveness and good articulation. The midband was neutral as well as transparent, matching the unexaggerated musical treble register. Stereo effect was very good and the overall sound sweet and well-balanced tonally. Compared with certain other models however the Orion could sound less 'sharp'. which could be interpreted as 'softness' on its part.

Conclusion

Engineering and sound quality meet the required standard but considering the high price, the arm can hardly be described as good value for money in the accepted sense! But it can be strongly recommended on the basis of its overall performance.

Approximate effective mass, inc screws, excl cartridge110
Type/mass of neadshellhon-detachable
Geometric accuracyexcellent
Adjustments providedoverhang/offset/height
Finish and engineeringvery good/very good
Ease of assembly/setting-up/usegood/difficult/very good
Friction, typical lateral/verticalless than 5mg/less than 5mg
Bias compensation methodthread and level
Bias force, rim/centre (set at minimum)
Downforce calibration error
Cue drift, 8mm ascent/descent none, 1.0 secs/8 secs
Arm resonancesvery good
Subjective sound quality
Lead capacitance/damping method
Estimated typical purchase price£395

Tonearm



Structural arm resonances, audio band



Heybrook TT2 Mecom Acoustics, Knighton Hill, Wembury, Plymouth, Devon Tel (0752) 863188



Noted for their specialist speaker designs. Heybrook have made their first foray into the turntable field with the TT2. It is a comprehensively designed full subchassis model in the UK audiophile tradition. The price is placed in the middle sector, substantially undercutting the audiophile decks, and yet hopefully solving important design problems.

Every manufacturer has his own approach, and in the case of the *TT2* rigidity and solidity heavy cruciform of thick guage welded steel, box section, a heavy nylon coating protecting the surface and adding some damping. By comparison the platter is of moderate mass at 2.6kg — a fine-quality cast component in the familiar two-piece form; it comes with the cartridges alignment protractor. increasingly popular dense felt mat.

The arm board is made of a wood composition material secured to the chassis by a large concealed bolt. The whole thing is suspended at three points on three deep multi-turn (8-9 turns) coil springs, whose adjustment points are conveniently located on the top surface of the deck. Belt-driven by the usual synchronous slow-speed motor, the pulley has two diameters, speed being selected by hand after removal of the outer platter. The combination of heavy chassis and compliant springs resulted in a rather low suspension resonance of a little under 4Hz. Recovery was fairly slow weighted and with only the merest trace of

after excitation and evidence of a rather higher-frequency rotational mode was seen and estimated at 8-10Hz, possibly due to the proximity of two of the suspension centres to the arm board, an area of reduced mass compared with the platter centre.

The high constructional quality, generous use of materials and thought that has gone into such aspects as adjustment access and alignment was much appreciated, and in conappear to be key factors. The subchassis is a trast to many other models, useful instructions were also included — a critical factor with this type of turntable. Our sample came with a Heybrook arm accessory called the AK-1 comprising a kit of steel sockethead cartridge bolts, a wrench and spanner plus a two-point

Lab report

The disc impulse response showed poor damping of the initial transient but thereafter the decay was rapid and clean, an above-average result overall. Weighted wow and flutter was fine at 0.08% with very low flutter while pure wow was also good at 0.09%. It ran close to absolute speed and slowing under load was well within the accepted subjective tolerence. Start up was slow, as is usual for this type of turntable.

Rumble was excellent at -79dB DIN

mains related signal at 150Hz - this was insignificant. Despite the number of turns on the suspension springs, vibration rejection was truly excellent as was acoustic breakthrough. Hum was very low and the unit was also highly resistant to acoustic feedback, while shock was also guite well rejected.

Sound quality

With a top class lab performance and its fine constructional guality we had high hopes of a good subjective result. In the event the findings were encouraging, particularly on lab related parameters, but the TT2 failed to make the top grade. Before criticising, it is worth pointing out the model's merits; namely in terms of feedback, tonal balance, integration and pitch stability. It proved less rewarding in the more subtle areas of dynamics where, strangely, the sound seemed mildly compressed and as regards clarity where some 'veiling' and muddle were noted in the mid and lower mid/upper bass range. The sound was suggestive of a mild but continuing low-level hangover (acoustic not physiological!) and somehow the attack and momentum of the programme appeared diluted. I have no proof but only a suspicion that the heavy steel beam subchassis was acting as a longer term energy store — an unwanted reverberator — while the chassis rotational mode may also have been a factor.

Conclusion

If the subjective report seems tough, it should be viewed in the context of the competitive pricing of this model for what is, after all, a well made well finished turntable of excellent lab performance, durable construction and reliable, stable alignment. I suspect that with a lower mass arm and less resonance-inducing cartridge the sound quality would improve still further. Despite our criticisms, as it stands the subjective performance was sufficient to merit recommendation.

GENERAL DATA Motor unit
Typebelt-driven, synchronous motor, subchassis
Platter mass/damping2.6kg/average+
Finish and engineeringvery good/very good
Type of mains/connecting leads
Speed options
Wow and flutter (DIN peak wtd, sigma 2)0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) 0.09%/0.05%
Absolute speed error
Speed drift, 1 hour/load variationsynchronous/-0.18%
Start-up time to audible stabilisation
Rumble, DIN B wtd L/R average (see Spectrum) 79 dB
Size/clearance for lid rear
Ease of usefairly good
Typical acoustic breakthrough and resonancesexcellent
Subjective sound quality of complete system
Hum level/acoustic feedbackvery good/very good
Vibration sensivity/shock resistanceexcellent/good
Estimated typical purchase price£195



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Charts above characterise general turntable behaviour. See text for commentary on these results. see Technical Introduction for explanation of test techniques

Linn Sondek LP12

Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ Tel 041-634 0371



With a decade or so of production behind the *Sondek*, the 'Nirvana' modification covered by the review in the last *HFC* 'Turntables' edition has now been augmented by a further development called 'Valhalla' (as with the 'Nirvana', this is an easy retrofit). For years now, the popular slow-speed synchronous motors generally fitted to the sub-chassis belt drive turntables have been at the mercy of the mains supply. The latter's frequency, distortion, noise level, transient fluctuations and voltage all affect the motor's output and also the level of vibration emitted from the motor frame.

Ideally such motors should be run from a two phase supply, but the second phaseshifted line has generally been optimised in a less-than-ideal fashion by using a phase shifting capacitor. When a turntable is intended for UK and for US markets, a pulley change is also required to account for the 20% mains frequency difference, in addition to the 2:1 change in voltage.

'Valhalla' solves these problems by effectively isolating the motor electronically from the mains supply. Mains power is rectified and smoothed to feed a bi-phase 100V low distortion power amplifier acting as the motor

source. The exact 50Hz frequency is synthesised from a quartz oscillator. When fed clear, stable 50Hz, the motor generates less vibration and mains harmonic components, attaining a near perfect pulley speed stability over both the long and the short term. Power into the belt is more stable, with (in theory at least) a lower rumble and reduced subchassis vibration resulting from the power feed. For simplicity's sake the single 33 rpm speed has been retained.

General alignment has also been improved with the recent introduction of larger and more accurate suspension springs and deckplate bolts. However the deck is still at present subject to suspension settling with use, and thus requires occasional realignment though new low-fatigue springs are promised to solve this problem in the near future.

To return to basic features, the LP12 comprises a straightforward full sub-chassis belt driven turntable unit capable of accepting a variety of high quality tonearms. Deceptively simple in design, long experience with the product has shown that it has been subjected to such a high level of detailed development and refinement that almost every component down to the humblest screw fixings can be

shown to have a significant effect on the performance of the whole.

A substantial main bearing is used, with a hardened spindle ground to a slightly radiused point bearing on a thrust plate. High density PTFE sleeves in the bearing provide sufficient rigidity and very low rotational noise levels. The two piece platter is of considerable mass, cast in Mazak and turned to close tolerances, with a special grade of black felt used for the platter mat. Even now, considerable care is needed in setting up an *LP12* in a final installation, and the help of an experienced dealer is virtually mandatory.

Other minor improvements concern the light touch on-off switch with LED indicator, as well as extra screws front and back to help keep the baseboard in position.

The well damped platter weighs some 4.1kg. Our assessment of disc damping was revised for this issue, and while the initial transient was certainly poorly damped by the felt mat, the impulse died away quickly thereafter, this a good result. A measurement taken last year showing the frequency transform of the felt mat versus an absorbent one has assumed greater significance this time round, inasmuch as it can be seen that while the 'composition' mat produced greater attenuation, its frequency response was uneven, while that of the felt was more uniform, suggesting lower overall coloration.

'Vallahalla' made its mark on the motor results with excellent wow and flutter, plus significantly lower linear wow. Absolute speed and accuracy was satisfactory, while loss under load was very good at 0.13%, another important result. DIN weighted rumble improved to a superb – 80dB. In fact the spectrograms for residual measuring system noise and for the *Sondek* were very similar and to check this result the two were submitted to subtraction providing the second rumble photo – no mains related rumble components remain!

The LP12 was not the very best in the issue as regards vibration isolation or acoustic breakthrough but the curves did confirm a high standard for these parameters nonetheless. Shock resistance was also quite good, with both acoustic feedback and hum very good.

Sound quality

A few years ago it was considered heresy to suggest that turntables could make a 'sound' at all, but meanwhile the *Sondek* has been a leading exponent in demonstrating just how different the subjective performances can actually be. It scored an excellent rating on audition, notwithstanding some mild spectral *Continued on page 108*



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

LINN SONDEK continued

imbalance and coloration; a consumer who feels that absolute tonal neutrality is paramount is entitled to reject the *LP12* but should be made aware of the importance of certain other factors. For example the *LP12* has long generated a feeling of 'involvement' with the music for reasons that are only partly becoming understood — some of these are becoming clearer now with the improvement afforded by 'Valhalla'.

After careful and prolonged listening the LP12 was found to excel in its ability to retain the timing, tempo, rhythm and pitch of complex percussive sections, failure here producing some loss of interest on the part of the listener. Additional qualities included rapid post-transient decay producing 'transparent silences' between successive notes and these were all too often obscured by hangover in other models. The felt mat also provided a level of tonal integration of bass and treble now considered optimum for the deck. However some anomalies were heard - a mild upper bass richness with marginally 'loud' and forward midband, although when the latter effect was identified, it was not felt to be important enough to affect the high subjective ranking. The Ittok arm still produces a spectacularly good sound with the Sondek.

and to my ears at least, the Alphason arm also matched it well, providing in some respects a sweeter and more neutral balance.

Conclusion

The Valhalla Linn costs more than before but the increase is not far out of line with inflation over the last year or two. Now better than ever, the LP12 had no trouble in maintaining its virtually pre-eminent ranking for its price category; many can pick holes in its performance but few can actually do better.

GENERAL DATA Motor Section

[vpemanual, belt-drive, synchronous motor, sub-chassis
Platter mass/damping 4 1kg/good
later mass damping.
-inish and engineeringexcellent/excellent
Type of mains/connecting leads
Speed options
Now and flutter (DIN peak wtd. sigma 2)
Now and flutter (LIN peak wtd 0.2-6Hz/6-300Hz). 0.09%/0.05%
Absolute speed error
Speed drift, 1 hour/load variation
Start-up time to audible stabilisation
Rumble DIN B wtd I /B average (see spectrum) - 80 dB
$2i_{12}(a) = 2i_{12}(a) = 2i_$
Size/clearance for hid real
ase of use
Typical acoustic breakthrough and resonances very good
Subjective sound quality of complete systemexcellent
lum level/acoustic feedbackverv good/verv good
/ibration sensivity/shock resistance very good/good
sumated typical pulchase price





Motor unit

Linn Basik LVX Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ Tel 041-634 0371



Encouraged by the runaway success of their low-cost *Basik LVV* arm, Linn have now introduced a second, which is Scots-designed and Japanese manufactured. Costing rather less than one-third the *Ittok* price, the *LVX* nonetheless manages to return something of the former's features as well as adding some of its owm.

An all-black creation, it is distinguished by its moderate arm mass — estimated at 12.5g — and yet it still offers a cast headshell of near-*lttok* quality, secured by a split-shaft lock, tensioned by a socket head bolt. This arm is an obvious choice for those wishing to undertake a comparative evaluation, be they reviewer or dealer demonstrator.

The LVX is fully calibrated, with a partially decoupled rotating counterweight providing the usual second slide scale. Closed loop bearing are used, these adjusted for zero play, an unusual characteristic where such an inexpensive arm is concerned. However there are bound to be repercussions — we examined a number of samples (several other manufacturers decks were fitted with a LVX) and we found variability with respect to pivot friction. The arm is also a little fragile, much more so than the *lttok*. It should be handled with care and never subjected to shock — not that this isn't good advice where any guality product is concerned. Our Linn-supplied LVX delivered 150mg of lateral friction which I consider to be in the reject class; however the sample used for audition was satisfactory.

The LVX uses the new large arm pillar but the baseplate is still unique to the Basik series inasmuch as a cutout is required to accommodate the cue damper cylinder. The low cap-

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citance output cable is to *Ittok* specification though the headshell tags and pins are not gold plated. However the 'giveaway' Linn Basic cartridge is included with the arm, and could be regarded as a no-cost 'starter' (see review).

Lab report

Estimated effective mass had been noted at 12.5g including hardware, this suitable for cartridges on the 10-20cu range. A special design with metal plug insert, the detachable headshell weighs 7g inclusive of screws, and a limited adjustment for vertical tilt is possible due to the takeup tolerance in the headshell lock overhang, height and lateral angle adjustments are standard. Both finish and engineering were very good, and the arm was easy to use. The usual internal spring system was used for bias, but levels were slightly on the low side, with no apparent differentation from rim to centre. Downforce was slightly low, while the cue worked well with sensible rates. On our 'good' sample lateral friction was around 50mg, while in the vertical plane it was excellent at less than 10mg. Rated good on arm resonance, the graph showed a well controlled behaviour up to the first major break at 750Hz, a commendably high frequency. A trifle disjointed thereafter (literally!), the remaining abberations were nonetheless very mild, and suggested a smooth treble, tidy bass and generally clean midband.

Sound quality

Awarded a promising 'good' on the listening tests, the *LVX* did not compare too favourably with the *LVII* but was nonetheless a fine arm in its own right. Subjectively, it was not as

'involving' as the former model but at the same time there was very little obviously wrong with it.

The overall tonal balance was very satisfactory, and as a whole the stereo image was well defined with both depth and ambience. It sounded a little 'thin' in the midrange, and the bass lacked some tautness, tending to appear a little 'boppy'. Treble was sweet and musical but lost some detail and stereo precision.

Conclusion

While Linn are unable to make a satisfactory 'cheaper' turntable, the *LVX* does make for a less expensive arm/deck combination. To my way of thinking the alternative *LVV* is not really acceptable unless viewed as a starter component only. The *LVX* represents a welcome medium-mass tonearm of fine quality with a detachable headshell, and both moving magnet and moving coil types work well in it. With our reservation concerning pivot friction variability noted, the *LVX* is nonetheless well recommended; indeed many consumers will never need to go beyond it.

SENERAL DATA Tone	arm
Approximate effective mass, inc screws, excl cartridge 1	2.5g
ype/mass of headshellspecial detachabl	e/7g
Geometric accuracyvery g	boog
djustments providedoverhang/offset/he	eight
inish and engineeringvery good/	boot
ase of assembly/setting-up/usevery good/good/very o	boot
riction, typical lateral/vertical approx 50mg/less than 1	Omg
Bias compensation method	bring
Bias force, rim/centre (set to 1.5g elliptical)150mg/15	0mg
Downforce calibration error, 1g/2g	/0.1g
Cue drift. 8mm ascent/descent negligible, 1.0 secs/3.3 :	secs
Arm resonances	boog
Subjective sound qualitygo	ód +
ead capacitance/damping method	
100pF/counterweight decoup	oling

Estimated typical purchase price.....£74 inc. cartridge



Structural arm resonances, audio band



229 OMBERSLEY RD. WORCESTER WR3 7BY TELEPHONE: 0905 - 58046



LIN PRODUCTS, REGA, NYTECH, CREEK, A & R, HEYBROOK MORDAUNT-SHORT, SUPEX, NAKAMICHI 229 OMBERSLEY ROAD, WORCESTER (0905) 58046

Linn Ittok LVII Linn Products Ltd, 235 Drakemire Drive, Glasgow G45 9SZ Tel 041-634 0371



When first released, the *LVII* immediately established an enviable reputation for excellent engineering, sound quality and technical performance. The current version still resembles the original arm, despite some minor constructional changes which have helped maintain a competitive state of 'tune', and the original is by no means rendered obsolete.

À rigid fixed head tonearm, it carries the relatively truthful label 'Direct Coupled' this referring to the ability of this arm to directly couple the cartridge mounting to the subchassis are board. Considering the requirements for high sensitivty in two planes of freedom at the bearings, this is no mean feat of engineering. While I would not encourage careless handling, my experience of a number of *Ittoks* suggests that not only are they consistently well adjusted but they are also fairly robust compared with many other models.

At close on a 14g effective mass including hardware, the design fits the upper end of the medium-mass group and is best suited to cartridges in the 8-16cu compliance range. Providing a strong foundation for cartridge mounting, the cast magnesium headshell carries a very well designed and non-resonant finger lift and the more recent counterweights exhibit a pretty tight fit on their slightly resilient synthetic bore liners; the importance of this particular aspect may be seen in the improved damping of the resonances at 400Hz, 900Hz and 1.6kHz, when a deliberately loose but non rattling counterweight was substituted.

This arm proved convenient to use, the effective cueing system controlled by a lengthened finger lever fitted with a roller at the top. This aids cueing on floppy subchassis turntables and reduces unwanted spurious shock effects post cueing. In marked contrast to the majority

of upmarket audiophile designs, the Ittok comes fitted with a well calibrated and respectably accurate dials for both downforce and bias, the latter adjustable during play. A precision low-torque flat coil spring is used for downforce, with a linear coil spring for bias correction. The small but worthwhile improvements noted with later models include an increase in diameter of the main pillar cylinder together with a larger socket head clamping bolt allowing an unrivalled strength three-point lock to be obtained between arm and base. The main tube is now hard anodised in a darker shade of grey with a lacquer coating and the bonding of various parts has also been uprated by the use of larger bolts with heads capable of accepting greater tightening torque.

Lab report

Geometric accuracy was considered excellent, with a properly square headshell and adjustment provided for overhand, lateral angle and height. The alignment is in fact virtually optimised for our two point minimal subjective distortion criterion. Finish and engineering were both excellent and the arm proved easy to assemble, set up and use. Friction was superb at around 10mg or less in both planes, with no detectable slack. Biasing was in the correct ratio if marginally low in our estimation (based on a normal elliptical stylus), but downforce was well within the required tolerance. The cue worked well with a sensible rate and negligible drift. Arm resonances were classed as very good with the first main flexure deferred to a high 1kHz, this suggesting a remarkable riaidity.

As has been noted previously, the close nature of the coupling between arm and mounting board meant that the latter becomes influential as regards final sound quality.

Sound quality

The overall rating is a secure 'very good, but as with all acoustic components the final result obviously represents some sort of balanced compromise. In our view the *lttok*'s strengths lie in its subjective speed of response to transients, its fine transparency and its ability to reveal atmosphere, depth and fine detail. The bass was to a fine standard with good extension and drive, while the treble was also revealing of detail if very slightly brash and forward at times. A trace of upper-mid hardness was also noted, where the stereo focus suffers a mild dilution. The importance of this depends on the final combination of equipment chosen.

Conclusion

In its price category the Ittok remains an outstanding design with a fine combination of technical performance, sound quality and finish, plus ease of adjustment and use. While this is a fine universal tonearm, working well with many decks, it excels on the Linn *LP12*, where its minor faults appear to be significantly ameliorated. Likewise it is well suited to the standard Linn *Asak* cartridge, these three components in combination providing a disc player of virtually unrivalled performance for the price.

GENERAL DATA Tonearm Approximate effective mass, inc screws, excl cartridge est. 13.50	
Type/mass of headshellnon-detachable Geometric accuracyexcellent Adjustments providedheight/overhang/lateral angle Finish and engineeringexcellent/excellent	
Ease of assembly/setting-up/use very good/very	
less than 10mg/less than 10mg	
Bias compensation method	



Structural arm resonances, audio band



REASSESSED

Logic DM101 Logic Ltd., 6 Guy Street, Learnington Spa, Warwickshire CV 32 4RT. Tel (0926) 20302



First reviewed in the last *HFC* 'Turntables' edition, the Logic *DM101* design has undergone considerable modifications since then and accordingly has been completely reassessed for this issue.

In several respects the performance in previous tests was very good indeed, but a weakness was present in the subchassis springing which was believed to have limited the ultimate performance attained.

The subchassis is open, fitting in a recess in the upper surface of the semi-solid plinth. Sawn from a thick, stress-free 8mm aluminium alloy plate, and asymmetrically shaped to reduce self resonances, the chassis is suspended at its three extremities on a total of six small diameter coil-springs acting as a sort of 'web'.

However, Logic have subsequently added a large central coil spring to the subchassis around the bearing housing, bringing the total number of springs used to seven.

A useful feature with the Logic design is the ability to lift the subchassis right out for arm fitting and lead dressing, while the levelling points are locking socket-head bolts, conveniently adjustable from above and clear of the platter. The precision machined two-part alloy platter of this belt drive model weighs 3kg. It is fitted with a bonded baize mat, and runs on an impressive-looking main bearing. This has a 12mm shaft and a single point (thrust ball), plus a rigid phosphor-bronze sleeve exhibiting excellent tolerances. Speed change is effected manually after removing the outer platter.

Lab results

²⁶ In previous tests, weighted wow and flutter

was an excellent 0.06%, following stabilisation after start-up. The time required for the chassis to settle down after starting was a rather long five seconds. Flutter and rumble were also very good when separately measured. The speed ran 0.05% slow - significant in A/B comparisons — and this had to be taken into account during auditioning. The slowing under load was a satisfactory 0.35%, and the DIN B weighted rumble was a first rate -77/-78dB. From the spectrum analysis it can be seen that the suppression of mainsrelated rumble components was very good. with barely any visible difference between the static electrical breakthrough and the total rumble content.

We also obtained promising disc impulse responses, allowing X10 scaling; noteworthy is the scarcity of the low frequency long wavelength components which were often encountered with other models, confirming the considerable bearing/platter rigidity. The Logic's previously standard disc support gave quite good transient damping, but the alternative *Audio Ref* showed a superior control in the mid/treble range.

Both acoustic breakthrough and vibration isolation were excellent and proved to be a strong point with this model, endowing it with a very high feedback immunity.

On the latest version the original low-slung suspension has been restored, affecting the rotational mode stiffness and giving a very low resonance (too low perhaps in my view) has been attained of around 2.5Hz. The turntable now takes some time to stabilise after shock and pure wow has also doubled to 0.22%, a significant result and believed due to this revised suspension.

A felt mat is fitted to current production models (see the new graphs for isolation and impulse) and this was thought to slightly worsen the performance, although the vibration isolation remained excellent.

Sound quality

On the listening tests the original and promisingly high standard was still demonstrated. with the previously-noted slight stereo stage defocusing (believed attributable to the old suspension) now absent. However prolonged audition suggested another effect — a subtle instability of pitch which was believed to be associated with the measured slow wow, a contributory cause being the 0.3% of load variation. As before, the low frequency range was unusually clear, even, detailed and well extended, while feedback was held well at bay. and the general tonal balance with the standard mat was both neutral and vet at the same time sufficiently 'lively'. The Ittok worked well. though it demonstrated greater midrange 'hardness' than when partnering the Sondek; the Helius or Mission arms gave 'sweeter' results.

Conclusion

When last tested, the Logic demonstrated many strong points in its technical and subjective performance, and can be recommended for its exceptional bass neutrality and good isolation. This time, the previous comments still hold true; generally pretty good and demonstrating a good potential, the Logic's development is, I feel, not yet complete. undeniably good sounds can be produced in its present state, but it still fails to meet the top grade in my view.

(Note: the manufacturer states that production models from early 1983 will have an electronic power supply with two-speed switching.)

Logic Ltd. Hurlburth Road, Heathcote, Warwickshire CV34 6DT. Tel (0296) 20302.

GENERAL DATA Motor unit Motor Section	
Typemanual, belt-drive, synchronous motor, sub-chassis Platter mass/damping	
Speed options	
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz). 0.22%/0.05% Absolute speed error+0.01% Speed drift. 1 hour/load variationsynchronous/-0.3%	
Start-up time to audible stabilisation	E
Ease of use. fairly good Typical acoustic breakthrough and resonances. excellent Subjective sound quality of complete system very good	
Hum level/acoustic feedbackvery good/excellent Vibration sensivity/shock resistanceexcellent/fairly good Estimated typical purchase price	



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques Logic Datum Logic Ltd, 6 Guy Street, Learnington Spa, Warwickshire CV32 4RT Tel (0296) 20302



Designed in conjunction with, and initially manufacturered by Scott Strachan of Syrinx fame, the Datum will be made by Logic themselves from now on, although I suspect that my sample was in fact of Scottish origin.

Logic also state that two versions will eventually be available — one with a permantly fixed headshell (as supplied for HFC), and the other with a detachable shell, though whether the latter will be a plug-and-socket type is not yet decided. The detachable version is quoted at 2.3g higher effective mass than the fixed-head test figure of 10.5g including hardware.

The headshell is the usual fairly thick perforated aluminium mounting platform. The generous diameter main tube is also of aluminium, strongly coupled to a thicker section comprising the pivots. Circular gimbals are used with the ball races presumably set for tightness and low friction. A rotating counterweight is fitted but not decoupled and once balance has been achieved, the instructions quote each graduation as 0.15g, allowing setting of downforce. Once set a small locking ring is contra-rotated to lock the counterweight into position. Setting controls the bias compensation, which incidentially could not be set to zero, a fact which complicated the measurement of friction.

Arm effective length is 228mm, with an overhang of 17.3mm and although a mounting template was suppled it was rather inaccurate, the hole punched for the centre pillar being way off centre. The pillar/base requires a 30.5mm diameter hole and is fixed via a large clamping nut in the conventional manner. SME mounting plates are also available as accessories.

An unusual high-quality connector is fitted to the arm base and provides low profile as well as a right angled connection. The arm lead is reasonably compliant, has a moderate capacitance of 135pF but was fitted with phono plugs of inferior quality.

Lab report

With an all-up effective mass of 10.5g, the *Datum* fits neatly in the medium-mass group and is suited to cartridges in the 12-24cu compliance range. Geometrical accuracy was very good, as was the finish. The arm was considered to be well engineered though the final adjustment of the review sample (brought by hand) left something to be desired. A trace of looseness was evident in the lateral bearing while it was overtight in the vertical, with a measured results of 25mg lateral and a marginal 100mg vertical reading (in fact these values were not judged significant as regards the auditioning with a 2000mg stylus downforce, but ought to be taken care of in future).

Biasing was confusing since at the zero setting values appropriate to a 1.5g downforce were measured, witht the 'centre' value on the high side. Downforce calibration was also inaccurate — we noted a 20% excess at both 1 and 2g settings. The cue exhibited some drift and the descent was almost too fast at 0.8 seconds. Arm resonance measurement showed some moderate breaks early on at 190Hz and 300Hz, with the expected main break strongly dissected from 600Hz to 1.2kHz possibly due to the bearing condition, while further modes were present at 1.8kHz and 3.6kHz. The overall result was however quite good, demonstrating a smooth energy trend.

Sound quality

Rated 'good' on audition, the *Datum* sounded farily transparent with fairly even bass plus areas of very presentable stereo depth in the frequency range. Tonally it was a trifle 'brittle' or 'toppy', with the treble a touch obvious and forward, while a loss of stereo focus was also noted in the upper frequency range.

Conclusion

On sound quality grounds, the *Datum* qualifies as a good value-for-money arm and can be put forward for recommendation. However the state of adjustment and inaccurate calibration did not say much for its quality control, and until these areas are properly attended to a final judgement must be withheld.

(Note: we have been informed that current and future production arms will include revised bearing location to enable 100% quality control on bearing fit; a revised bias compensator giving more consistent bias load and easier adjustment; and the cueing device will have adjustable height and an integral arm rest.)

Logic Ltd, Hurlburth Road, Heathcote, Warwickshire CV34 6DT. Tel (0296) 20302.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws	s, excl cartridge 10.5g
Type/mass of headshell	non-detachable
Geometric accuracy	very good
Adjustments provided	overhang/offset/height
Finish and engineering	very good/good
Ease of assembly/setting-up/usever	y good/good/very good
Friction, typical lateral/vertical	
Bias compensation method	* internal spring
Bias force, rim/centre (set to 1.5g ellipti	cal)*175mg/300mg
Downforce calibration error, 1g/2g	+ 0.2g/ + 0.45
Cue drift, 8mm ascent/descent	none, 0.7 secs/0.8 secs
Arm resonances	good
Subjective sound quality	good +
Lead capacitance/damping method	
Estimated typical purchase price	£70
*hias compensator heing improved in	current production

Structural arm resonances, audio band



Howland-West Ltd, 3-5 Eden Grove, London N7 8EQ Tel 01-609 0293

Lux PD370



By virtue of a remarkably ingenious mechanism installed as a functional part of the platter and actuated only when required by a power drive built into the plinth, Lux have managed to bring a 'vacuum' platter to an integrated turntable costing less than £300.

The underside of the platter has a strong integral bellows which when actuated suck the disc onto the platter, the interface slightly cushioned by a thin liner 'mat': (a thicker non vacuum mat is also provided.) By removing the need for an airtight airline main bearing, a standard direct drive motor can be used, and this is the key to the major price saving.

Superbly finished in the Lux tradition, the PD370 is fitted with an attractive fixed headshell tonearm. The headshell clamp allows rotation for vertical tilt angle adjustment. but the arm is not adjustable for height, this achieved instead by using cartridge packing spacers. The plinth design is of rigid form, lacking an isolating sub-chassis, although semi-compliant feet are fitted to help reduce vibration feedback. The above average quality lid is coupled directly to the plinth and thence the playing system. The motor is a two-speed guartz-locked type with a good guality bearing though the rigidity of the platter/plinth Sound quality interface was not too high.

Lab report

The substantial aluminium platter weighed 2.6kg and demonstrated very good impulse damping. However two components were superimposed on the photo, namely the slight one at 600Hz (a ringing internally) and the other at 20Hz — a platter rocking effect.

Wow and flutter were excellent, with good overshoot-free torque and excellent speed stability, while rumble was also very good, though with an unusual kind of low frequency 'noise' present below 150Hz. The arm was quite well adjusted showing little bearing play and good geometry, and effective mass was in the medium range at approximately 13g including hardware. Lateral friction was however slightly high and the bias compensation on the low side, set in the inverse ratio. Downforce calibration was fine, but some cue drift was observed. Arm resonances were classed as slightly better than average, their main flaw being the energy 'break' at 1.5kHz.

Reasonably good on acoustic breakthrough. the vibration isolation was just average, shock resistance only fair. Feedback immunity was fairly good.

Just making the 'good' category, the 370

showed some 'life', with reasonable bass plus satisfactory stereo focus and staging. The midband was above average and the music showed good subjective timing and pitch. However the treble appeared somewhat harsh. brash and uneven, with poorer stereo precision here: changing the test moving coil cartridge helped matters in this respect.

Conclusion

Recommended for use with moderate-compliance moving magnet cartridges with a 'sweet' upper range, the PD370 succeeds by virtue of its fine disc damping and motor, plus satisfactory arm. An uncritical, unfussy model possessing an excellent appearance, this unit is well worth considering.

GENERAL DATA

Motor Section Type......nanual, quartz-lock, direct-drive, vacuum platter Platter mass/damping......2.5kg/very goodexcellent/very good Finish and engineering. Type of mains/connecting leads.....3-core/phonos and earth Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) 0.06%/less than 0.04%

0.0070/100	0 (11011 0.0 4 / 0	
Absolute speed error	– 0.05%	
Speed drift, 1 hour/load variation	none	
Start-up time to audible stabilisation	2.5 secs	
Rumble, DIN B wtd L/R average (see spectrum)	77/78 dB	

Arm Section

Approximate effective mass, inc screws, excl cartridge13g
Type/mass of headshell
Geometric accuracyvery good
Adjustments providedoverhang/offset/lateral
Finish and engineering
Ease of assembly/setting-up/usegood/very good/very good
Friction, typical lateral/vertical
Bias compensation methodlever
Bias force, rim/centre (set to 1.5g elliptical)150mg/100mg
Downforce calibration error, 1g/2g+ 0.05g/none
Cue drift, 8mm ascent/descentnoticeable, 0.5 secs/1.3 secs
Arm resonancesaverage +
Subjective sound qualityaverage+
Lead capacitance/damping method

150pF/counterweight decoupling

Integrated turntable

System as a whole

Ease of use.....very goodgood Hum level/acoustic feedback.....very good/fairly good Vibration sensivity/shock resistance..average/below average Estimated typical purchase price£199



Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques

REASSESSED

Lux PD 300 Howland-West Ltd., 3/5 Eden Grove, London N7 8EQ. Tel 01-609 0293



Like the costly PD555, this Lux turntable also has an inbuilt suction pump guite conveniently operated by a front mounted hand lever. On this model Lux have taken the subchassis principle to heart, incorporating a superbly engineered die-cast example of unusually complex design. Much attention has been paid to such details as provision for a massive main bearing and its mounting, the symmetrical disposition of the three support components. and the webbed and reinforced arm mounting with its face-machined interchangeable alloy tonearm plates. The subchassis proved easy to level using knobs accessible on the plinth underside, but at some stage the designer(s) appeared to have had second thoughts, since the very good isolation afforded by the coil spring suspension has been compromised probably in the interests of improved shock resistance and handling stability - by the addition of plastic foam spring sleeves and silicone damping washers on the moving components. The potential performance of this deck was such that we auditioned and measured it first as supplied, and secondly with freed suspension and springs.

The 300 is a two-speed belt drive model, using an electronically controlled high quality DC motor. A quartz oscillator reflector type stroboscope is fitted for reference, since the drive is not quartz-locked, and fine variable speed control is via thumbwheels mounted underneath near the front edge. One complication in previous assessments arose with the solid flat platter, as the suction pump supplied an equivalent of 30kg pressure, and any dust or grit on the record underside or platter surface

will tend to impress itself onto the record surface when the vacuum is engaged. However, a very thin rubber platter mat is now available which does not impair the 300's excellent disc damping (see *PD370* review) but effectively negates any worry over hard disc contact and damage. Furthermore the model now costs around two thirds of what it did.

Lab report

With its substantial 3.4kg platter and high torque drive, the wow and flutter, torque and rumble results were all excellent. Speed drift was more than I would like at the price level, but start up was fine at 2.8 seconds, with no overshoot effects. Rated as good on shock prior to the modification, the acoustic and vibration isolation were also very good above 75Hz, while freeing the suspension produced 10-12dB acoustic improvement from 25 to 75Hz, and an even better 15 to 20dB improvement in vibration isolation; but shock resistance was somewhat impaired.

Lux have not made special provision for consistently dressing the arm leads, and an adhesive clip was added. X10 scaling was possible for the disc impulse tests, showing the transient was totally suppressed, leaving only minor low frequency ripples.

Sound quality

Setting a high subjective standard at all times, the *PD300* showed much of the '555 midrange neutrality and transparency, particularly on percussive sounds and the ambience surrounding them. At times it was almost clinically clear, and in tonal balance seemed slightly 'cold' and faintly 'glassy'. A trace of high frequency 'forwardness' and 'disembodiment' was encountered with several cartridges. The Asak/Ittok worked better than the Koetsu/Ittok, and a 'softer' sounding arm would suit best — for example, the Sumiko.

The chassis was slightly nervous in stability terms once 'free', but conversely as supplied the bass range lost some of the precise and open sound with good depth extension

Conclusions

One of the best engineered and certainly one of the best finished turntables covered in this issue, the *PD300* offers many valuable facilities and continues to be strongly recommended.

Careful matching of system components is necessary for the best performance, and it is capable of accepting a wide range of tonearms; genuine alternatives to the *lttok* are slowly emerging, and their tonal characteristics may suit the 300 better — for example, Alphason, Mission, Orion and Zeta.

Its good alignment stability remains an important feature — it should not need resetting after installation.

Motor Unit

GENERAL DATA

Туре	belt drive
Platter mass/damping	3.5kg/excellen
Finish and engineering	both excellen
Type of mains lead/connecting leads	3 core + earth
Speed options	variable, 33/45rpm
Now and flutter (DIN peak wtd sigma 2).	<0.05%
Nowand flutter (LIN peak wtd 0.2–6 Hz/6–300)Hz).,,,<0.1%/<0.05%
Absolute speed error	quartz referenced
Speed drift 1 hour/load variation	+0.25%/<0.1%
Start up time to audible stabilisation	approx 2.8 secs
Rumble: DIN B wtd L/R av (see spectrum)
Size/clearance for lid rear	42.0(d) x 18.8(h)/6cm
Ease of use	good
Typical acoustic breakthrough and resona	ances very good
Subjective sound quality of complete sys	tem very good-
Hum level/acoustic feedback	very good/very good
/ibration sensitivity/shock resistance	ery good+/fairly good
Estimated typical purchase price	£500
see text	



Breakthrough as modified (see text): above, acoustic; below, vibration.



Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0–500Hz lin) as supplied: above, acoustic; below, vibration.

REVISED AND REPRINTED

Michell Focus Motor

J. A. Michell Engineering Ltd., 2 Theobald Street, Borehamwood, Herts. Tel 01-953 0771



Features and design

Now in its third year of production, the price of the *Focus* has remained competitive over this period, and the deck has undergone several refinements. The main improvements include an enlarged main bearing with a strengthened fixing to the deck plate, plus a revised drive assembly and motor decoupling to give reduced rumble and improved wow and flutter. Our lab measurements verified the value of all these changes.

The unit comprises a two-speed rubber cord drive design powered by a synchronous motor, and the flat 2.0kg platter is fitted with an effective 'suede' mat bonded into position. The high quality acrylic lid is hinged directly to the wood/ plastic laminated chassis, which is not an ideal situation, but the whole is suspended on quite effective steel springs with absorbent rubber cushions, giving an overall low resonant frequency around 5Hz.

Lab results

As the figures show, this model now provided exemplary results for wow and flutter, both separately assessed and weighted. Torque and speed accuracy were both good, and although the weighted rumble figures were also fine at near -75dB (several dB better than before), spectrum analysis did reveal a 100Hz component

at -73dB, which is poorer than average. The disc impulse response was quite good allowing X10 scaling and demonstrating good high frequency damping. Acoustic breakthrough was above average and vibration isolation fine, but shock immunity was not spectacular.

Sound quality

For some reason the decknever seemed quite at home with the *Focus* arm, but it provided pleasantly balanced and relaxed results in partnership with the Linn *Basik*. Above average with the lid installed, the bass was reasonably clean, the midrange quite transparent and detailed, and the stereo presentation above average. The sound was distinctly cleaner however with the lid removed, and for critical listening this is worth doing.

Conclusion

Possessing a fine handcrafted finish and distinctive styling, the *Focus* has improved significantly in mechanical terms since its introduction. It is now available at an attractive package price (\pounds 170), factory fitted with the Linn *Basik* arm/ cartridge. This package gains a comfortable recommendation, and indeed the motor unit alone is worth considering at around \pounds 130. (Note: On the latest version of the Focus, retested for this edition, Michell have revised the motor mounting as well as the plinth/chassis material. Lab figures are very similar this time except for a slight worsening in mains rumble component, but overall conclusions remain unaltered.)

GENERAL DATA

Typemanual, belt-drive, synchronous motor
Platter mass/damping2.1kg/good
Finish and engineeringvery good/very good
Type of mains/connecting leads
Speed options
Wow and flutter (DIN peak wtd, sigma 2)0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)

Motor uni



Rumble, electrical (above)and total (below) on latest sample — compare previous result.



Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

Mission Electronics Ltd, Stonehill, Huntingdon, Cambs Tel (0480) 57477

Mission 774SM

Mission Electronics Ltd., PO Box 65, London SW7 1PP. Tel 01-589 0048



Features and design

Arguably one of the finest low mass tonearms in current production (5.5a effective), the rigidity of this design is such that many cartridge types may be used, including the whole spectrum of high quality moving magnet models, as well as those high trackability high compliance moving-coils such as the AT32 or the fine Denon 303 and 305. The more temperamental low compliance moving-coils can also be successfully accommodated, but in this case some precautions must be taken: for example, if using the Asak (a 6g mass model of around 12cu at 10Hz), the low frequency resonance appears at 15Hz, which is enough to noticeably increase the bass register even with Mission's variable fluid damping. For this and other similar cartridges, I would suggest a steel interplate of between 5 and 10g in weight to mass-load the cartridge and headshell assembly.

Employing easily detachable straight alloy tube carriers, with the connections made via a flying lead fitted with a miniature gold-plated plug, the headshell has been reduced to a rather small contact rectangular block in the interests of low mass. This head block is internally threaded, the cartridge bolted up from below; in the case of the Dynavector Karat series, the block must be drilled through to give access to the threaded holes in the cartridge body itself (a special version is available).

A rigid arm design, all the components are tightly clamped together, and the precision ballrace bearings are pre-stressed by an offset technique which eliminates play. The counterweight resonance problem encountered with many tonearms has been solved here by the use of a new synthetic engineering polymer called *Sorbothane*, a cast insert of this decoupling the counterweight from its threaded adjustment bush. The very high loss characteristics of the insert provide strong damping of the main resonance as well as some secondary beam effects.

Lab results

Good geometric alignment has been maintained on the latest samples, and the design offered a full range of adjustments except for cartridge lateral angle (which is determined by the headshell block fixings). Provided that the flying lead on the arm carrier was carefully dressed, friction was low in both planes with no detectable notching. Bias compensation was uncalibrated. and we found an approximate setting for 1.5-2.0g was one weight at the lever extremity, or alternatively two set a little less than halfway out. The bias lever was not always well fixed in its pulley, and the linking thread adjustment could be quite fiddly to set properly. Ample damping was provided, though not much difference was observed between the various paddle sizes; excess damping is more damaging than none at all, and we would suggest using the smallest paddle. and then only where a very compliant and/or lively cartridge is concerned.

The resonance graph showed excellent control over a wide range, with a notably even energy Partly developed by Mission and built for them by GB Engineering the 774SM tonearm is the company's second arm model, augmenting rather than displacing the exisiting design. The latter comprises a low mass rigid pivot arm with optional fluid damping, while the SM is an entirely new design, lacking damping and possessing much higher mass — we estimated it at about three times higher.

At the time of writing, the high-mass *SM* was incompatible with the current range of Mission cartridges, but we were told that compatible low compliance types would shortly be available. A compliance range of 6-14cu would seem appropriate for this 16g arm.

The front end of the *SM* parallels that of the Zeta, with a massive unperforated slotted headshell milled from solid and thermally bonded to a large diameter black anodised aluminium tube — the main beam. Full circle gimbals are used, set for zero play and with moderate friction. The whole is a strong structure with a low-resonance 'feel'. The large counterweight is uncalibrated and fitted with a spring-loaded locking arrangement — insufficiently tight to prevent minor rattles on our sample, which admittedly was a prototype.

Connection is made by a standard Japanese-type plug and arm lead — a fairly stiff for correct dressing on a sub-chassis turntable, and needing some care to minimise the height required below the pillar. The gold-plated phono plugs were good quality, with a low lead capacitance of 85pF — much lower than that of the old 774.

An *Ittok*-compatible arm mounting base is expected to be made available for this design.

Lab report

The medium-high mass has been noted already. Once a sample error had been corrected, the geometry was judged to be very good, with adjustments for height, overhang and offset angle. Easy to assemble and use, setting up was however more difficult due to the lack of calibration for bias compensation and downforce. Friction was commendably low on this design. A thread-and-weight bias compensator was fitted, which when set to its mid position gave readings of 100mg, and 200mg when close to 'maximum'; the bias correction could be increased to advantage in this design. The cue worked well, with satisfactory rates of ascent and descent.

Charted for structural resonances, the arm's behaviour was judged very good, particularly as regards the even energy trend. The main break appeared at a high 1kHz, with minor effects preceding this and, apart from a 'ring' at 3.3kHz, the rest was pretty smooth.

Sound quality

Rated highly on the listening tests the 774SM was felt to offer a tonally neutral performance with good clarity and stereo focus throughout the frequency range. The bass was notably deep, powerful and articulate while the treble was lively but free of harshness. The whole

effect was one of relaxed security.

Conclusion

Mission have provided us with a genuine advance in arm performance and sound quality with this new product. Well suited to top performance, low-compliance moving-coil cart ridges it offers fine sound quality at a most realistic price and is therefore warmly recommended.



MISSION 774 continued

trend. Main resonances occurred at 500 and 750Hz but these were well disquised on the reproduced curve, with the break at 350Hz representing a mild pillar/bearing flexure.

Sound quality

Perhaps due to its low mass the 774 showed an ability to provide a consistently good standard of reproduction using a wide range of motor units from a Linn to a Thorens, from a Marantz TT1000 to a Lux PD555. Many tonearms have a strong tonal character, exhibiting 'richness', 'brightness' or simple coloration; but the 774 was distinguished by its dry and controlled neutrality. If anything the upper midband was slightly hard in the manner of the Ittok, but it lacked the latter's comparative upper range brightness; whether or not this is an advantage will depend on the balance of the cartridge being used. The bass was slightly reduced in power by comparison with some, but conversely it offered a fine transient performance with excellent control.

Conclusion

The 774 continues to provide an exceptional performance for a low mass design, proving unusually versatile as regards the choice of player and cartridge on the grounds of both sound quality and mechanical compatibility. In consequence our established recommendation holds, though we would like to see marginally higher standards of quality control.

	Approximate effective mass inc screws excl cartridge 16g
	Type/mass of headshell
	Geometric accuracy*very good
-	Adjustments providedoverhang/offset/height
,	Finish and engineeringexcellent/very good
/	Ease of assembly/setting-up/use.very good/difficult/very good
-	Friction, typical lateral/verticalless than 5mg/15mg
-	Bias compensation methodthread and weight
ŧ	Bias force, rim/centre (uncalibrated, set at max). 200mg/200mg
ι	Downforce calibration error, 1g/2g.,
/	Arm reappanees
	Subjective sound quality
_	Lead capacitance/damping method 85pE/none
	Estimated typical nurchase price \$197
	*First sample tilted 2 deg from vertical, second sample fine
1	

GENERAL DATA

Tonearm Approximate effective mass inc screws, excl cartridge .5.50 Type/mass of headshell special detachable arm/N/A Geometric accuracy excellent Adjustments provided tilt, height, overhang, damping Ease of assembly/setting up/use

fair/requires care and skill/very good Friction: typical lateral/vertical less than 15mg/less than 10mg Bias compensation method lever, thread, pulley Bias force: rim/centre (set to 1.5g elliptical) uncalibrated Downforce calibration error: 1g/2g.....<0.05g/<0.05g Cue drift/8mm ascent/descent.....negligible/1sec/1.2secs Arm resonances Subjective sound quality very acor Lead capacitance/damping method

180pF/variable, silicone fluid well Estimated typical purchase price.....£157



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REASSESSED

Pink Triangle Pink Triangle Products, 1 Cossington Court, Alder Road, Sidcup, Kent. Tel 01-302 1257



From the outside, the name and distinctive logo may seem all that is remarkable about this turntable, which has been designed in the UK along classic lines, using a sprung subchassis and belt drive. More detailed examination however reveals many unique features; for example, the platter is solid matt finished acrylic, supplying the record support and termination itself. A semi-glass black finish is used for the top deck, replacing the earlier tinted glass mirrors, and while the latter were removable the newer alloy plates are fixed. Fine speed control adjustment is available by the use of a screwdriver inserted in the small holes in the deck plate adjacent to the speed change switch, the drive being electronic via a small DC motor.

The subchassis is very light, but is an exceedingly rigid and well damped plate — an asymmetric section of honeycomb-cored aircraft flooring material.

The main bearing has been inverted and comprises an inherently self stabilising single point design. The inverted cup now has a ruby bearing surface as standard. An ingenious system of three small-diameter, but fairly long, coil-springs allows the chassis to hang freely in near isolation, with the vertical mode controlled by spring stiffness, and the lateral and torsional modes assisted by gravity as

well — a good feature.

Arm mounting is by means of a 'U' shaped section alloy extrusion, which is firmly bolted to four studs set in the subchassis. Adequate provision for lead dressing has been made, and the unit came fitted with an *Ittok*, which suited it well.

One point to bear in mind here is that the relatively low total suspended mass and high spring compliance results in slightly altered states of level with different record weights. The *lttok* is little affected by this, but if using a Syrinx, for example, which is sensitive to absolute levelling, it could prove disastrous. However, the deck is easily levelled *via* concealed external nuts in the plinth sides.

Lab results

State of the art rumble figures were achieved, the spectrum analysis revealing nothing of significance. The drive was remarkably stable with very low wow, very good flutter and fine weighted wow and flutter. As no dynamic wow overshoot occurred, this helped to mitigate the fairly low torque which resulted in a significant 0.5% slowing under standard loading. With a moderate 1.7kg platter mass, the flywheel effect was lower than in competing models.

The expanded X10 scaling proved possible for the disc impulse measurement, and the result was very good, with balanced impulse decay control over a wide frequency range. This performance carried through to the vibration and acoustic isolation results, which were exemplary, and aural testing with a live cartridge showed that this platform was singuiarly inert overall in terms of resonances, yet the subchassis freedom also resulted in quite good 'footfall' shock resistance.

Sound quality

For this issue the Triangle was tried with both the Ittok and Orion tonearms and qualities of low coloration tonal neutrality as well as a pleasing musical balance were immediately apparent. The bass register was well above average showing an open and articulate quality - tuneful and with good weight and solidity. The sound was alive yet somehow unforced. Disc/platter contact seemed particularly good, with a well focused treble, the whole delivering stable, clear stereo images. With rock-orientated material we heard a mild lack of pitch stability which slightly detracted from the timing and tempo of the music, although this negative effect depended on the listener's sensitivity as well as on the programme type.

Conclusion

Completely retested for this issue, the performance was virtually identical to that obtained previously and accordingly the original test results still stand. Notably, the pitch slowing under load is unaltered, a factor we were now aware of under audition, and a second sample showed no significant improvement. To conclude, this unit has been improved as regards some physical details, and maintains a high performance with respect to stereo depth, tonal balance and coloration levels. Only the individual purchaser can judge the importance of the pitch stability by personal audition, and with this mild reservation, the recommendation is continued.

GENERAL DATA

Typebelt drive	
Platter mass/damping	
Finish and engineeringvery good/very good	
Type of mains lead/connecting leads	
Speed options	
Wow and flutter (DIN peak wtd sigma 2)	
Wow and flutter (LIN peak wtd0.2-6Hz/6-300Hz) < 0.06%/0.07%	
Absolute speed error adjustable, +1%	
Speed drift 1 hour/load variation+0.2%/-0.5%	
Start up time to audible stabilisation	
Rumble: DIN B wtd L/R av (see spectrum)	
Size/clearance for lid rear 45.5(w) x 38.5(d) x 15.2(h)/6cm	
Ease of use	
ypical acoustic breakthrough and resonances excellent	
Subjective sound quality of complete system very good+	
Hum level/acoustic feedbackvery good/excellent	
/ibration sensitivity/shock resistanceexcellent/good	
Estimated typical purchase price£398	

Motor Unit



Disc impulse transmission, magnified X10.



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0–500Hz lin): above, acoustic; below, vibration.

Rega Planar 3

Rega Research Ltd, Swaines Industrial Estate, Ashington Road, Rochford, Essex Tel (0702) 333071



For several issues now, the Rega has been omitted at the maker's request on the grounds of a manufacturing shortfall in comparison with demand. However as Rega now dominate the lower priced audiophile end of the market in the UK, it was thought politic to purchase a deck and review it on our readers' behalf.

A simple design, it comprises a solid chipboard plinth covered in tough matt black laminate. Three fairly stiff stepped rubber feet provide a stable tripod foundation while the high quality lid is directly hinged to the chassis plinth with neither springs nor isolation. A plain main bearing with a thrust ball is used, and tolerances were close here, with no detectable play. Belt-driven via a rubber cord, the inner platter hub is a reinforced plastic moulding, the uppermost projection forming the tapered centre spindle and the outer platter boss. The platter is made of thick plate glass (reduced in thickness for the Planar 21), and surmounted by a thick felt mat. In a simple and ingenious gravity suspension, a second drive belt is looped to support the slow speed synchronous drive motor and surpress vibration coupling to the platter.

The arm is the traditional Rega unit made to their specification by Lustre in Japan, with improved bearings, a side entry cable fixing, and a stainless steel arm tube. Fitted with a universal detachable headshell, the arm has magnetically actuated bias compensation plus a rotating-scale calibrated counterweight, with some controlled decoupling from the arm tube. The lateral balance outrigger also has a damped stem. Effective mass is estimated at 16g, suited to lower compliance cartridges,

and in our (brand new) sample, some play was evident in the arm bearings.

Rega recommend that the deck should be placed on a light shelf, wall mounted, rather than a 'coffee table' or floor cabinet; this we found to be good advice.

Lab report

The platter was clearly well founded as the minimal low frequency ringing on the disc impulse response shows. The initial transient was poorly damped, however, a characteristic of thick felt mats.

Almost no metal work was present in the unit and this meant very little humfield screening was provided. In fact, hum levels were poorer than average and the choice of cartridge will need some care. Weighted wow and flutter was satisfactory but linear wow was on the high side at 0.21%, this measured without the mat as the felt is of slightly variable thickness. Speed was fairly accurate, but slowed a significant 0.4% under load with some overshoot after recovery due to motor suspension tension rocking. Start-up was average for a belt drive at 4.5 seconds.

Rumble levels were just satisfactory for the price averaging -71dB DIN. Spectrum analysis showed a considerable content of mains-related vibrations such as 100 and 200Hz, with 'pole harmonic' components around 200-300Hz. The bearing alone measured better than -78dB with the motor off, however. Acoustic breakthrough was about average and the lid was found to be influential here, and results were better when was entirely removed. The plot is shown expanded by 10dB for lid up and down, the latter being preferred. Vibration isolation was also poorer than average.

The arm was well finished with very good geometry. It was easy to set up and use and demonstrated low bearing friction. Bias compensation was set to sensible levels and the cue worked well. Downforce calibration proved satisfactory. Charted for arm resonances, the design demonstrated surprisingly good control of the first headshell socket flexure at 230Hz; comparatively clean in the 300 to 3kHz range, the energy trend was rather broken up thereafter.

Sound quality

Belying traditional assumed relationships between a number of technical parameters and sound quality, the Rega proves that a well-

developed, subjectively-assessed balance of performance counts for more than technical excellence with regards to any one parameter. On the debit side the Rega did suffer from a modicum of programme wow, particularly on rock programme, but this was not considered serious at this price level; a mild loss of stereo depth was also noted, together with an accompanying impairment of low bass definition and evenness. Conversely it sounded 'musical' in a balanced and coherent manner. Upper bass definition was actually quite good, the midrange slightly 'warm' but well focused and the treble lively as well as transparent without the 'smear' and 'splash' evident with some cheaper turntables. Presentation of detail was considered well above average. little inferior to super-fi models in this respect.



Disc impulse transmission showing damping

Conclusions

I have mild reservations concerning certain aspects of this model's lab performance but in truth the results are reasonable enough at the price, and I suspect that the cheaper *Planar 2* is equally good value. If you are very pitchsensitive the Rega might pose problems — if not, the overall sound quality is such that it gains a warm recommendation. A good audition should confirm your decision either way.

GENERAL DATA	Integrated turntable
Motor Section	0
Туре	manual, belt-drive
Platter mass/damping	2.2kg/good
Finish and engineering	very good/very good
Type of mains/connecting leads	2-core/phonos and earth
Speed options	
Wow and flutter (DIN peak wtd, sigm	a 2)
Wow and flutter (LIN peak wtd 0.2-6H	lz/6-300Hz). *0.21%/0.45%
Absolute speed error	+0.4%
Speed drift, 1 hour/load variation	, synchronous/ – 0.4%
Start-up time to audible stabilisation	n4.5 secs
Rumble, DIN B wtd I /R average (see	spectrum) - 72/ - 70dB

Arm Section

Approximate effective mass, inc screws, excl cartridge...16g Type/mass of headshell.....universal detachable/8.0g Geometric accuracy.....very good Adjustments provided....overhang/lateral angle Finish and engineering.....excellent/very good Ease of assembly/setting-up/use very good/very good/very good/very good Friction, typical lateral/vertical.....less than 25mg/15mg

Bias compensation method	internal magnet
Bias force, rim/centre (set to 1.5g elliptical).	200mg/210mg
Downforce calibration error, 1g/2g	– 0.1g/ – 0.07g
Cue drift, 8mm ascent/descent negligible	e 0.5 secs/1.5 secs
Arm resonances	average +
Subjective sound quality	average+
Lead capacitance/damping method	
	sent a la dia a a serie dia a

70pF/counterweight decoupling

System as a whole



Rumble, electrical (above) and total (below)



Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques SME 3009 Series III(SB) SME Ltd., Steyning, Sussex BN4 3GY. Tel (0903) 814321



Features and design

This review covers the two models in the SME Series III range, with the cheaper S sharing many of the fundamental components of its more expensive brother, including a virtually indistinguishable performance. In addition to all the basic adjustments, the top price version has a rack and pinion adjustment for geometric overhang, and fine screw adjustment for both bias and downforce; the silicone fluid damper assembly, an optional extra on the S, is fitted as be added as required; two are in fact supplied. standard.

The main parts are constructed of carbon fibre reinforced mouldings, the arm using the traditional SME bearing combination of a horizontal plane ball race and knife edges in the vertical plane; the vertical bearing axis runs through the stylus tip to maximise downforce stability and reduce warp wow.

Although a friction-fit interchangeable arm carrier has been incorporated, the design objective was undoubtedly that of low mass. Viscous damping has been included (S optional) to help control the high Q subsonic resonances of certain moving magnet cartridges which possess excessive compliances. A low 5.0g effective mass has been achieved by using a damped thin wall nitride-surface-hardened titanium arm tube, with a vestigial reinforced plastic cartridge platform/shell. Unfortunately this headshell is so small that some of the longer bodied cartridges produce a very tight fit; in addition, very little support is provided ahead of the fixing screws. These are made of plastic to reduce mass, but consequently cannot be done up tightly-the reverse of the thinking behind the Mission, Syrinx, and Linn etc designs, which

stress tight cartridge fixing. SME do however provide some bituminous mastic to help couple the cartridge to the headshell.

Improvements have been made to the cartridge wiring tags, which were previously rather too stiff and easily broken off the wires during fitting. An increased mass option has recently been made available to give better matching with lower compliance cartridges, comprising accessory mass loading plates for the headshell which can weighing 4.4 and 2.2g. The augmented effective mass including steel fixing screws works out at 12q, and the combination is suitable for cartidges down to 8cu. At the other extreme, and in conjunction with mild damping (we believe that SME's damping recommendations are excessive). models up to 60cu can be accommodated without the ballast weights.

Lab results

Demonstrating excellent geometric accuracy, a full range of adjustments was provided, including tilt, which is awkwardly set by a friction lock on the headshell and requires much trial and error. Bearing friction was excellently low, and on our sample measured below 10 mg in both planes. As in previous issues we found the bias settings were excessive by about 50%, but this can easily be compensated, while downforce also tended to be several percent on the low side. The cue descent was too slow at 4 seconds for a 8mm drop: one second is ample and minimises record damage when cueing on music tracks.

We found that when damping was applied as recommended, stereo image stability suffered due to excess forces being applied to the stylus on mild low frequency record warps in the 0.5 to 4 Hz range: minimum damping thinned by 30% of diluent stabilised the most severe resonance combinations successfully. In fact many cartridges worked well without damping.

The resonance characteristics in the audio range were fairly well damped but very complex, with a flexure associated with the counterweight at 88 Hz, a shell/tube mode at 220 Hz, and further effects at higher frequencies. On this sample some 'noise' was present on the graph, suggesting play in the assembly, which is suspected to be in the counterweight mechanics. A second graph taken with 6g of ballast showed an even more complex result; superficially demonstrating more resonance damping, in energy terms the trend is in fact less favourable, with a 15dB discontinuity.

Sound quality

This arm was charcterised by a 'soft' balance. with a subjectively subdued treble. Coloration was comparatively low and the overall sound pleasantly relaxed. Stereo imaging was to a good standard and the bass register reasonably detailed and extended. Low compliance movingcoils gave quite good results with the ballast, although some loss of transient precision and focus was evident when compared with the top class higher mass competition. The arm was at its best when used with more compliant cartridges that made less demands in terms of rigidity.

Conclusion

Despite the higher effective mass option, this finely made and exceedingly versatile arm is not really suited to top moving-coil cartridges possessing lowish compliances. However, it remains one of the best low mass tonearms at its price. and may be aligned to a high state of precision: the optional capacitance loading is a further advantage, though the lead-out cables are still rather stiff for subchassis turntables, but can easily be changed.

SME 3009 IIISB

The IIISB is a new addition to the existing SME Series III arms, also reviewed in this book. SME have increased their versatility and geometric performance by the simple expedient of adding some accessories to a new version of the carrier arm CA1. These include the established mastic mounting compound, to be placed between cartridge back and arm: a properlyfitting type '3818' ballast weight which approximately doubles the effective mass to 10g inclusive of screws, plus a return to aluminium mounting hardware. Carbon fibre reinforced nylon screws are also provided as standard, the final accessory being a revised

GENERAL DATA Tonearm Approximate effective mass inc screws, excl cartridge . 5.0a Type/mass of headshellplug in arm tube/N/A Geometric accuracy . excellent Adjustments provided.....overhang, tilt, arm height Finish and engineering..... excellent/very good Friction: typical lateral/vertical less than 10mg/less than 10mg Bias compensation method.....suspended weight (pulley) Bias force: rim/centre (set to 1.5g elliptical) 275mg/275mg Downforce calibration error: 1g/2g -0.12g/-0.18g Cue drift/8mm ascent/descent.....negligible/0.6sec/4.0secs Lead capacitance/damping method

optional to 300pF/variable fluid damping (not 'S')



Structural arm resonances, audio band,



Arm resonances: solid, cartridge tight; dotted, cartridge loose.



SME 3009 III SB continued

two point alignment protractor to go with the new geometry, the latter a small revision to offset angle. This is necessary since the SME carrier has single hole fixings, and only overhang can be adjusted, this via the pillar base slide. The headshell has been slightly enlarged and strengthened to give more space for the deeper cartridges and a broader base for mounting. Our sample came in a handsome all-black finish.

Lab report

For comparative purposes, the arm was retested with the ballast weight, this condition suitable for low to medium compliance cartridges, particularly moving coil types. On most mechanical and measured parameters the performance was very good. Bias compensation appears to have been reduced to more realistic levels compared with previous samples, but the cue descent rate remains a trifle slow.

The complexity of the arm resonance plot reflects the pivot design and the large number of attached mechanical components. The trend was considered favourable with reasonable control of breakup modes, though some of these were rather low in frequency, for example 90Hz and 200Hz (ballast version).

Sound quality

Placed in the 'good' category, the latest Series III was felt to offer an improved performance with moving coil cartridges as the bass felt more extended, with better detail and articulation. The heaviest possible counterweight helps matters here. The mid had the usual. slightly bland, 'rich' characteristic of the III, and the treble did not sound as clear or well localised as some more recent tonearms, although admittedly the latter are usually much Structural arm resonances, audio band

more expensive. A mild loss of stereo depth and immediacy was also observed.

Conclusion

On grounds of its respectable sound quality and high versatility with excellent finish and construction, not to mention the fine written instructions, the III continues to qualify for recommendation in its latest SB form.

GENERAL DATA	Tonearm
Approximate effective mass, i	inc screws, excl cartridge
	- E(*10)a

	0(10/9
Type/mass of headshell	letachable carrier
Geometric accuracy	excellent
Adjustments providedtil	t/overhang/height
Finish and engineering ev	cellent/very good
Fase of assembly/setting.un/use	anod/anod/anod
Lase of assembly/setting-up/use	. good/good/good
Friction, typical lateral/vertical	mg/less than 5mg
Bias compensation methodt	hread and weight
Bias force, rim/centre (set to 1.5g elliptical).	150ma/150ma
Downforce calibration error, 10/20.	– 0.05a/none
Cue drift 8mm ascent/descent none	0.9 secs/3.9 secs
Arm resonances	boon
Anni icsonanocs	····good
Subjective sound quality	good
Lead capacitance/damping method	.280(*75)pF/none
Estimated typical purchase price	£90
*See text	

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Features and design

The 305 M was the first and more costly version of this motor unit to be released some years ago now, comprising a two-speed belt drive with a four-spring subchassis. It exhibited a high standard of plinth construction and finish commensurate with its price range, but STD also found it possible to produce a less expensive version by economising on externals yet retaining the essential mechanics. This is designated the 305S, and uses a heavy, moulded black plinth.

STD 305S(M)

Rather light in construction, the subchassis is heavily damped by bituminous cladding. Levelling and adjustment requires the removal of the bottom cover as well as the setting of the four spring tensions to produce a clean. 'free' movement. The lid is of heavy gauge and non-resonant plastic, mounted on friction hinges.

Lab results

Weighing 2.0 kg, the flat alloy platter is fitted with a felt mat that provides reasonable disc support. Two disc impulse responses were tried and are presented for comparative purposes, one with the mat as supplied and the other with the Audio Ref mat substituted: note that the latter did not affect the low frequencies, the disturbance here being due to platter rocking. At 0.07 %, combined wow and flutter was very good, as were the rumble results although the spectrum analysis did reveal some spurious components around -80 dB. Speed error and torque were both good, and both acoustic and vibration isolation were fine; in this instance the acoustic results were taken with the lid shut, using an Audio Ref mat.

Sound quality

In its price class the S was undoubtedly capable of a high sound quality. The benefits of negligible motor imperfections, good resistance to feedback, and the isolated nature of the disc platform were reflected in the precision of the stereo staging, good detail and depth rendition, an extended and fairly even bass, and a general lack of 'muddle' which is an unfortunate feature of the majority of plinth plus feet turntables.

Conclusion

While the M remains worth considering, the S can be confidently recommended as providing good value for money. The shock resistance achieved by some foam damping in the springs. is a little better than for other competing subchassis models, and this might be a particular factor in its favour under certain circumstances.

GENERAL DATA	Motor Unit
Туре	. belt drive
Platter mass/damping	.2ka/aood
Finish and engineering.	dood/dood
Type of mains lead/connecting leads	2 core/-
Speed ontions	33/45rnm
Wow and flutter (DIN neak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd) 2–6 Hz/6–300 Hz) 0.1	1%/<0.06%
Absolute speed error	+0.25%
Speed drift 1 hour/load variation	uc/_0.25%
Stort up time to audible stabilization	2 5 0 0 0
Start up time to audible stabilisation	
Rumple: DIN B wto L/R av (see spectrum)	-/5/-/60B
Size/clearance for lid rear .,,,47.5(w) x 36.5(d) x 15.	.5(n)/5.5cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	. very good
Subjective sound quality of complete system	. very good
Hum level/acoustic feedback very good	/verv good

Vibration sensitivity/shock resistance very good/fairly good

Estimated typical purchase price.....£170



Disc impulse: black Audio Ref mat; white, STD felt mat (X10).



Rumble (0-500Hz lin): above, electrical only; below, total.



Breakthrough (0-500Hz lin): above, acoustic; below. vibration.



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Technics SL7, SL10, SLDL1, SLQL1, SL15 National Panasonic (UK) Ltd. 300-318 Bath Road, Slough, Berks SL1 6JB Tel Slough 34522



This range of Technics turntables has so many common factors in engineering and in component elements that it is logical to assess them as a group. The first model was the SL10, an extraordinarily compact and ingenious integrated player of superb external appearance. However, it proved hard to manufacture, and furthermore Technics underestimated demand for the product. Accordingly a year or so ago they introduced a companion model of virtually the same dimensions with an essentially comparable performance called the SL7. An improved microprocessor plus rationalised motor and control circuitry allowed a massive reduction in components as well as easier construction, resulting in a 30% price saving. Since then the SL7 design has been widened and stretched physically to match normal component and rack dimensions, producing the SLQL1 and the cheaper SLDL1. At the top end of the range, the SL10 has been supplemented by the SL15, which has additional track selection facilities, allowing the choice of any track in any order via a numbered array of pushbuttons. The successful incorporation of this complex additional feature within the limited space of the SL10 frame is something of an shock resistance than conventional models. achievement.

The major component that all these models have in common is the basic tonearm from the SL10, a parallel tracking device built into a heavy set of precision castings. On the '10 and '15 the casting is continued to form the entire lid, while

the other models have transparent front lid cueing position. Manual override is however σ,

sections, comprising plastics mouldings of a far heavier grade than usually fitted to turntables. A lid-mounted tonearm is admittedly sensitively located, but the exceptional rigidity and weight of the lids has proved to be beneficial for acoustic isolation and feedback immunity.

Cartridges of above average guality are fitted, and use a special fixing which gives a low effective mass total of 9g, ensuring good mechanical compatibility for the arm/cartridge subsonic resonance (10-12Hz). Physically completely symmetrical, the tonearm is based on a precision optical angle sensor which detects errors from the tangent in the arm as it tracks, holding any error to +0.1 of a degree, which is many times better than for an offset fixed pivot arm. The arm has a reasonably rigid rectangular metal tube beam, with guite strong bearings and miniature four-point gimbal ball races. A variable rate micro-motor energises the leadscrew drive. and manual cue traverse at two speeds are provided according to the pressure exerted on the pushbuttons. Spring loading for downforce gives good dynamic balance, and with the lack of bias requirement endows the arm with a higher

All the turntables are fully automatic and fitted with protection devices, for example to cue up the arm instantly when the lid is moved or lifted. Small slots in the mat/platter allow the lidmounted LED lamps to activate sensors underneath, detecting record size and setting speed/ possible, for example for a 45rpm 12 inch disc, and a repeat play function is also provided.

All the models are powered by Technics direct drive motors - quartz-locked with two fixed speeds except in the case of the cheaper SLDL1. which has a mains stroboscope plus fine speed control via a thumbwheel on the front section of the plinth, instead of the guartz reference. The basic controls of all models may be operated with the lid shut, and no additional clearance need be provided at the rear to accomodate lid elevation. A common constructional feature is the heavy/inert baseplates of either mineral-loaded plastics mouldings or of cast metal, and the units are supported on four steel coil spring feet with rubber damping inserts.

The cartridges

The cartridges fitted range from a special version of the 305MC moving-coil model in the SL10 (which has an integral and switchable movingcoil pre-amp and can thus accept moving magnet alternatives), to the good quality moving magnet fitted to the 'DL1. A top quality moving magnet model is fitted to the SL15, being a version of the Choice recommended EPC205 IIIL, while the SL7 uses a P202, which also has many similarities to the '205, including the hollow boron cantilever, the low inductance generator giving wide electrical bandwidth and good tolerance of loading, plus a top guality naked elliptical diamond stylus. A slightly different version is fitted to the SLQL1, the cantilever carrying a shank-mounted elliptical tip (EPS22ES), which can be replaced by the EPS-22ED (EPS 202ED) stylus of the SL7 if so desired at a later date.

A P23E model is used for the SLDL1, still employing the broad electrical bandwidth generator, and tracking at a 1.25kg downforce as all the models do quite comfortably. But here the output is a little higher than before, and the cantilever uses an aluminium micro-tube fitted with a shank-mounted elliptical tip.

All the cartridge masses are identical, and hence are interchangeable without any necessary readjustment. In addition Ortofon have now built a compatible version of one of their own 30 series, though appropriate electrical loading should be applied here to give the best results.

Lab results

Not every unit in the range has been tested, but key models have been evaluated which are generally representative of the group as a whole.

SLDL1

The SLDL1 delivered an excellent mechanical performance with high torque, overshoot-free, with low drift and negligible wow or rumble. The arm performed well, judged largely by the fine stability and tracking performance of the supplied









cartridge at a 1.25g downforce. (See SL10 trace for the arm audio band resonance behaviour). The subsonic resonance was near ideal at +8dB. 10Hz, while acoustic and vibration isolation were both very good above 100Hz, though the latter showed some deterioration at lower frequencies. The disc impulse transmission photos could not be taken, but platter damping was guite good, and all the models were fitted with a sensibly flat rubber mat possessing satisfactory absorbtion properties.

6	GENERAL DATA
\sim	Motor Section

Integrated Turntable

Motor Section
Type direct drive, parallel tracking, automatic
Platter mass/damping 1.4kg/good
Finish and engineering very good/very good
Type of mains lead connecting leads2 core/phonos + earth
Speed options
Wow and flutter (DIN peak wtd sigma 2)
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) 0.1%/<0.06%
Absolute speed error
Speed drift 1 hour/load variation
Start up time to audiole stabilisation approx 1 bsecs
Rumble: DIN B wtd L/R av (see spectrum)77dB
Arm Section
Approximate effective mass, excl cartridge
Type/mass of neadshell plug in cartridge, special type/m/A
Adjustments provided
Einish and engineering both very good
Ease of assembly/setting up/use excellent/excellent/excellent
Eriction: typical lateral/vertical
Bias compensation method not required
Bias force: rim/centre (set to 1.5g elliptical) N/A
Downforce calibration error 10/20
Cue drift/8mm ascent/descent
Arm resonances N/A (see SL10)
Subjective sound quality (complete unit)
Lead capacitance/damping method N/A/none
System as a whole
Size/clearance for lid rear
Ease of use excellent
Typical acoustic breakthrough and resonances very good
Subjective sound quality of complete system

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Vibration sensitivity/shock resistance..... average +/very good Estimated typical purchase price.

Total rumble via lacquer, SLDL1/SLQL1.



Breakthrough SLDL1/SLQL1: above, acoustic; below, vibration.

The good tracking properties of the cartridge have already been mentioned, and to this must be added an above average distortion performance as well as the good frequency response/separation characteristics printed here. The channel balance was very good, the response $\pm 1 \, dB$ 20Hz-16kHz, and the separation, typically -28dB in the midband, still measured well at 10kHz.

SLQL1

Very similar to the 'DL1, the QL1 showed the benefit of its quartz lock in higher speed accuracy. The sample of P202 cartridge supplied produced a very well balanced and uniform response, but gave disappointing midband separation of under 20dB. The results with a second sample as fitted to an SL7 can be seen from the appropriate curve, where a rather better result was obtained, but on this occasion the cartidge demonstrated poorer channel balance. It should be noted that the cartridges do appear to have an element of sample variability, though this is by no means confined to Technics' models.

SL7

÷180

All these turntables had to be measured for rumble using a lacquer acetate test disc, rather than the more sensitive rumble bridge employed where possible elsewhere. Nevertheless the indications were of a DIN B weighted figure better than -76dB, and I have no reason to doubt the spec of -78dB given for all models and applicable to the SL-7. The rumble spectrogram compares pure electrical breakthrough with the total rumble including disc charted below, and no pole switching harmonics can be seen - a tribute to the slotless full-wave current-controlled motor.

GENERAL DATA

Integrated Turntable

Motor Section
Type direct drive, parallel tracking, automatic
Platter mass/damping 1.35kg/good
Finish and engineeringvery good/very good
Type of mains lead/connecting leads2 core/phonos + earth
Speed options
Wow and flutter (DIN peak wtd sigma 2)
Wow and flutter (LIN peak wtd0.2-6 Hz/6-300 Hz) < 0.1%/<0.06%
Absolute speed error
Speed drift 1 hour/load variation
Start up time to audible stabilisation approx 1 3secs
Rumble: DIN B wtd L/R av (see spectrum) better than -76dE
Arm Section
Approximate effective mass inc screws, excl cartridge approx 3
Type/mass of headshell plug in cartridge/N/A
Geometric accuracyexcellen
Adjustments provided
Finish and engineering very good/very good
Ease of assembly/setting up/use very good/excellen
Cue drift/8mm ascent/descentnegligible/1.0sec/1.0sec
Arm resonances
Subjective sound quality
Damping method
System as a whole
Size/clearance for lid rear
Ease of useexcellen
Typical acoustic breakthrough and resonances very good
Subjective sound quality of complete system
Hum level/acoustic reedback very good/very good
Vibration sensitivity/snock resistance average +/very good
Estimated typical purchase price£200

A +10dB resonance at an ideal 11Hz was recorded for the arm/P202 cartridge combination. but channel balance was slightly erratic: 1 dB out at low frequencies, it was matched at 7 kHz and then diverged above 10kHz to a maximum of 1 dB. 15kHz, so the frequency balance of the two channels will be slightly different. Fine stereo separation was recorded - still 22dB. 10kHz. and approaching 30dB in the midband. The cartridge proving to be an excellent tracker with low distortion evident throughout the tests.



Rumble via lacquer disc (0-500Hz lin).



Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

SL10

Overall the performance of the SL10 can be seen to be similar to the other models in the group, though one detail difference was noted, in that the power level and speed of the arm tracking servo-motor was higher than for the later turntables in the series. Very critical listening involving relatively quiet, clean programme such as solo piano showed a trace of arm-drive rumble, which proved undetectable with the SL7 arm and those of its companions, due to their slower and hence quieter arm motors.





/ow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)
<0.16%/<0.048%
bsolute speed error <0.05%
pool drift 1 hour/load uprintian
peed drift i nourroad variation
tart up time to audible stabilisation approx 1.2secs
umble: DIN B wtd L/R av (see spectrum)
rm Section
pproximate effective mass inc screws, excl cartridge
vne/mass of headshell none/N/A
eometric accuracy excellent
distance accuracy
ajustments provided
inish and engineering
ase of assembly/setting up/use excellent/excellent
riction: typical lateral/verticalN/A / N/A
ias compensation methodnot required
ias force: rim/centre (set to 1.5h elliptical) N'A / N/A
ownforce calibration error: 1 a/2 a N/A / N/A
up drift/9mm appart/descent
ue unit/omm ascent/descent
rm resonances
ubjective sound quality
ead capacitance/damping method N/A/none
vstem as a whole
ize/clearance for lid rear 31.5(w) x 31.5(d) x 8.8(h)/none required
ase of use excellent

size/clearancerornulrear
ase of useexcellent
ypical acoustic breakthrough and resonances very good
Subjective sound quality of complete system
lum level/acoustic feedback very good/very good
'ibration sensitivity/shock resistance above average/very good
stimated typical purchase price £300 (inc cart & head amp)

continued overleaf

However in other respects, the tests on this model provided the main data for the tonearm performance of the group as a whole. On arm resonances (measured with the *305MC* cartridge and the lid partially dismantled) a flexure was present at 250Hz, probably in the rear assembly, with the first beam mode deferred until 590Hz, which is a relatively high frequency. Following a 'scrappy' region between 800Hz and 2kHz, it quickly settled down to a tidy performance up to 20kHz.

Similar results for acoustic and vibration isolation were achieved, and the 305 MC cartridge proved to be a good performer, providing a $\pm 0.3 dB$ response from 40Hz to 11kHz, with 30dB separation between 100Hz and 10kHz. Trackability and distortion performances were both very good, though towards the frequency response extremes (20Hz and 20kHz), a 3dB lift occurred, and in this area the moving magnet alternatives are rather smoother.

Sound quality

A 'generic' sound quality was exhibited by all these turntables, but there were differences between the models which are worth discussing.

As a group feedback levels were low and shock immunity good, while the bass registers were above average, though not quite as clear, firm or even as the manual subchassis models in similar price ranges. Stereo presentation, image stability and detail were all well above average, but on coloration grounds the models appeared

a trifle 'hard' and 'forward' in the midband, if not unduly so. The frequency balance gave an 'open' and 'lively' effect, with good clarity in the treble, and the overall impression was of a 'light' and 'lively' balance.

Of the less expensive models, the *SLDL1* was preferred, giving a more pleasant and relaxed performance than the *SLQL1*, which seemed a trifle 'edgy'. The *SL7* was better still, giving improved detail, and it was also found to sound better than the original *SL10*. Trial fitting of the 'luxury' cartridge option '205*III* produced further depth, refinement and detail in the *SL7*.

Conclusions

All models set high standards in terms of complete integrated players. The *SLDL1* offers fine value for money and may be confidently recommended. Little advantage would appear to be gained from the more costly *SLQL1*, which was still good but is less competitive.

Bar the remarkable *SL10* styling (in which respect I feel the *SL7* is inferior), the latter supercedes the '10 in all other respects, and is excellent value at nearly \pounds 100 less than the '10. The latter still remains a fine 'buy' in its own right, and if the styling is paramount and the auto track programming important, then the more costly *SL15* provides both, as well as the updated features of the '7 and Technics' best possible cartridge option. However, in strict hi-fi terms it cannot be said to offer such good value at around \pounds 400.







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Thorens TD166 II

Cambrasound Ltd. Britannia Road. Waltham Cross. Middlesex EN8 7EF Tel Waltham Cross 716666



Originally popular a number of years ago the 166 has been revised and reintroduced after a long absence. On the face of it, this would appear to be quite a competitive product: for under £120 a good quality, well adjusted tonearm is provided, fitted to a true subchassis belt-drive deck.

The arm uses the Thorens detachable wand system offering a low effective mass in the region of 5.6g, and suited to medium to high compliance cartridges. Calibrated adjustment is provided for downforce and bias compensation while plinth mounted, shock-free cueing is built-in. Only manual operation is provided, and the plinth and hinged lid are rather resonant: in practice this is immaterial since the player components are isolated on the springsuspended internal sub-chassis. A generous cast machined platter is fitted with a main bearing of satisfactory quality. Power is Experiments with the arm resonances revealed supplied by a slow-speed synchronous motor via a compliant belt. The old-style Thorens mat is used for this economy model, but it could easily be updated by a felt or other type.

Lab report

While a promising 2.5kg platter is fitted, the disc impulse response was uninspiring with considerable post impulse ringing; a good mat would help matters here considerably. Finish and engineering were generally guite good and two speeds are provided with a good mechanical changeover. Weighted wow and flutter was

very good, though some mild pure wow was noted. The 166 ran 1.4% fast, which might just be noticed by a someone with absolute pitch acuity, but showing under load was negligible. Rumble was above average at -72dB, DIN weighted, and nothing untoward was evident from the spectrum analysis. As it should, the 166 rated as good on both acoustic and vibration isolation, while hum levels were moderate, feedback resistance well above average, and shock resistance fairly good.

The arm showed good geometry and was adjustable in all planes, which is unusual at this price level. As in the past, I found the Thorens system for cartridge fixing awkward but otherwise the arm was easy to set up and use. The bearings provided very low friction levels and bias compensation was in the right ratio if slightly low, while the cue operation was fine. a significant improvement in sound with the finger lift cropped to about one third its original length, or even removed altogether. Curtailing the lift meant that the 400Hz resonance then disappeared, and that at 500Hz was moderated.

Sound quality

Used as supplied, the sound quality was rather special for the price. It portrayed dynamics well and demonstrated worthwhile stereo depth and space, proving to be guite detailed and articulate throughout the frequency range.

The bass was quite good with a surprisingly stable tempo and drive. Substitution of a better mat and altering the finger lift gave greater clarity and smoothness.

Conclusion

The 166 is unhesitatingly recommended. For the price it offers a good arm, a stable motor drive, good environmental isolation and a well balanced performance. The sound quality is well above the general competition, and furthermore the arm's low mass and high sensitivity allow the use if guite delicate higher compliance cartridges while still working well with medium compliance types.



Integrated turntable

Motor Section Type.....manual, belt-drive, synchronous motor, subchassis Platter mass/damping......2.5kg/poor Type of mains/connecting leads.....2-core/phonos and earth

Arm Section

Approximate effective mass, inc screws, excl cartridge6.0g
Type/mass of headshelldetachable carrier
Geometric accuracy
Adjustments providedoverhang/offset/height
Finish and engineering
Ease of assembly/setting-up/use
Friction, typical lateral/verticalless than 5mg/10mg
Bias compensation methodpulley
Bias force, rim/centre (set to 1.5g elliptical) 150mg/150mg
Downforce calibration error, 1g/2g – 0.2g/none
Cue drift, 8mm ascent/descentnone, 0.8 secs/3.1 secs
Arm resonances*average +
Subjective sound qualityaverage +
Lead capacitance/damping method

240pF/counterweight decoupling

System as a whole

Ease of use very good Subjective sound quality of complete system good + Hum level/acoustic feedback.....very good/good Estimated typical purchase price £115 *with fingerlift as supplied - see text



Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Charts above characterise general turntable behaviour. See text for commentary on these results. see Technical Introduction for explanation of test techniques

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In the last edition, the TD160 was reviewed in two versions: the standard basic Thorens model, and a German-modified version fitted with Hadcock or Mayware arms which was imported by some dealers: known as the ATR, this version is no longer available in the UK, and is in any case usurped by the new '160S (see review). In point of fact the dealers who handle the TD160 frequently offer their own similar modifications to the basic '160 (mat change, removal of foam spring cores etc.) while carrying out the necessarily skilled and time consuming process of properly fitting an arm.

In mechanical terms, the TD160BC is a synchronous motor two speed belt drive turntable, with massive main bearing and a die cast balanced outer platter mounted on an effective, low working resonance, suspended sub-chassis. Engineering was to a high standard as the measured data confirmed, and even without the simple mat substitution it remains the best choice of motor unit at this as well as much higher price levels.

Rated as very good on both wow and rumble. slowing under load was acceptable: no overshoot was of course present due to the synchronous drive and dynamic wow was thus negligible. A reasonable 3 second start-up was demonstrated, but absolute speed proved a trifle fast at +0.6%. Acoustic breakthrough was however very good and improved further with ATR's better mat and its removal of the foam cores from the springs.

Rated as good for the standard Thorens version and as very good with the ATR style modifications, the subjective performance attracted very little criticism. The mat change resulted in a significant

improvement in midrange detail and stereo depth. similar to the LP12 in terms of neutrality, low frequency depth, eveness and ambience.

In both forms, very good value is offered, and a strong recommendation holds.

Thorens TD160BC

Cambrasound Ltd. Britannia Road, Waltham Cross, Middlesex EN8 7EF

GENERAL DATA	Motor Unit
Туре	belt drive
Platter mass/damping	2.5kg/good
Finish and engineering	very good
Type of mains leads	2 core
Speed options/variable?	. 331; 45rpm/no
Wow and flutter (DIN pk wtd σ^2)	
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.11%/0.08%
Speed accuracy/drift/variation under load+0.0	6%/none/0.4%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	
Size/rear clearance for lid) x 15(h)/9.5cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/Acoustic feedbackvery	good/very good
Vibration of shock sensitivity	very good
Ease of use	straight forward
Estimated typical purchase price.	£120



(0dB = approx. 10 cm/s RMS, DIN rumble level. equivalent to loud music output from turntable). Thorens TD147

Cambrasound Ltd, Britannia Road, Waltham Cross, Middlesex EN8 7EF, Tel Waltham Cross 716666



In essence the *TD147* comprises a development of the upmarket *160S*, with a fitted Thorens tonearm based on the *TP16* detachable-carrier wand system, and allowing the inclusion of some semi-automatic facilities.

A substantial thick chipboard plinth is provided for the 147, the review sample being mahogany veneered. A lever control is fitted for speed change, with another for remote arm cueing. Thorens have used a new motor for this model, a low voltage (16V) 16-pole synchronous type, and the accompanying miniature transformer is fitted into the supply cable to reduce cartridge hum induction.

The 147 is a full sub-chassis design, the inner chassis a reinforced light steel pressing suspended on three adjustable coil springs. The large zinc alloy platter is belt-driven at two fixed speeds and is fitted with a pulley clutch to improve start-up. The low mass arm has precision bearings with spring downforce and frictionless magnetic bias compensation.

Lab report

Weighing 3.5kg, the accurately-machined platter came fitted with a reasonably flat mat affording fairly good disc damping. The unit was well engineered and finished, with a substantial and well-toleranced main bearing. All readings for wow and flutter were to a good standard, the speed accuracy being satisfactory and the slowing under load of moderate proportion. Rumble was guite excellent at

- 80dB with the spectral analysis revealing very little spurious effects.

Ácoustic isolation edged into the very good class while vibration energy was also well rejected. Shock resistance was satisfactory but feedback margins were up with the best. Hum levels were low and the unit was easy to use, unlike many sub-chassis types.

Arm bearings were commendably free of play yet provided low friction levels. The bias compensation worked well though the readings were somewhat on the low side. Downforce calibration was accurate at the higher settings, while the cue operated at a decent rate with no drift. The arm geometry was very good overall, though height adjustment was by means of clumsy spacers; Thorens could well improve on this. Arm lead capacitance was also rather high at 240pF, and would be unsuitable for certain cartridges when added to amplifier input capacitance.

The arm resonance graph suggested quite a good behaviour with the energy trend quite well maintained, the minor modification of the springy finger lift giving a further improvement.

Sound quality

The sound was felt to present an improvement over the favourable level already established by the 166, though not anything like as great an improvment as the 2:1 price increase might suggest. Characterised by a 'tuneful stability', the 147 gave good rendition of bass inform ation with considerable detail throughout the range. The arm could sound a trifle hard and brash at times, with fair depth but slightly vague stereo focus but the addition of a felt mat, deletion of the lift and packing the cartridge to an accurately set vertical tracking angle helped considerably, and almost took the sound into the uppermost category.

Conclusion

While clearly not as good value as the *166*, the *147* is a fine-sounding integrated turntable of honest, well adjusted, conventional design, whose overall performance certainly warrants recommendation.

GENERAL DATA Integrated turntable Motor Section

Arm Section

Approximate effective mass, inc screws, excl cartridge6.0g
Type/mass of headshelldetachable carrier
Geometric accuracyvery good
Adjustments provided overhang/offset
inish and engineeringvery good/very good
Ease of assembly/setting-up/use
Friction, typical lateral/vertical
Bias compensation methodmagnetic
Bias force, rim/centre (set to 1.5g elliptical) 150mg/150mg
Downforce calibration error, 1g/2g+0.2g/+0.05g
Cue drift, 8mm ascent/descent negligible, 0.5 secs/0.9 secs
Arm resonancesaverage +
Subjective sound qualityaverage +
_ead capacitance/damping method240pF/none

System as a whole

Size/clearance for lid rear
Ease of usevery good
ypical acoustic breakthrough and resonances very good
Subjective sound quality of complete system
Hum level/acoustic feedbackvery good/very good
/ibration sensivity/shock resistancegood +/fairly good
Estimated typical purchase price£240



Structural arm resonances, audio band



Disc impulse transmission showing damping





Charts above characterise general turntable behaviour. See text for commentary on these results, see Technical Introduction for explanation of test techniques Walker CJ55 CW & J Walker Ltd., Brentwood, Red Lane, Frodsham, Warrington WA6 6RA. Tel (0928) 33326



For the last issue, a pre-production sample of the *CJ55* arrived just in time to meet our deadline, but this year we were able to test a full production model. Designer Colin Walker is well known in the hi-fi industry, and with this turntable has at last brought the benefit of his two decades of product experience to bear on one of his own creations, rather than on behalf of others.

Stressing traditional design rather than pointless innovation, the unit uses an open hardwood frame for the subchassis, floating on four coil-springs whose setting is easily achieved from above. A full size rectangular arm board is incorporated. Belt driven from the usual synchronous motor, the double unit platter is different in being machined from a long established organic heavy engineering material called *Tufnol*, which provides an inert hard platform for the record; however additional mats can be used if so desired. The large 10mm main bearing employs a hardened steel shaft in a plain, high strength bronze bearing, and runs on a central thrust ball. A nonresonant friction-hinged cover is fitted to the traditional veneered plinth, and a full-sized arm board is fitted. In fact as very little plastic or metal is used in its construction, in material content the '55 might be regarded as closer to a musical instrument than a piece of audio engineering!

fact that no concessions have been made in important engineering aspects; even spectrum analysis of rumble failed to unearth any significant effects. Likewise the acoustic and vibration isoation were very good, although a low frequency platter rocking mode (not too serious) at about 50Hz prevented the use of X10 scaling for the disc impulse test, which otherwise gave a very good result.

Sound quality

The new sample acquired for retest in this issue gave substantially the same good performance. Reauditioning with a Misssion 774 tonearm, this year we felt that subjectively the performance was further improved by the use of a felt mat which appeared to reinforce the stereo imaging and give a better-defined bass. The overall effect was still slightly 'rounded' in terms of tonal balance, and consistently musical, while pitch and tempo were well preserved.

Conclusion

At around £150 this motor unit has fulfilled its original promise. The sound quality is high commendable at the price — and all significant aspects of its technical performance are to a respectable standard. It is worth trying it with a felt mat which has the additional advantage of being kinder to disc undersides, but as it stands the *CJ55* deserves a confident recommendation.

GENERAL DATA

Typebelt drive, subchassis
Platter damping
Finish and engineering
Type of mains/connecting leads
Speed optionsmanual change 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)0.11%/<0.05%
Absolute speed error + 0.2%
Speed drift, 1 hour/load variation
Start-up time to audible stabilisation
Rumble, DIN B wtd L/R average (see spectrum)76/78dB
Ease of usefairly good
Typical acoustic breakthrough and resonancesvery good
Subjective sound quality of complete system
Hum level/acoustic feedbackvery good/very good
Vibration sensivity/shock resistancevery good/fairly good
Estimated typical purchase price£149

Motor unit





Disc impulse transmission, standard X1.



Rumble (0-500Hz lin): above, electrical only; below, total.

Breakthrough (0–500Hz lin): above, acoustic; below, vibration.



Lab results

- The fine measured performance testified to the
- 67

Esoteric Marketing, 49 Leys Road, Pattishall, near Towcester, Northants Tel (0327) 830670



Firmly in the 'super-fi' class at close on £400, the Zeta arm is a UK-designed and manufactured product with a very business-like construction and exterior.

Zeta

Finished in satin black throughout, the arm comes packed in a handmade, hinged plywood case. A fixed headshell design, rigidity is its byword, with the massive construction clearly amplifying this concept. The entire pillar/base and gimbal support is machined from a solid block and likewise the oversize beam tube is a continuous structure, running right through the bearing assembly. The headshell is free of perforations aside from the cartridge fixing slots, representing an excellent mounting platform. As in the Sumiko, those few parts which are joined are thermally bonded, thus avoiding the variability of the adhesives normally-used.

The large counterweight consists of an aluminium shell containing a series of steel weights, these being selected in combination for the required counterbalance force, then locked in position. The whole assembly may then be locked on the rear arm beam section using large socket head screws and downforce must be set using an auxiliary gauge. An internal hair-spring bias compensator is fitted, integral to the pillar housing and controlled via small knurled wheel. Uncalibrated, this needs to be set by trial and error, using a tracking test record and via listening tests.

Geometrically, the offset is at 23.75 deg in order to bring the stylus tip into alignment with

the arm beam centre line and to reduce torsional excitation. Heavily gold-plated professional connectors are used for the arm cable which has fine phono plugs at the other extremity, these also gold plated. The cable was judged to be reasonably compliant and offered a low 100pF lead capacitance.

The gimbal bearings are set virtually to tightness and employed a large number of race balls on superfinished hardened surfaces. Effective mass approaches the 'heavy' category specially suited to low compliance, high performance moving coil cartridges.

Lab report

Estimated at 16g, the effective mass would ideally partner cartridges in the 7-14cu compliance range. The geometric accuracy was excellent, and the arm was superbly crafted and finished. Friction was satisfactorily low at 25mg in both planes, and when set to 'off', very little bias was developed. At the mid click position 200mg was noted, with 325mg at 'max' this is a very sensible control range. The cue worked well with sensibly chosen rates.

Charted for resonances, the start of the graph is low down due to the mass contribution; thereafter it is distinguished by a uniquely even energy trend. A few minor resonances are present, but do not significantly disturb the result. A trace of bearing play was noted with our sample but the designer indicated that this should be typical.

Sound quality

Immediately recognisable as a top-class product, the Zeta was most rewarding on audition. The bass was exceptionally good deep, powerful, tight and articulate. Tonal balance as slightly 'heavy' in a relaxed, unstrained fashion — full of depth, detail and sharp stereo focusing, while the treble was sweet and transparent with negligible blurring.

Conclusion

Here is another UK-built, front-rank audiophile product. Its constructional quality, finish and sound were all first rate and would satisfy the most discerning of purchasers, and while a high price must be paid for this, for many the results will justify the outlay.

GENERAL DATA

Arm Section
Approximate effective mass, inc screws, excl cartridge 16.0g
Type/mass of headshell
Geometric accuracyexcellent
Adjustments provided height/overhang/offset
Finish and engineering excellent/very good
Ease of assembly/setting-up/use
Friction, typical lateral/vertical
Bias compensation methodinternal spring
Bias force, rim/centre (set to click-stop position
200ma/200ma
Downforce calibration error, 1g/2guncalibrated
Cue drift, 8mm ascent/descentslight, 0.7 secs/1.9 secs
Arm resonancesvery good
Subjective sound qualityvery good
Lead capacitance/damping method 100pF/none
Estimated typical purchase price£399

Tonearm



Structural arm resonances, audio band



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CARTRIDGES

The hi-fi cartridge is a miracle of micro-engineering yet it is the one component in the hi-fi chain that is most commonly taken for granted. So often cartridges are ill-matched electrically or mechanically to amplifiers and tonearms, badly installed or just never maintained. It is even worth reminding readers in this introduction that a stylus is a disposable item and requires occasional replacement.

All cartridges work to convert the physical analogue of a musical event (the LP record) into an electrical signal by following the record groove with a stylus, and converting this movement through an electrical generator assembly. Cartridges are, like dynamos, motors in reverse; they may operate by moving a magnet near a coil, by moving a piece of magnetic material near a fixed magnet near a coil (which amounts to the same thing), or by moving a coil near a magnet. The mechanism of the generator is used to decribe the cartridge: in our example the first are magnetic cartridges, moving magnet and moving iron respectively, while the latter is a moving-coil type. The electrical properties of the different generators will differ and this is covered under Getting the best from your cartridge.

It is important toget a feeling for the truly small world in which the cartridge operates before you can respect the device for the remarkable job it does. Imagine that the V shape made by your hands when you put your wrists together is the crosssection of an LP groove. The stylus that tracks such a groove would be a scale 4ft diameter and 10ft high. The cantilever to which the stylus is attached would be about 9ft in diameter and the generator mechanism would be about 150ft away!

Design

Obviously the cantilever needs to be hinged and suspended to allow it to trace the modulations of the record groove. This makes it a compliant system, say like a spring; the interaction of the mass of the cartridge on the other side of the cantilever suspension, coupled with the mass of the arm which the cartridge 'sees', creates a 'spring' which resonates at a specific frequency. This is the fundamental arm/cartridge resonance and is required to be down below the music bass signals on a record, say 20Hz, but above the frequency of warps in the vinyl, say about 3 to 6 Hz, so that neither of these can 'excite the system into resonance. Designers often gofora 12Hz resonance or thereabouts. This is defined by the mass of the cartridge and the compliance of the cantilever suspension for a given arm mass. There is a graph that lets you work out what arms and cartridges work well together from this point of view included in the chapter Putting together a system.

The rigidity of the suspension also affects the ability of a cartridge to track small high frequency signals in the record; also the lower the mass of the moving parts the easier this job is. The catch here is that the smaller the parts, the more costly they are to pro duce; but this gives one indication of why some cartridges cost more than others.

The stereo signal is produced by two generator assemblies; these lie in the plane of the two walls of the stereo record groove, and are always at right angles to each other. The ability of a cartridge to keep the signal coming from the left wall separate from the signal from the right wall at all frequencies is known as its stereo separation. This is just one of the measurements made in our tests. The accuracy with which a cartridge is built and aligned by the manufacturer affects the separation figure. But just as important is that the cartridge is mounted in the tonearm square to the record to help it track the stereo groove to the best of its ability.

A flat frequency response (or at least one with gentle trends) is a prime requirement for a hi-fi cartridge. The goodness of a cartridge's frequency response is a measure of the best compromise between the various mechanical and electrical design considerations.

The stylus

The area of most rapid development in cartridge design over recent years has been in stylus profile. The basic problem here is that the cutter used to create the record groove is rather like a chisel; tracing this chisel-cut groove with anything other than another chisel must cause there to be lost information. Obviously you can't use a chisel-shaped replay stylus as records are designed to be played more than once — but you can get near to these conditions without jeopardising your vinyl treasures!

A true spherical tip has the one big advantage of being less than critical about how it's set up in the first place but its big rounded countour will miss out and skip over some high frequency information. So designers produced what was called an elliptical stylus (more correctly known as a bi-radialtip). Here the radius that contacts the groove wall is reduced to enable higher frequencies to be scanned. But because the area where the tip contacts the wall has decreased, the tracking weight has to be reduced too; this set off a downward spiral of ever lower tracking weights and ever higher compliances.

The glimmerings of a solution came from an unlikely source — CD4 quadrophony. The *Shibata* profile stylus had been specifically designed to read off the supersonic 'quad' information frequencies from a CD4 disc and so had a much reduced minor radius but a much longer contact area down the groove wall to avoid the tracking weight problems. The catch was that the stylus tip could drag in the dirt at the bottom of the groove or even bottom out there and reduce fidelity because of increased noise.

Developments were soon made, and more and more specialised grinds became available, which retained the long thin contact area but swept the tip up away from the groove bottom. These 'line contact' tips are nowadays used on nearly all of the top designs and go under a variety of names *Aliptic* (ADC), *Fine Line* (Ortofon), *Vital* (Supex), *Hypereliptic* (Shure). The latest of these grinds is the van den HuI profile as used on the Goldring G900/IGC cartridge.

Electricity

All amplifier disc inputs have particular characteristics in the load they present to the cartridge -- remember the cartridge acts like a dynamo and has to drive the input load. This load comprises a value of resistance, nominally 47kohm, plus some capacitance. The leads between the cartridge and amplifier themselves add some capacitance. The typical magnetic cartridge has not only a source resistance but an inductance brought about by the great lengths of thin wire coiled up in the generator which act like chokes. Put all this together and you get an electrical resonance rather like the mechanical resonance described earlier. This electrical resonance is found in the high frequency region, that part of the spectrum where a stylus/vinyl-spring mechanical resonance also occurs, rather than the very low frequency mass/compliance resonance.

Designers can use the electrical resonance of the cartridge/input interface either to minimise the mechanical HF resonance or to extend the flat response by counteracting suspension damping. While this was nearly always the case in the past, these resonant interactions can now be designed to occur in the cartridge's supersonic range but as usual this costs.

This leaves us with the problem that some cartridges are load sensitive and will change their frequency response when faced with certain electrical loads at the disc input. Others are impervious to loading. A rough average optimum is an input impedance of about 47 kohms with capacitance of about 150pF to 250pF. Any cartridge mentioned as requiring different loading from this in the tests may well benefit from 'phono equalisers', which can be used to change the disc input loading to achieve a flatter response.

Moving-coil cartridges have very low inductances and so tend not to suffer from these loading problems. The catch with this kind of cartridge is that they produce a lower voltage output, than magnetic types, and often require extra amplification from step-up devices. The moving-coil cartridge is an inherently flat device and can throw out supersonic signals far above the signals generated by a magnetic; this may mean that some pre-amps are in jeopardy of running out of headroom because they are having to handle these signals as well as audio frequencies.

Step-up or gain can either be achieved with a head-amp or preamp or through a transformer (though the latter has problems handling frequency extremes). Mismatched input impedance with moving-coils seems only to affect the output level rather than the quality or the frequency response, but this is a broad generalisation and source of endless hours of discussion among audiophiles.

What to choose

The simplest advice to give here is on what not to choose! Check the mechanical compatibility of your arm and the cartridge you intend to buy. Massy arms can't cope with high compliance cartridges on even slightly warped records. The mechanical behaviour of a cartridge is affected by the amount of internal self-damping; note from our tests which cartridges need additional damping at the arm pivot. If you can't damp your arm don't choose a cartridge that needs arm damping.

Lower compliance designs, which tend to be synonymous with movingcoil cartridges, do create a lot of 'needle-talk' vibration, and really require a rigid, quality to produce their best. A low compliance moving-coil in a flimsy low mass arm is unlikely to perform well.

While discussing moving-coils it is worth pointing out that the cost of a suitable step-up device may need to be taken into consideration from the outset, though many modern amplifiers now include these as part of the total package.

Getting the best from your Cartridge

Cartridge alignment becomes easier to understand if you stop to think of the problems faced by the tonearm. To start with, records are cut by a cutter head that travels a path along a radius of the finished disc. A pivoted arm can only move the cartridge and stylus along an arcthat approximates to the straight line radial path made by the cutter. Cartridge alignment is what gets that approximation as close as possible. With a correctly set up arm less than 0.6 per cent distortion (2nd harmonic) can be generated across the record from run-in to inner groove; an error of 1 mm or so in adjustment can triple that figure.

The end result should be minimum distortion across the whole playing surface of the record and this is not

quite the same thing as minimum tracking error, errors at certain points being worse from the distortion point ofviewthanthesameerroratanother place on the disc. Mathematical theory can show that the least distortion is created over the greatest part of the record when the arc of the pivoted tonearm crosses the imaginary path of the cutter at two points where the distortion will be zero. Most protractors show only the inner point and don't offer such accuracy as a true two-point protractor with zero distortion points at 63.5 and 119.5 from the centre of the record. A suitable protractor is provided in the chapter Putting together a system.

Not only should the stylus touch the radius at these two zero points but it should be aligned square to the radius. If the cartridge needs twisting to achieve this sobe it—the cartridge should lie square to lines drawn parallel to and at right angles to the radius at these points. The headshell may not be parallel at this point if the arm designer hasn't got the arm geometry spot on — which happens more often than it should.

The cartridge can now be checked for square from the front aspect, which is done most conveniently with a mirrored surface, squaring the cartridge and its reflection.

The angle at which the stylus meets the disc (as viewed from the side) is correctly called the Vertical Tracking Angle. The differing depths of car-tridgebodies means it is difficult to be certain of getting this angle right by adjusting the arm height (or packing the cartridge) until the arm comes parallel to the record surface. For easiertocheckforthebottomandtop of the cartridge being parallel to the record surface. Use ruled paper or graph paper behind the cartridge to check this. If adjustment is required lift or lower the arm pillar if this is possible, if not insert packing between the arm and cartridge but check the overhang measurement again afterwards and don't jeopardise a good bond between the arm and cartridge with flimsy packing pieces.

Tracking weight requirements for best tracking are covered in the individual reviews, but as a rule the best tracking is achieved towards the upper limit of the range quoted by the manufacturer. Arm bias can be set as per the manufacturer's instructions or better still with a test disc. If mistracking or breakup starts in the left channel then the arm is trying to swing outwards and the stylus is losing contact with the left (inner) wall of the record. This means that the arm is over-biased. Reduce the bias and check there is no mistracking at centre, inner and outer portions of the test disc. If right channel breakup is heard, increase the bias until the mistracking disappears completely (the bias is right), or is heard equally in both channels (the tracking weight can then be increased a little if it is not outside the manufacturer's range).

It is better to obtain secure tracking at a higher tracking weight than to use a lower tracking weight, mistakenly thinking that this may wear records less. Mistracking occurs when the stylus cannot follow the heavily modulated record groove and breaks away from the groove wall to rattle catastrophically down the groove. Mistracking does more damage to records than an extra ½ gram downforce.

Maintenance

Record cleaning devices proliferate and there are few in which Choice has full confidence in recommending. The remark 'the best record cleaner is your stylus' is too often greeted with derisive laughter, but we are back to the problem of dimensions. many record clearners act as though you were trying to get the moss out of a row of gutters with a bunch of telegraph poles. (Not easy!) The stylus will remove micro dust from the grooves and requires periodic brushing to keep it clean. Lubricants present on records (metallic soaps) and vinyl itself can build up on the stylus - the stiff bristle Discwasher tip · brush and cleaning fluid with vinyl solvents can be recommended for the audiophile. Other users could make a cheap domestic alternative with a trimmed camel hair brush and a little bottle of vodka. Fluids should not however be allowed to wash around the stylus assembly as they can damage or age the suspension rubbers.

Periodic electrical maintenance can be recommended too. Once a year or so the pickup connections should be pulled apart and remade to ensure an electrically sound contact through mechanical wiping. This applies particularly to low output moving coils.

Stylus life

By the time you hear it you're too late! Microscopic examination by an experienced eye can detect the first signs of wear, but this help is hard to find. For the hyper-criticial listener using a quality elliptical tip, 400 hours would be the time to check for tip wear. Line-contact styliseem to keep better. Moderate use at the rate of 6 albums a week suggests a life of 18 months. Remember to budget for stylus replacement.

Other models worth considering

In view of the 'musical chairs' situation between many product ranges and distributors over the past year there are many bargains to be had from deleted ranges and from old stock. The principle bargains would include the ADC QLM34 III, ADC VLM III Imp and ADC XLM III, along with models in the Ortofon LM range.

Old favourites like the **B&O MMC2OCL** and the **Dynavector 10XII** have been discontinued in favour of new models. Cartridges covered in the last issue in summary review form and which are certainly worth considering include the **Nagaoka MP20** (£37) and **Nagaoka MP50** (£75) and the Hyper-elliptical stylus fitted version of the **Shure V15 III** (£63). The HE stylus could be considered a suitable upgrade for V15III users as the stylus gives the cartridge a new lease of life with excellent tracking and neutral sound balance.



Up ^{hill} and down dale...

In Utopia records may be concentric and flatbut they seldom are in reality.

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C Phase IV

Harman Audio UK Ltd, Mill Street, Slough, Berks, SL2 5DD Tel (0753) 76911



An inexpensive moving magnet cartridge. the Phase II is a sort of marriage of the QLM 34 and '36 models, suited to higher tracking forces and moderate quality arms. Its lowish compliance endowed it with good arm compatibility and damping was not strictly necessary. A cheap pseudo-elliptical stylus was fitted, possessing just adequate polish in fact, in our view ADC would have done better to fit a good quality spherical tip here.

With a smooth characteristic, the frequency response tilted gently downhill - giving a Replacement stylus cost inc. VAT 'rounded' effect in the treble. Separation was just satisfactory, but the vertical tracking angle was close on 28° which is rather high. Distortion was quite good except at the highest frequencies, where even at a 2g downforce both the 10kHz pulsed and 20kHz noise tracks gave trouble. Otherwise trackability was fine at mid and low frequencies.

Scoring a little above average on sound quality, which is fine in view of its low price, the II showed a lack of treble precision in its splashy slurring of sibilants and cymbal transients. Tonally, it was quite well balanced and seemed pretty secure in the grooves and fine detail was presented although stereo Frequency response, rel output and separation ref OdB depth was flatter than usual. These criticisms (1mV/cm/sec) aside, the general performance and sound were sufficient at the price for Best Buy status.

Cartridge type and weightinduced magnet, 5.75g Estimated dynamic compliance at 10Hz $14cu(\times 10^{-6}cm/dyne)$ Specified downforce: 1.5 to 2.5gtested at 2.0g I E resonance in test arm (Mission 774, 5.5g me + cart) + 11.5dB at 12Hz Subjective sound qualityaverage plus

ADC Phase

Tel (0753) 76911

Harman Audio UK Ltd, Mill Street, Slough, Berks. SL2 5DD

Recommended loading: 47kohms plus 275pFtested a	t 250 pF
Recommended arm mass	6-180
Recommended arm damping	argina
Cartridge coil resistance/inductance	/580mH
Induced hum level	ry good
Stylus type	mount
spec 10	x 18µm
Finish and alignment just adequate polish, good alig	Inment
50° 000	o o o o la

Tip geometry 10 x 20µm, pseudo-elliptica
HF resonance (tip mass/vinyl)estimated at 24KH
Frequency response, wideband (30Hz-20kHz) + 1dB, - 2.5d
Frequency response, midband (100Hz-5kHz) . + 0.5dB, - 1.2dl
Stereo separation, 100Hz, 1kHz, 10kHz 19dB, 21dB, 21dB
Channel difference, 1kHz, 10kHz 0.2dB, 0.2dB
Trackability, 300Hz vertical + 12dB1.2
Trackability, 300Hz lateral + 15dB 1.6
Trackability, 300Hz lateral + 18dB ('Supertrack') 2.0
Distortion, 300Hz vertical + 6dB
Distortion, 300Hz lateral + 9dB
High frequency waveform quality fairly good
Midband intermodulation (1kHz + 1.5kHz 24cm/sec) 3.0%
HF intermodulation (pulsed 10kHz, 24cm/sec peak)1.5%
Pink noise intermodulation.

Typical price (inc. VAT)£20 when reviewed, now £25 dealer will quote

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1kHz squarewave (ignore ultrasonic cutter ringing)



Stepping into the XLM's shoes, the Phase IV is a medium-priced model from ADC's new range. which externally at least do not appear markedly different from the old. The stylus fitted was a naked elliptical diamond specified, and measured by us, at $8 \times 18 \mu m$ which is larger than optimum in the minor radius. Finish and alignment were reasonably good, though the shape would have benefited from more care taken with the elliptical 'blending' process. Possessing moderate compliance, it suited low-to-medium mass arms and the need for arm damping was marginal.

Measured with 250pF loading the response met very tight limits in the central frequency range but overall it showed a droopy treble falling by 5dB at 20kHz, referenced to 200Hz. Stereo separation was exceptionally good, as was trackability, while distortions over all the tests were within bounds. The design was wellbehaved as regards all the major technical aspects.

On audition the loss of treble was noted, the output in this region also on occasion a trifle forward and grainy, but definition was promising in the bass-mid with guite good representation of stereo depth. The midrange showed a trace of veiling which detracted from the detail and immediacy present on some programme excerpts, but overall a 'good' rating was achieved, just sufficient for Best Buy status at the price.

Cartridge type and weightinduced manget, 5.75g stimated dynamic compliance at 10Hz 24cu(×10 ⁻⁶ cm/dyne) specified downforce: 1.0 to 1.4gtested at 1.3g E resonance in test arm
(Mission 774, 5.5g me + cart) + 11.5dB at 9.5Hz
Sensitivity at 1kHz
subjective sound quality
lecommended loading: 47k ohms plus 275pF . tested at 250pF
Recommended arm mass3-10g
Recommended arm dampingmarginal
artridge coll resistance/inductance 820 onms/580 m H
itylus type detachable, naked, oriented, elliptical, 5 x 18µm
inish and alignment fairly good finish and alignment,
50° cone angle
ip geometry
IF resonance(tip mass/vinvl) estimated at 35kHz
requency response, wideband (30Hz-20kHz) + 1dB, - 4dB
requency response, midband (100Hz-5kHz) . + 0.8dB, - 0.8dB
tereo separation, 100Hz, 1kHz, 10kHz 31dB, 39dB, 29dB
rackability 300Hz vertical + 12dB
rackability, 300Hz lateral + 15dB
rackability, 300Hz lateral + 18dB ('Supertrack')
listortion, 300Hz vertical + 6dB , , ,
ligh frequency waveform quality
lidband intermodulation (1kHz + 1.5kHz 24cm/sec)3.6%
Fintermodulation (nulsed 10kHz 24cm/sec neak) 1.0%

Pink noise intermodulation. 12kHz. 16kHz, 20kHz.1.8%.3.9%.5.5% 43 when reviewed, now £45 Typical price (inc. VAT) Replacement stylus cost inc. VAT dealer will quote



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

ADC MC 1.5

Harman Audio UK Ltd. Mill Street, Slough, Berks, SL2 5DD Tel (0753) 76911



Built in Japan to ADC's exclusive specification, the MC1.5 is a low-output moving-coil cartridge possessing a higher than average coil inductance and resistance. Active step up units are thus best suited - for example, a 470 ohms plus 10nF input. By moving-coil standards it is compliant, suiting low mass arms without extra damping as its internal damping was already rather high. A top-quality naked elliptical stone is fitted to the titanium tube cantilever.

Minor deviations were shown in the response, which demonstrated an excellent channel balance. A slight sag of 1.5dB was measured in the 2-4kHz 'presence' range, while fine stereo separation was evident throughout the range. A slight increase in downforce to 1.8g was required to negotiate the 'Supertrack' cut, but in general the trackability and distortion results were to a high standard and were well balanced. Vertical generator linearity was particularly good despite a slightly high vertical angle estimated at 28°.

A very low tip mass was shown, with a tip mass resonance estimated at 53kHz, and the fast squarewave risetime confirmed this, as did the clear but unexaggerated portrayal of the record ringing abberation.

On the listening tests the MC1.5 achieved a respectable score, sufficient for recommendation regardless of price, and was marked well ahead of the Astrion, thereby joining the small and select group of top-ranked performers. The panel noted mild response uneveness and a trace of mid-hardness or coarseness, with some treble 'steeliness', plus a bass register lacking in ultimate control. But conversely the stereo was stable and deep, while the resolution of musical detail was most encouraging.

Update

1 In-line 2000hm phono loading plugs are now provided.

Cartridge type and weightlow output moving coil, 5.0g Estimated dynamic compliance at 10Hz $33cu(\times 10^{-6}cm/dyne)$ Specified downforce: 1.2 to 1.8gtested at 1.6g LF resonance in test arm (Mission 774, 5.5g me + cart) + 6dB at 9.0Hz

Subjective sound quality very good
Recommended loading: 200-1K ohms plus 100-1000 pF.
tested at 250 pF
Person monded arm mass
Recommended annihass
Recommended arm damping none required
Cartridge coil resistance/inductance
Induced hum level
Stylus type fixed oriented naked elliptical spec 5 x 18 m
Einich and alignment both yory good 55° appa angle
Finish and any intent
lip geometry
HF resonance (tip mass/vinyl)
Frequency response, wideband (30Hz-20kHz) + 2dB 0.3dB
Frequency response midband $(100Hz-5kHz)$ + 1dB - 0.3dB
Stereo separation 100Hz 1kHz 10kHz 28dB 32dB 27dB
Chapped difference 1kHz 10kHz
Trackability, 300Hz vertical + 120B
Irackability, 300Hz lateral + 15dB1.1g
Trackability, 300Hz lateral + 18dB ('Supertrack')
Distortion, 300Hz vertical + 6dB
Distortion 300Hz lateral + 9dB 0.5%
High frequency waveform quality
Midbard intermedulation (1/LHz + 1 5/LHz 24em/acc)
Midband internodulation (TKHZ + 1.5KHZ 24cm/sec)2.0%
HF Intermodulation (pulsed 10kHz, 24cm/sec peak)1.0%
Pink noise intermodulation,
12kHz, 16kHz, 20kHz
Typical selling price inc VAT £149
People company stylus cost inc VAT apply to distributor



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



This Japanese made cartridge is one of three models specified and commissioned by A&R of Cambridge. The modest mass and equally modest compliance of 23cu, together with a marginal need for damping, should provide compatibility with a useful range of effective arm masses ranging from 3 to 12g. An unusually good, UK-sourced stylus was fitted comprising a square shanked, low mas line contact 'Profiled' tip.

The frequency response was commendably flat, showing a mild droop at higher frequencies; 300-400pF loading was found to give a good result. Although uniform over the frequency range, the channel separation was nonetheless disguieting, measuring only 21dB in the midband. However A&R state that recent production is improved in this area. Distortions were well controlled, except for the mild intermodulation section where mistracking was beginning. The Supertrack itself required a 2.8g downforce, and one could expect that the '77 would occasionally be caught out on programmes at the usual setting of 1.8g. The squarewave response was quite clean, with only a mild overshoot and rounding.

Ranked as good on overall sound quality, the '77 was described as possessing a slightly dull and smooth character. Surface noise and disc distortions were kindly handled, and the reproduction was quite detailed, but the stereo presentation was noticeably two dimensional. with depth comparatively restricted.

In conclusion this model represented quite good value, with a pleasant overall character. A well-balanced lab and subjective performance and very fine stylus tip as well as a sensible compliance and electrical matching requirement should enable it to be matched to a wide range of amplifier/turntable combinations. This design can thus be recommended. Closed mounting lugs are now provided while there have been improvements in the generator which it is claimed will improve crosstalk figures from those shown here.

Califidge type and mass
Estimated dynamic compliance at 10Hz 23cu(× 10 - °cm/dyne)
Specified downforce: range 1.5g to 2.0g tested at 1.8g
LF resonance in test arm
(SME 111, 6g me + cart)+ 10dB at 10Hz
Sensitivity at 1kHz0.75mV/cm/sec
Relative output (0dB = 1mV/cm/sec) 2.5dB
Subjective sound quality good
Recommended loading
Recommended arm mass3-12g
Recommended arm dampingoptional
Induced hum level
Stylus type and spec detachable naked oriented 'Profiled',
spec 6-8 × 50µm
Finish and alignmentboth excellent
Tip geometry, essentially of stereohedron form, $8 \times \text{line } \mu \text{m}$
HF resonance (tip mass/vinyl)above 30kHz
Frequency response 30Hz-20kHz+ 1, – 1.5dB
Frequency response 100Hz-5kHz±1.0dB
Stereo separation, 100Hz, 1kHz, 10kHz 18dB, 21dB, 18dB
Channel difference at 1kHz, 10kHz0dB, 0./dB
Trackability 300Hz lateral ±15dB,1.5g
Trackability 300Hz vertical ±12dB1.2g
Trackability 300Hz lateral + 18dB ('Supertrack')2.8g
Distortion 300Hz lateral + 9dB0.4%
Distortion 300Hz vertical + 6dB2.6%
High frequency waveform quality
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec) 3.2%
HF intermodulation, pulsed 10kHz, 24cm/sec peak0.3%
Pink Noise intermodulation,
12kHz, 16kHz, 20kHz0.72%, 1.2%, 6.4%
Typical selling price inc VAT
Replacement stylus cost inc VAT

o



Frequency response, rel output and separation ref OdB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



Audio-Technica AT33E

Audio-Technica UK Ltd, Hunslet Trading Estate, Low Road, Leeds Tel (0532) 771441



The earlier AT32E was not received with particular favour but this new model, with gold-vaporised tapered beryllium cantilever, offers a great improvement, albeit at a higher cost. A moderate-compliance, low-output moving coil, it was fitted with a superb naked elliptical stylus of fine minor or scanning radius, with a low tip-mass.

Two samples were tried, the second significantly improving on the first's moderate stereo values. The frequency response showed slight anomalies, namely a slight presence suckout plus a treble bump at 11kHz, but in the midband $\pm 1dB$ limits were met, while channel balance and stereo separation were both good. Tested at a 1.6g downforce, the trackability was exemplary and the *AT33E* sailed through all tests without fuss. Distortion was particularly good with close conformity to the ideal 20° vertical tracking angle.

Scoring an impressive 'very good' in audition, the *AT33E* added a slight 'bite' or 'glare' to the treble emphasising the upper harmonics of a saxophone, for example. Bass was clear and well differentiated, surface noise pretty good and stable, with precise stereo exhibiting good depth. The midrange was transparent as well as clean, and comments were in fact made by the panel concerning the low subjective distortion, in agreement with the lab findings.

Arguably the best Audio-Technica cartridge so far to appear in *Hi-Fi Choice*, the *AT33E* is well worth auditioning and is confidently recommended. Cartridge type and weightlow output moving coil, 6.8g Estimated dynamic compliance at 10Hz 19cu(x 10 - ° cm/dyne) Specified downforce: 1.2 to 1.8gtested at 1.6g LF resonance in test arm

LF resonance in test ann
(Mission 774, 5.5g me + cart) + 15dB at 10Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec) 18.8dE
Subjective sound quality very good
Becommended loading 30-500 ohms
Recommended arm mass 4-120
Recommended arm damning would be beinfu
Cartridge coil resistance/inductance 17 obms/70
Stylus type fixed criented paked elliptical and 5 x 19 m
Finish and alignment both very good 50° concerned
Times and any ment
Tip geometry
excellent fillist
HF resonance (tip mass/vinyi)
Frequency response, wideband (30Hz-20KHz) + 3dB, - 1dE
Frequency response, midband (100Hz-5kHz) + 1dB, - 1dE
Stereo separation, 100Hz, 1kHz, 10kHz 23dB, 26dB, 24dB
Channel difference, 1kHz, 10kHz
Trackability, 300Hz vertical + 12dB0.9g
Trackability, 300Hz lateral + 15dB 1.3g
Trackability, 300Hz lateral + 18dB ('Supertrack') 1.5g
Distortion, 300Hz vertical + 6dB1.4%
Distortion, 300Hz lateral + 9dB0.14%
I line for an an an an an an an all the second se

*25dB, 30dB, 30dB second sample



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Audio-Technica AT31E

Audio-Technica UK Ltd, Hunslet Trading Estate, Low Road, Leeds Tel (0532) 771441



This neat and low-mass moving-coil cartridge has a detachable stylus assembly. The tapered aluminium cantilever carries a fine-quality naked orientated elliptical stone $6.5 \times 20\mu m$, with a 55° cone angle and good alignment.

With some channel imbalance, the channel separation was nonetheless very good, averaging 33dB even at 10kHz. Smooth at high frequencies, the output fell gently from 50Hz to 5kHz, giving a slightly 'rich' balance, while the tip-mass resonance was a high 48kHz – this is clearly shown by the exaggerated cutter ringing in the squarewave response, although the overshoot itself was well controlled. The *AT31E* provided low distortion throughout with typical good vertical linearity and an accurate 20° vertical tracking angle. Trackability was itself very good, the 'Supertrack' passed at just 0.1g above the test 1.6g downforce.

Auditioning placed this cartridge in the 'very good' category – a great result for the price. Sounding slightly rich, with a tonally rounded mid balance, the stereo image demonstrated fine detail, good depth and instrumental perspective, with definition maintained throughout the frequency range. Compared with the finest examples, a slight blurring and loss of transparency was evident but the overall effect was notably relaxed and well balanced. Audio-Technica clearly have a winner in the medium price bracket with the '31E, which is immeasurably better than its predecessor the AT30E.

contracting and weight	n Jy
Estimated dynamic compliance at 10Hz 22cu(× 10 ⁻ °cm/c	lyne
Specified downforce: 1.2 to 1.8gtested at	1.6g
F resonance in test arm	
(Mission 774, 5.5g me + cart) + 13dB at 10	.5Hz
Sensitivity at 1kHz	/sec
Relative output (0dB = 1mV/cm/sec)	23dB
Subjective sound quality service sources and sources of the source of the sources of the s	jood
Recommended loading	hms
Recommended arm mass	-12g
Recommended arm dampinghe	lpful
Cartridge coil resistance/inductance	ÓμΗ
nduced hum level	jood
Stylus typedetachable, oriented, naked, ellipt	ical,
spec 8x 1	8µm
inish and alignment	ood,
ip geometry 6.5μm x 8μm, elliptical, good shape, 55° o	cone
HF resonance (tip mass/vinyl)	3kHz
requency response, wideband (30Hz-20kHz) + 1.2dB, -1.	2dB
requency response, midband (100Hz-5kHz) + 1.2dB, -1.	2dB
Stereo separation, 100Hz, 1kHz, 10kHz27dB, 35dB, 3	3dB
Channel difference, 1kHz, 10kHz	.4dB
rackability, 300Hz vertical + 12dB	1.0g
rackability, 300Hz lateral + 15dB	1.4ğ
rackability, 300Hz lateral + 18dB ('Supertrack')	1.7g
Distortion, 300Hz vertical + 6dB	.7%
Distortion, 300Hz lateral + 9dB0	.2%
ligh frequency waveform quality	. fair
/idband intermodulation (1kHz + 1.5kHz 24cm/sec) 3	.0%
IF intermodulation (pulsed 10kHz, 24cm/sec peak)0	.6%
Pink noise intermodulation,	
12kHz, 16kHz, 20kHz,	6%

low output moving coil 5

artridae type and weight

Typical price (inc VAT)......£56 when reviewed, now £49 Replacement stylus cost inc VAT.....£32.84



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Videotone Ltd, 98 Crofton Park Road, London SE4



This budget high-output moving coil cartridge is a direct sale item, available primarily by post from the distributors, but also stocked by a limited number of dealers. Care must be taken when removing it from the awkward packaging so as not to bend the cantilever (as we did!).

The stylus was of the shank mounted variety but was surprisingly good at the price, and contributed substantially to the performance. Compliance was fairly high, indicating the use of low-mass arms for the best results. For what it's worth, the response extended smoothly to 50kHz, reflected in the fast squarewave with the cutter ringing clearly exposed.

Frequency response in the audio band was commendably flat with fine channel balance and quite good channel separation. Lateral distortion was a trifle high but distortions were kept within reasonable bounds on other tests, and the trackability was sufficient for the vast majority of modern records. Vertical linearity was above average, with the vertical tracking angle only a couple of degrees above target.

Ranked a little above average on audition – which is good for the price – the bass and midrange were presentable with stable imaging and moderate depth. The treble however represented an area of weakness, occasionally sounding strident, grainy and insecure, but surface noise was reasonably quiet. This cartridge has a lot going for it at the price, and carries our recommendation.

Cartridge type and weighthigh output moving coil 5g Estimated dynamic compliance at 10Hz 29cu(x 10⁻⁶ cm/dyne) Specified downforce: 1.8 to 2.2gtested at 2.0g LF resonance in test arm

(Missic ~ 774, 5.5g me + cart) + 9dB at 9Hz
Sensitiv at 1kHz0.55mV/cm/sec
Relative output (0dB = 1mV/cm/sec) 5.5dB
Subjective sound qualityaverage plus
Becommended loading 47kohms
Becommended armmass 4-80
Recommended arm damping none required
Cartridge coil resistance 110 ohms
Induced hum level and
Stylus type fixed shank-mount elliptical spec 8 x 18um
Finish and alignment both good particularly at the price
Tin geometry 8 x 18 m good shape properly blended elliptical
HE resonance (tin mass/vinvil) (8kHz (+ 3dB)
Frequency response wideband $(30Hz_20kHz) + 1dB = 0.6dB$
Frequency response, midband $(100Hz - 5kHz)$ + 1dB, - 0.6dB
Storeg congration 100Hz 1kHz 10kHz 26dB 22dB
Chapped difference 1kHz 10kHz
Trackability 200Hzyortical + 12dP
Trackability 200Hz lateral + 15dP
Trackability, 300Hz lateral + 19dB
Distortion 200Haustical + 6dB
Distortion, 300Hz vertical + 0dB
High frequency waveform quality
Middand Intermodulation (IKHZ + 1.5KHZ 24cm/sec) 3.0%
HF intermodulation (pulsed 10kHz, 24cm/sec peak)1.2%
Pink noise intermodulation,
12KHZ, 16KHZ, 20KHZ
Typical selling price inc VAT
Replacement stylus cost inc val£16.50



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Denon 303

Hayden Laboratories Ltd, Churchfield Road, Chalfont St Peter, Bucks SL9 9EW Tel Gerrards Cross 88447



The 303 is a notable member of a new and costly group of moving-coil cartridges. A relatively low mass model at 5.8g, it has unnecessarily high compliance of 44cu, resulting in a recommendation for use with low mass damped arms only.

However it did produce a healthy output for a moving-coil, though still requiring a step-up device, while hum rejection was not particularly good. Tested at the recommended downforce - rather low for a m-c design - it provided exceptional trackability and distortion results on all tests, while the frequency response was virtually flat with excellent channel balance and fine geometric symmetry. The HF resonance was well out of band at 40kHz, allowing harmless display of the recorded cutter ringing on the good squarewave response. The special stylus turned out to be an excellently finished and well-mounted 1/2-chip oriented stone with well-swept radii of line contact form.

On sound quality it just achieved the 'very good, category, and was liked for its exceptional stereo imaging and tracking ability, while both surface noise and distortion were kindly handled. Most panelists agreed on its virtues, but for reasons not entirely understood and possibly to do with the high compliance in combination with our test arm, they did express mild reservations concerning a touch of 'vagueness' and occasional lack of firmness and definition, coupled with a tonal balance which seemed a trifle recessed in the lower treble, but slightly forward higher up.

This good but costly cartridge was fussy about the choice of arm, needs a higher than average step-up impedance, and when all is said and done cannot be regarded as very good value. It will however be kind to your record collection, and does set a generally high performance standard.

Cartridge type and ma	asslowo	utput moving c	oil, 5.80
Estimated dynamic co	ompliance at 10Hz	44cu(x 10 - 6c	m/dyne
Specified downforce:	range 1.0g to 1.4g	,teste	1 at 1.3c
LF resonance in test	arm		
CME 111 Came	0.0 **)	10dD	

(SME III, 6g me + cart) + 100B at 7.6Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec) (-24dB alone) + 2dB*
Subjective sound quality very good
Recommended loading 100-150 ohms plus uncritical pF
Recommended arm massless than 5g
Recommended arm damping moderate damping essential
Cartridge coil resistance/inductance 40 ohms, negligible mH
Induced hum level
Stylus type and spec fixed, naked, oriented, line
Finish and alignmentexcellent finish, fine alignment
Tip geometry properly swept radii line contact, $8 \times \text{line}_{\mu}$ m
HF resonance(tip mass/vinyl)+8dBat40kHz
Frequency response 30Hz-20kHz – 0.5, + 1.5dB
Frequency response 100Hz-5kHz
Stereo separation, 100Hz, 1kHz, 10kHz 28dB, 39dB, 26dB
Channel difference at 1kHz, 10kHz0.3dB, 0.2dB
Irackability 300Hz lateral ±15dB,0.85g
Trackability 300Hz vertical ± 12dB
Trackability 300Hz lateral + 18dB ('Supertrack')1.2g
Distortion 300Hz lateral + 9dB 0.25%
Distortion 300Hz vertical + 6dB 1.45%
High frequency waveform quality fair
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec) 1.4%
HF intermodulation, pulsed 10kHz, 24cm/sec peak0.15%
PINK Noise intermodulation,
12KHZ, 16KHZ, 20KHZ

12kHz, 16kHz, 20kHz.£160 when reviewed, now £145 Replacement stylus cost inc VAT£160 when reviewed, now £145 * assuming 26dB step up



Frequency response, rel. output, and separation ref 0dB (1mv/cm/sec)



1kHz squarewave, (ignore ultrasonic cutter ringing)

Tel 01-549 7645



Replacement for the famous 20A, this mark two version sports a lower mass reinforced plastic body with an elliptical rather than Shibata tip. Output has been increased to a remarkable (for a moving-coil) 0.9mV, and no matching problems should occur with any preamplifier. Compliance is however high, and although damping is not required, low to medium mass arms are, 10g being the ideal maximum. The naked diamond stylus was well polished and aligned, possessing a pseudoelliptical grind but with over-polishing to provide blended elliptical radii of $8 \times 29 \mu m$.

The well-damped overshoot and flat-topped squarewave confirmed the good transient behaviour and essentially flat frequency response (ignore the cutter ringing). Separation was fairly good and channel balance fine, while at close to the test 1.8g downforce it tracked almost everything bar the mid intermodulation section, which was significantly broken up. The distortion results were also good, with the exception of the lateral value which was high at 1%.

A commendable 'good plus' was achieved by this cartridge after all the panel's listening test data had been analysed. Sounding almost as flat as it had measured, the reproduction was well integrated. Generally guite stable, the stereo presentation was precise with reasonable depth, and the sound was generally transparent with a good presentation of detail. Occasionally a slight sharpness was evident - on strings for example - but it proved guite kind to surface noise and disc distortion, much more so than its predecessor.

The 20All is sufficiently advanced over the original 20A to maintain its market position, despite the higher standards dictated by the improved level of performance of the new generation of cartridges. A versatile moving-coil design, it merits recommendation and should work well with many systems, without the added complication of a high gain input or head amplifier. Incidentally the 20BII is similar *1kHz squarewave*, (ignore ultrasonic cutter ringing)

but with a berylium cantilever, and in listening tests ranked a little below the 20All.

Cartridge type and mass.....high output moving coil, 5.3g Estimated dynamic compliance at 10Hz $27cu(\times 10^{-6}cm/dyne)$ Specified downforce: range 1.6g to 2.3g tested at 1.8g LF resonance in test arm

(SME 111, 6g me + cart) + 7dB at 9.5Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec)
Subjective sound quality good plus
Recommended loading
Recommended arm mass 4-10g
Recommended arm dampingnot needed
Cartridge coil resistance/inductance
Induced hum level
Stylus type and spec fixed, naked, oriented, elliptical,
spec 8 x 18µm
Finish and alignmentboth very good
Tip geometry blended pseudo-elliptical,
effective contact 8 × 20µm
HF resonance (tip mass/vinyl)approx + 3dB at 28kHz

Frequency response 30Hz-20kHz±1.0dE
Frequency response 100Hz-5kHz+0.6dE
Stereo separation, 100Hz, 1kHz, 10kHz 20dB, 26d 3, 20dE
Channel difference at 1kHz, 10kHz0.3dL, 0.2dE
Trackability 300Hz lateral ±15dB1.6c
Trackability 300Hz vertical ±12dB1.20
Trackability 300Hz lateral + 18dB ('Supertrack') 2.00
Distortion 300Hz lateral + 9dB 1.0%
Distortion 300Hz vertical + 6dB 2.0%
High frequency waveform quality fairly good
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)4%
HF intermodulation, pulsed 10kHz, 24cm/sec peak 0.25%
Pink Noise intermodulation,

Typical price (inc VAT) .. . £123 when reviewed, now £130 Cartridge part exch. thro distrib £79.35



Frequency response, rel. output, and separation ref 0dB (1mv/cm/sec)



Dynavector DV23R 'Ruby'

Dynavector Systems UK Ltd, 52 Park Road, Kingston KT2 6AU Tél 01-549 7645



Quality control problems with early 'Rubies' gave rise to some cause for concern in the previous issue, but these are now happily resolved. The 23R employs a short 2.3mm long sapphire (ruby) cantilever with a line contact stylus, though our consultant's report described a form nearer to the elliptical. possessing excellent shape and finish, and measuring $6.4 \times 20 \mu m$. Alignment was however disappointing on our first sample, with a serious 5° error, although this is not typical of Dynavector's generally high standards.

As usual the cartridge returned a highly linear response with excellent balance and very good separation maintained over the whole frequency range. Compliance was moderate at 19cu, offering wide arm compatibility, strictly speaking damping was not necessary. Tip mass was clearly low, being estimated from 1005 disc at 45kHz, while the squarewave trace confirmed the wide bandwidth and -a uniform audible response. Trackability was undoubtedly good with only slight trouble on the most taxing of bands, and distortion was also well controlled throughout. The high level vertical linearity was fine - vastly better than the much more costly 17D — and a better stylus alignment would provide a further improvement as regards noise and distortion results.

Auditioning the first sample gave a 'very good' ranking, and checking a second and correctly-aligned model gave a marginal improvement as regards treble sweetness. The stereo stage possessed good depth with stable imaging and good musical detail, while tonally the sound was open, neutral and generally very clean. Just a hint of treble slurring was present, where the high frequencies then appeared a trifle forward. The 23R is now clearly a very fine cartridge and, setting aside the alignment problems on our sample, is well worth a recommendation.

Cartridge type and weight . Estimated dynamic complia Specified downforce: 1.2 to L E resonance in test arm	low output moving coil, 5.3g ance at 10Hz 19cu(×10-°cm/dyne) 1.8gtested at 1.6g
(Mission 774, 5.5g me + c	art) + 11dB at 11Hz
Sensitivity at 1kHz	0.05mV/cm/sec
Relative output (0dB = 1mV)	/cm/sec) – 25.6dB
Subjective sound quality	very good
Recommended loading	
Recommended arm mass.	
Recommended arm dampin	gmarginal
Cartridge coil resistance/in	ductance
	fined animated ashed line anatom
Stylus type	fixed, oriented, naked, line contact
Finish and alignment	very good finish, poor alignment,
Tip geometry 6 4 x 20m	55 COne angle
HE reconance (tip mass/vip)	d d d d d d d d d d
Frequency response wideb	and $(30Hz-20kHz) + 1.8dB_{-} = 0.1dB_{-}$
	and (concentration of the concentration of the conc

	alou formill (1 fub)
Frequency response, wideband (30Hz-20kHz) + 1.8dB, - 0.1dB
Frequency response, midband (100Hz-5kHz)	. + 0.1dB, - 0.1dB
Stereo separation, 100Hz, 1kHz, 10kHz	.31dB, 35dB, 26dB
Channel difference, 1kHz, 10kHz	0.1dB, 0.3dB
Trackability, 300Hz vertical + 12dB	
Trackability, 300Hz lateral + 15dB	1. 1ğ
Trackability, 300Hz lateral + 18dB ('Supertra	ıck')
Distortion, 300Hz vertical + 6dB	1.8%
Distortion, 300Hz lateral + 9dB	
High frequency waveform quality	
Midband intermodulation (1kHz + 1.5kHz 24c	cm/sec)
HF intermodulation (pulsed 10kHz, 24cm/sec	c peak)1.0%
Pink noise intermodulation.	
	1 0 0 / 0 4 0 / 0 0 0 /

12kHz, 16kHz, 20kHz.....1.8%, 3.4%, 6.0% Typical price (inc VAT) £150 when reviewed, now £160 Cartridge part exch. thro distrib . £93 15



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

80

Fidelity Research FR101SE

Wilmex Ltd, Compton House, New Malden, Surrey KT3 4DE Tel 01-949 2545



Only recently available the '101 is a moving magnet type cartridge possessing a medium compliance and suited to arms in the 4-12g range, and damping could be helpful with the heavier examples. Tested at a 1.8g downforce, the cartridge tracked simple mid-frequency tones well but gave trouble on the complex intermodulation tracks as well as on the high frequency tests. Here results were below average, possibly a consequence of the marginal stylus quality. The sample we measured showed asymmetry of the major radius with respect to left and right groove walls, and the polish was not up to typical Japanese standards. Tip mass was not particularly low, as the 23kHz resonance indicated, and this accounting for the 'slow' ringing on the otherwise good squarewave response.

Ignoring the chart fault, the frequency response was smooth to 10kHz with good balance, above which a rise of 3dB occurred. Potentially promising, the imbalance of left-on-right versus right-on-left separation was disturbing, while the vertical tracking angle was excessive at some 33°. Low-frequency distortion levels were however quite reasonable.

Auditioning placed the '101 in the 'good' category which qualified it for a reserved recommendation, as I would like to see better stylus quality at this price level. The reproduction often hinted at great quality but was marred by sibilance and emphasised surface noise.

Cartridge type and weightmoving magnet; 6.0g Estimated dynamic compliance at 10Hz 22cu(x 10 -6 m/dyne) Specified downforce: 1.5 to 2gtested at 1.8g

* Severely mistracked



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Empire 200E

Harman Audio UK Ltd, Mill Street, Slough, Berks. SL2 5DD Tel (0753) 76911



Specified for 2-4g tracking, this robust looking model was used at 2.50 for our tests. A 8 x 18µm shank-mounted elliptical stylus was specified in Empire's literature, but we found the stylus to be of poor quality - in common with previous Empires we have tried in this price category. The shape was irregular and nearer spherical than anything else, with the state of polish potentially damaging to the first few records played. Tip-mass was high, as judged from the poor 15kHz noted for resonance, while the compliance was very low - suiting high mass arms, but imposing rather a severe penalty on trackability. For example the second-level lateral 300Hz tracking-test band required a 2.4g downforce.

Frequency response was smooth, but stereo separation was below average although demonstrating good uniformity and channel balance. Distortions were also poorer than average, particularly on the high frequency tests.

Auditioning rated the 200E as average which is good for the price. While not sounding particularly secure, with what is best described as increased vinyl 'roar', the 200E gave a presentably neutral and accurate sound with good lateral stereo. Barring the occasional mistracking the level of detail rendition was good though with some treble stridency and roughness. On the basis of its overall soundquality-versus-price this model is accorded a recommendation but with some strong reservations, notably concerning the quality of the stylus tip.

Cartridge type and weight Induced magnet, 5.3g
Estimated dynamic compliance at 10Hz 10cu(x 10 - cm/dyne)
Specified downforce: 2 to 4gtested at 2.5g
LF resonance in test arm
(Mission 774, 5.5g me + cart) + 12dB at 15Hz
Sensitivity at 1kHz 1.1mV/cm/sec
Relative output (0dB = 1mV/cm/sec)+ 0.7dB
Subjective sound qualityaverage
Recommended loading: 47kohms plus 250pFtested at 250pF
Recommended arm mass
Recommended arm dampingmarginal
Induced hum level
Stylus type detachable, shank-mount, elliptical spec, 8 x 18µm
Finish and alignmentboth poor, 60° cone angle
Tip geometry, approx 8 x 18µm, very poor shape, low grade
HF resonance (tip mass/vinyl) 15kHz
Frequency response, wideband (30Hz-20kHz) + 1dB, - 1dB
Frequency response, midband (100Hz-5kHz)+0.8dB, -1dB
Stereo separation, 100Hz, 1kHz, 10kHz 20dB, 21dB, 19dB
Channel difference, 1kHz, 10kHz , 0.4dB, 1.0dB
Trackability, 300Hz vertical + 12dB1.4g
Trackability, 300Hz lateral + 15dB 2.4g
Trackability, 300Hz lateral + 18dB ('Supertrack')>3.5g
Distortion, 300Hz vertical + 6dB2.9%
Distortion, 300Hz lateral + 9dB1.0%
High frequency waveform quality fair only
Midband intermodulation (1kHz + 1.5kHz 24cm/sec) 2.5%
HF intermodulation (pulsed 10kHz, 24cm/sec peak)2.5%
Pink noise intermodulation,
12kHz, 16kHz, 20kHz
Typical selling price inc VAT£18
Replacement stylus cost inc VATapply to dealer

* Significant mistracking



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Fidelity Research MC201

Wilmex Ltd, Compton House, New Malden, Surrey KT3 4DE Tel 01-949 2545



The *MC201* is a 'new-generation' Fidelity Research cartridge retailing at a fairly typical moving coil price. It is fitted with a fine quality stylus of line profile. Compliance was fairly high, requiring low-medium mass arms for the best results, although the need for damping was marginal. The wild ringing seen on the squarewave trace corresponded to a minimally damped tip-mass resonance of + 9dB, which could conceivably embarrass some head amps.

Tested at a 1.8g downforce, surprisingly good trackability was demonstrated and 1.5g should be ample for normal duty. Distortion was moderate and the results showed a good balance over the respective frequency bands. Concerning the frequency response, some unevenness was present at the upper frequencies. Output was more or less level up to 15kHz, above which it rose leading to that tipmass resonance mentioned above. Good separation was demonstrated with a justsatisfactory channel balance.

Well liked by the panel, the '201 scored high on audition, ensuring a comfortable recommendation despite the high price. Damping aided stability, with the stereo presentation showing an enviable transparency and good depth. Bass definition was fairly good and treble slightly altered in character – 'faintly metallic' was the comment from one panelist, while another described it as 'euphonically colored' and gave a high score. The *MC201* clearly has character and could win many friends. Cartridge type and weightlow output moving coil, 7.5g Estimated dynamic compliance at 10Hz $22cu(\times 10^{-6} \text{ cm/dyne})$ Specified downforce: 1.5 to 2gtested at 1.8g LF resonance in test arm

(Mission 774, 5.5g me + cart) + 10dB at 9.3Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec) 31.7dB
Subjective sound quality very good
Recommended loading
Recommended arm mass
Recommended arm dampingmarginal
Cartridge coil resistance
Induced hum level
Stylus type fixed, naked, line contact, spec, $5 \times 50 \mu m$
Finish and alignment both very good indeed, 55° cone angle
Tip geometry 7.6 \times 50 μ m, well shaped swept line contact
HF resonance (tip mass/vinyl) + 9dB at 33kHz
Frequency response, wideband (30Hz-20kHz) + 2.5dB, - 1.5dB
Frequency response, midband (100Hz-5kHz) . + 1.5dB, - 1.5dB
Stereo separation, 100Hz, 1kHz, 10kHz 28dB, 29dB, 30dB
Channel difference, 1kHz, 10kHz0.8dB, 1.3dB
Trackability, 300Hzvertical + 12dB0.9g
Trackability, 300Hz lateral + 15dB1.2g
Trackability, 300Hz lateral + 18dB ('Supertrack') 1.5g
Distortion, 300Hz vertical + 6dB 2.8%
Distortion, 300Hz lateral + 9dB0.4%
High frequency waveform qualityfair
Midband intermodulation (1kHz + 1.5kHz 24cm/sec) 2.7%
HF intermodulation (pulsed 10kHz, 24cm/sec peak)0.5%
Pink noise intermodulation,
12kHz, 16kHz, 20kHz 2.2%, 5%, 6.5%
Typical selling price inc VAT£133

Replacement stylus cost inc VATapply to distributor



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Glanz MFG31E

Ambience Audio, 1458 Buxton Road, Heaviley, Stockport, Cheshire Tel 061-483 9656



Moderately priced, the Glanz '31E proved to be fitted with a high-quality true elliptical stylus, very close to specification, and commendable at the price. Possessing moderate body mass and compliance, it is suited to low-to-medium mass arms (4-10g) and damping was not strictly necessary. The cartridge proved uncritical of electrical loading and was tested using 47K/250pF at a 1.5g downforce.

Ignoring the slight graph synchronisation slip, the '31E showed a very uniform and wellbalanced frequency response. Good levels of stereo separation were established and were maintained to high frequencies. Tip mass was low, as the 30kHz resonance indicated – the reduced output beyond this frequency accounts for the cleaned-up squarewave response, which shows a good performance. The 31E exhibited good trackability and low distortion at mid-frequencies, though the 20kHz noise intermodulation distortion was a little higher than average. Technically at least, this model was vice-free.

Scoring a little above average on audition, the '31E sounded somewhat bland and occasionally produced a little more surface noise than usual, with some treble uncertainty. Tonally however it was quite neutral and stereo depth, detail and definition were all average or marginally above. Its character is pleasant enough and this model offers sufficiently good value for recommendation.

Cartridge type and weightinduced magnet flux, 5.5
Estimated dynamic compliance at 10Hz 24cu(x 10 - 6 cm/dyne
Specified downforce: 1.25 to 1.75g tested at 1.5
LF resonance in test arm
(Mission 774, 5.5g me + cart) + 10dB at 10H
Sensitivity at 1kHz 0 75mV/cm/se
Relative output (0dB = $1mV/cm/sec$) - 2.5dF
Subjective sound quality average plus
Becommended loading: 47kohms plus 100 nF tested at 250 nF
Recommended arm mass 4-10
Recommended arm damping margina
Cartridge coil resistance/inductance z = 900 obm
Stylus type naked detachable oriented elliptical 8 x 18 m
Einish and alignment both very good cone angle 53
Fin geometry 8 × 20 m very good shape true elliptica
HE reconance (tip mass/vinvl)
$\frac{1}{2} \frac{1}{2} \frac{1}$
Frequency response midband ($100Hz-5kHz$) $\pm 0.8dB = 0.3dE$
Stereo separation $100Hz$ 1kHz $10kHz$ $27.5dB$ 20.5dB 21dE
Chapped difference 1kHz 10kHz
Frankability 200Hzyartical + 12dP
Frackability 200Hz lateral + 120D
Trackability 200Hz lateral + 19dB (Supertrack')
Distortion 200Hz vortical + 6dP
Distortion 200Hz lateral + 0dP
Jistoriion, Suumzialerai + 90B
Aidbard intermedulation (1kHz + 1 5kHz 24em/eas)
/ilubation intermodulation (IKHz + 1.5KHz 24cm/sec) 2.3%
hr intermodulation (pulsed lokHz, 24Cm/sec peak)0.95%
10kHa 16kHa 20kHa



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Goldring G920 IGC

Goldring Products Ltd, Anglian Lane, Bury St Edmunds IP32 6SS Tel (0284) 64011

С



Goldring have at last realised that high trackability achieved by the use of excessive compliance can be an overall disadvantage. Compared with the original G900 IGC model. their new 920 /GC has a more moderate compliance value of 24cu, tracking competently at a suitable downforce, and suitable for 5-13g effective mass arms, with damping not strictly necessary. The stylus we measured was nearer elliptical than line contact in form and although well shaped it had rather a fine minor radius considering the state of alignment and downforce range specified.

Meeting tight response limits with 47kohm/250pF loading, the 920 exhibited very good separation up to 8kHz, and was still good beyond that. Channel balance was excellent, and with minimal overshoot plus a restricted supersonic bandwidth, the slight squarewave curvature reflected the essentially mild amplitude response variations. A sensible balance of distortion and trackability was obtained except for the noise intermodulation test, where the stylus geometry was believed to have had a disturbing influence. With exotic tips such as the Van den Hul, the designer's specification must be adhered to for consistent results.

On the listening tests the rating was good, which qualified this model for 'Best Buy' status at the price. It impressed many panelists, demonstrating decent stereo depth with a stable and decisive sound. Bass was presentable, with good midband clarity and detail plus above-average treble. The treble band did occasionally show a hint of sibilance and wiriness, but string tone was good, and surface noise well controlled. It is interesting to reflect that with tighter quality control on the stylus, the results could be better still!

Cartridge type and weight	moving magent, 4.25
Estimated dynamic compliance at 10H	z 24cu(x 10 - ° cm/dyne
Specified downforce: 1 to 2.5g	tested at 2.00
LE resonance in test arm	

(Mission 774, 5.5g me + cart) + 10dB at 10.5H	z
Sensitivity at 1kHz	С
Relative output (0dB = 1mV/cm/sec)	В
Subjective sound quality	d
Becommended loading: 47k ohms	_
nlus 150-200nF tested at 250n	F
Pecommended arm mass 5.13	5
Recommended arm damning	Я
Centridae acilia dustanae	1
Cartriage coll inductance	H.
Induced hum levelvery goo	a
Stylus type detachable, naked, oriented, super elliptical-lin	е
Finish and alignmentfairly good, 65° cone angl	е
Tip geometry	с.
HF resonance (tip mass/vinyl)estimated at 26kH	łz
Frequency response, wideband (30Hz-20kHz) + 0.5dB, - 1.6d	в
Frequency response, midband (100Hz-5kHz), + 0.5dB, - 0.8d	в
Stereo separation 100Hz 1kHz 10kHz 28dB 34dB 20d	B
Channel difference 1kHz 10kHz 0dB 0d	Ř
Trockability 300Hz vertical + 12dB	ă
Trackability 200Hz loteral + 15dB	in a
Trackability 200Hz lateral + 19dB ('Supertrack') 21	a
Trackability, SUUHZ lateral + Toub (Supertrack)	y
Distortion, 300Hz vertical + 6dB	(0
Distortion, 300Hz lateral + 9dB	<u></u>
High frequency waveform quality	a
Midband intermodulation (1kHz + 1.5kHz 24cm/sec) 3.3%	/o
HF intermodulation (pulsed 10kHz, 24cm/sec peak)0.6%	%
Pink noise intermodulation,	
12kHz, 16kHz, 20kHz	6



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Goldring G910 IGC

Goldring Products Ltd, Anglian Lane, Bury St Edmunds IP32 6SS Tel (0284) 64011

We had reservations concerning the samples of the G900 IGC reviewed in the last edition. due to their excessive compliance. The G910 is a different version, specifically designed with a compliance value reduced from the original 42 to a far lower 23cu. Tested at a 1.8g downforce, it happily coped with all the test trackability sections throughout the frequency range, showing it to be a balanced design. The stylus was of reasonable quality but was not to the Van den Hul specification, and it could also have had a better polish as well as alignment - both critical areas with this tip.

Suited to low-medium mass arms, the need for damping is guestionable with this cartridge, and it worked well with 47Kohms plus 250pF loading. Frequency response was smooth, meeting good +1.2, -0.5dB limits overall, and fine mid-frequency channel separation was recorded although this deteriorated rather quickly at high frequencies above 10kHz. Tip-mass resonance was well controlled at about 28kHz, this and the limited bandwidth beyond being responsible for the clean-looking squarewave. Distortion was also well controlled throughout the test bands.

Rated highly on audition the '910 sounded slightly sibilant on occasions, but in the main it sounded clear and clean over the whole frequency range, with quiet disc surfaces and a generally neutral tonal balance. Detail, depth and acoustic space were well portrayed and the panel agreed on its open yet confident character. Taking a critical stance, a slight loss of transient detail and transparency was noted as compared with first-rank (and far more costly) designs, but for the money the '910 is certainly good value and achieves Best Buy status.

Cartridge type and weightmoving magnet, 4.25g Estimated dynamic compliance at 10Hz 23cu(× 10 -* cm/dyne) Specified downforce: 1 to 2.5gtested at 1.8g LF resonance in test arm
(Mission 774, 5.5g me + cart) + 11dB at 10.5Hz Sensitivity at 1HHz 1.1mV/cm/sec Relative output (0dB = 1mV/cm/sec) + 1.2dB
Subjective sound qualityvery good Recommended loading: 47kohms plus 150-200pFtested at 250pF
Recommended arm mass
Induced hum levelvery good Stylus typedetachable, naked, oriented, line contact Finish and alignmentboth just 'good', 65' cone angle
Tip geometry6 × 18µm of fairly good shape, lacks true extension to line HF resonance (tip mass/vinvl)
Frequency response, wideband (30Hz-20kHz) + 1.2dB, - 0.5dB Frequency response, midband (100Hz-5kHz) + 0.8dB, - 0.5dB Stereo senaration 100Hz 1kHz 10kHz 33dB 35dB 20dB
Channel difference, 1kHz, 10kHz
Trackability, 300Hz lateral + 18dB ('Supertrack')>1.8g Distortion, 300Hz vertical + 6dB
Distortion, 300Hz lateral + 9dB
HF intermodulation (pulsed 10kHz, 24cm/sec peak)0.7% Pink noise intermodulation,
Typical selling price inc VAT



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Grado GT Super

Grado Products UK Ltd, 27 Long Causeway, Peterborough PE1 1YJ Tel (0733) 45890



The *GT Super* is a new, inexpensive model from Grado, comprising a medium compliance design specified with an elliptical stylus and suited to medium-to-low mass arms. The arm should preferably be damped, though unfortunately damped arms are a luxury here considering the price of the cartridge. However, low generator impedance of Grado cartridges makes these models insensitive to electrical load variations, and their temperature stability is also good.

Stylus examination revealed a low-grade shank-mounted pseudo-elliptical (virtually conical) stone of inadequate polish. Such stones are neither kind to records nor do they promote low noise levels. Typical of Grado models in the past, the frequency response was quite uniform with only a small 1dB presence droop recovering to + 1dB at 20kHz. Good separation and quite good channel balance were measured.

Both trackability and low frequency distortion were good for the price, though the results were less favourable at high frequencies namely on the 10kHz pulsed and 16/20kHz noise intermodulations. We tried two samples and both were similar except that the second possessed rather poorer channel separation. On the 300Hz lateral tests the 0.4% distortion result was dominated by third-harmonic content, rather than the usual second-harmonic distortion, which might be responsible for the subjective brightness and 'sharpness' of this model. In fact it did quite well in the listening tests, providing a firm and well defined bass plus good detail and pleasing stereo. But the treble range was emphasised and steely, with increased surface noise and clicks, and it also showed some groove contact instability. However despite these subjective criticisms, and reservations concerning stylus guality, the GT Super did well enough at its modest price level to merit recommendation.

Finish and alignmentpoor finish, fairly good alignment, 48° cone angle 48° cone angle Tip geometry8 × 15µm pseudo-elliptical, rough grind HF resonance (tip mass/vinyl)25kHz Frequency response, wideband (30Hz-20kHz) ... + 1dB, - 1dB Frequency response, midband (100Hz-5kHz). + 0.5dB, - 0.8dB Stereo separation, 100Hz, 1kHz, 10kHz......28dB, 29dB, 25dB Channel difference, 1kHz, 10kHz 1.2dB, 0.8dB Distortion, 300Hz lateral + 9dB0.4% High frequency waveform guality fair High frequency waveform qualityfair Midband intermodulation (1kHz + 1.5kHz 24cm/sec)2.8% HF intermodulation (pulsed 10kHz, 24cm/sec peak) 1.6% Pink noise intermodulation, Replacement stylus cost inc VAT£14.62





1kHz square wave (ignore ultrasonic cutter ringing)

Koetsu 'Black'

Absolute Sounds, 42 Parkside, London SW19 Tel 01-947 5047



This low output moving coil is a less expensive version of the rosewood-bodied Koetsu, which is covered in the revised review printed opposite. The Koetsu is also available in an onyx-bodied form. The *Black* has an all-metal body with a stepped boron cantilever and a super-elliptical stylus, the latter of fine quality with a narrow 5μ m scanning radius. Compliance is higher, which promises improved trackability although the resonance rise at low frequencies suggested that damping would prove helpful. Hum levels were low and the cartridge was uncritical of loading.

The frequency response was very uniform and more 'open' than the *Rosewood*, with minimal treble lift, plus consistently good stereo separation and superb channel balance. The squarewave confirmed the wide bandwidth and excellent control, the output within $\pm 2dB$ right up to 50kHz. Distortions were well balanced and while the 'Supertrack' required 2.7g, the level just 3dB lower was happily passed at a modest 1.5g. It should be difficult to catch this model out on music programme.

Auditioning placed the *Black* in the 'excellent' class. Very slightly rich, with a detailed and unexaggerated treble, the bass was firm and well focused with great apparent extension while the midrange was startling clear, coherent and finely detailed. It sailed through complex choral passages without hardening or muddle, and was exceptional on piano transients. Stereo depth and stability were also very good.

The price is undoubtedly high, but the level of music refinement offered by this craftsmenbuilt design renders a recommendation mandatory – a purchase that those with deep, pockets will find easy to justify.

Cartridge type and weight medium output moving coil, 9.5g	
Estimated dynamic compliance at 10Hz 14cu(x 10 ⁻⁶ cm/dyne)	
Specified downforce:	
F resonance in test arm	
(Mission 774, 5.5g me + cart) + 15dB at 11Hz	
Sensitivity at 1kHz	
Relative output (0dB = 1mV/cm/sec) 21.6dB	
Subjective sound quality	
Recommended loading	
Recommended arm mass	
Recommended arm dampingcould be helpful	
Cartridge coil resistance/inductance	
nduced hum level	
Stylus typesemi-line contact, unspecified size,	
fixed, naked, orientated	
Finish and alignment both very good, 55° cone angle low mass	
Tip geometry $5 \times 18 \mu m$, true elliptical stone, excellent shape	
HF resonance (tip mass/vinyl)(× 2dB) >50kHz estimated	
requency response, wideband (30Hz-20kHz) + 1.5dB, - 0.6dB	
requency response, midband (100Hz-5kHz) . + 0.8dB, - 0.5dB	
Stereo separation, 100Hz, 1kHz, 10kHz 30dB, 30dB, 26dB	
Channel difference, 1kHz, 10kHz	
rackability, 300Hz vertical + 12dB	
rackability, 300Hz lateral + 15dB 1.5g	
rackability, 300Hz lateral + 18dB ('Supertrack') 2.7g	
Distortion, 300Hz vertical + 6dB	
Distortion, 300Hz lateral + 9dB	
high frequency waveform quality tairly good	
Alighand intermodulation (1KHz + 1.5kHz 24cm/sec) 2.0%	
IF Intermodulation (pulsed 10kHz, 24cm/sec peak)0.55%	
rink noise intermodulation,	
12KHZ, 10KHZ, 20KHZ	



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Linn Products Ltd, 235 Drakemire Drive, Castlemilk, Glasgow G45 9SZ Tel 041-634 0371



Now well-established, the Asak has been fully retested for this issue. It was perhaps inevitable that we should encounter sample variations, as the better a product is the more often it is tested and the more obvious any variations appear! We tried three samples; one exhibited excessively low compliance (a faulty batch) and none of them attained the exemplary separation levels of earlier examples we have tried. Nonetheless, the fine sound quality of our three when properly set up was never in doubt, and in our view the Asak remains the only serious competition to the Koetsus. when optimally mounted.

Of moderate compliance, the Asak is suited to medium-high mass arms, and tends to excite unwanted audio resonances in infereior arms. An excellent 'Vital' elliptical stylus was fitted possessing a low tip mass. Frequency response exhibited a mild but consistent downtilt falling almost 1.4dB from 30Hz-5kHz. with a smooth treble thereafter lending a weighty, slightly 'distant' tonal balance. Separation (usually better than the graph reproduced here) was typically 35dB midband. Our first Asak was an adequate tracker in view of its very low compliance, while the later samples were even less compliant than the 14cu recorded in our previous issue. The nominal squarewave overshoot and shape confirmed the wide smooth response of this design, while distortion levels were low except where mistracking was evident.

In good working order, the Asak despite its slight tonal 'richness', is a top class performer. Its bass was clear and clean with good dynamics, the mid detailed, neutral and transparent, and the treble generally well integrated and of good quality. Sample variation showed some trackability limitation and a slight loss of stereo depth, but with a watchful eve on quality variations, the Asak

Still remains a highly recommended design.

Cartridge type and weight low output moving coil 6.0g Estimated dynamic compliance

Linn Asak

opecified downloree. 1.0 to 2.2g 1111111111111111111111111111111111
LF resonance in test arm
(Mission 774, 5.5g me + cart) + 13dB at 16Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec) - 27.8dB
Subjective sound quality excellent
Becommended loading 30-500 ohms
Becommended arm mass 12-26a
Recommended arm damping might be beinful
Cartridge coil resistance 3.5 ohms
Induced hum level
Stylus type fixed oriented naked elliptical spec 5 x 18um
Finish and alignment both very good 55° cone angle
Tin geometry 6 x 18 m well shaped 'Vital' true elliptical
HE reconcision $f(x) = \frac{1}{2} \frac{1}{2$
Frequency response wideband (20Hz 20kHz) 2dP 15dP
Frequency response, widebald (30Hz-20KHz) + 30B, - 1.30B
Storeo apparation 100Hz 1kHz 10kHz 24dB 26dB 24dB
Channel difference 1kHz 10kHz
Trackability 200Hzyartical + 12dB
Trackability, 300Hz vertical + 120B
Trackability, SUUHZ lateral + 150B
Frackability, 300Hz lateral + 180B (Supertrack) . falled at 3.0g
Distortion, 300Hz vertical + 60B
Distortion, 300Hz lateral + 9dB
High frequency waveform quality fairly good
Midband intermodulation (1kHz + 1.5kHz 24cm/sec) 6.0% *
HF intermodulation (pulsed 10kHz, 24cm/sec peak)0.6%
Pink noise intermodulation,
12kHz, 16kHz, 20kHz
Tunical calling price in a VAT COOT

Typical selling price inc VAT£207 Replacement stylus cost inc VAT£155.25 Sample variation

** Mistracked, trackability was better with third sample, serial no. 6666 (uses for response graph)





1kHz square wave (ignore ultrasonic cutter ringing)

Mission 773HC

Mission Electronics, Stonehill, Huntingdon, Cambs Tel (0480) 57477



The original 773 was fitted with a boron rod cantilever and a Paroc line contact stylus. tending to a slightly 'glassy' treble, but with an impeccable frequency response. The new HC version retains much of that neutral character. despite the switch to an allov tube cantilever and a super-elliptical stylus. This high-output moving coil design does not require a step-up device, but a pre-amp of good sensitivity (2mV) is needed. Moderate mass and well-damped medium compliance indicate its suitability for low-to-medium undamped arms. The stylus proved to be a well-shaped and finished superelliptical of fine scanning radius with a slightly extended major radius, with a sensible 55° cone angle. Vertical tracking angle was trifle high at 27°.

The frequency response showed a slight droop from 100Hz to 5kHz, but output remained uniform to beyond 50kHz, as the fast but well controlled squarewave response clearly demonstrated. Stereo separation and channel balance were very good throughout, and moderate signal levels were tracked well with low distortion figures. However the highest modulation gave some trouble, and trackability limits performance pretty quickly in this rarified high-modulation region. Highfrequency tracing was nonetheless particularly good.

The new 773 attained a very good sound quality rating, marred only by very mild breakup and muddling on the highest level and most complex passages. The bass was to a good standard, the treble lucid and neutral with the mid open and clean, while stereo image was impressive in depth, clarity and stability.

This is now a subtle and refined cartridge of low apparent distortion, possessing great neutrality. Such a level of performance. coupled with its compatibility with standard preamps, earns it a warm recommendation.

Cartridge type and weighthigh output moving coil, 6.0g Estimated dynamic compliance at 10Hz 24cu(× 10 - ° cm/dyne Specified downforce: 18n
LF resonance in test arm
(Mission 774, 5.5g me + cart)
Relative output (0dB = 1mV/cm/sec) 9.2dE
Recommended loading: 47k ohms
plus 0-1000pFtested at 250pF
Recommended arm dampingnot required
Cartridge coil resistance
Stylus typeoriented, fixed, naked, elliptica
Finish and alignmentboth good, with a 55° cone angle Tip geometry
Frequency response, wideband (30Hz-20kHz) + 1dB, - 0.8dE
Stereo separation, 100Hz, 1kHz, 10kHz,, 29dB, 35dB, 26dE
Channel difference, 1kHz, 10kHz
Trackability, 300Hz lateral + 15dB
Trackability, 300Hz lateral + 18dB ('Supertrack')
Distortion, 300Hz lateral + 9dB
High frequency waveform quality
HF intermodulation (pulsed 10kHz, 24cm/sec peak)0.6%
12kHz, 16kHz, 20kHz1.8%, 2.2%, 3.7%

Typical selling price inc VAT£157 Replacement stylus cost inc VAT£257 Mistracked at 20cm/sec. 0.6% IM distortion



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Nagaoka MP30

J Osawa & Co (UK) Ltd, 10 Forge Court, Reading Road, Yateley, Camberley, Surrey Tel (0252) 879121



A medium-price cartridge, the *MP30* has a metal body of higher mass than the *MP11*, and interestingly, it also has a lower compliance of 20cu. As such, and in view of its 9g mass, 4-10g effective-mass arms are suitable and it should not require damping. A good quality elliptical stylus was fitted, although not quite up to the standard of some Japanese tips.

We tried two samples, one of which gave just average stereo separation, with the second not representing a great significant improvement. Tested with 250pF of loading. the response was quite uniform, but using 100pF, the 20kHz point was better maintained. albeit at the expense of a less desirable dip around 9kHz. Separation was fairly good with excellent channel balance, while the upper (tip mass) resonance occurred at 27kHz, its mildness reflected by the minimal overshoot and ringing on the squarewave test. Trackability and distortion were good at moderate frequencies and levels, but deteriorated rapidly at peak levels - on the 300Hz 'Supertrack' test and on the high frequency sections the performance was poorer than average.

Rated a somewhat surprising 'good plus' on the listening tests – just enough for Best Buy status – the *MP30* sounded confident and neutral, with stable stereo with good midband dynamics and detail. The treble register was suspect on occasion, with more noise and sibilant slurring than usual, but not unduly so. Cartridge type and weight induced magnet, 9.0g Estimated dynamic compliance at 10Hz 20cu(x 10 - * cm/dyne) Specified down force: 1.3 to 1.8g tested at 1.6g LF resonance in test arm

(Mission 774, 5.5g me + cart) + 10dB at 9.5Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec) 3.8dB
Subjective sound quality
Recommended loading: 47kohms plus 100pF tested at 250pF
Recommended arm mass 4-10g
Recommended arm dampingnot required
Cartridge coil resistance/inductance z = 4.3kohms
Induced hum level very good
Stylus type detachable, oriented, naked, elliptical, $10 \times 18 \mu m$
Finish and alignment both good, 55° cone angle
Tip geometry 7 x 18µm, well shaped ellipitical, could benefit
from more blend
HF resonance (tip mass/vinyl)
Frequency response, wideband (30Hz-20kHz) + 0.5dB, - 3dB
Erequency response midband $(100Hz - 5kHz) \pm 0.5dR = 0.8dR$

Frequency response, midband (100Hz-5kHz).+0.5dB,-0.8dB
Stereo separation, 100Hz, 1kHz, 10kHz	22dB, 24dB, 23dB
Channel difference, 1kHz, 10kHz	0dB,0dB
Trackability, 300Hz vertical + 12dB	
Trackability, 300Hz lateral + 15dB	
Trackability, 300Hz lateral + 18dB ('Supertri	ack')
Distortion, 300Hz vertical + 6dB	
Distortion, 300Hz lateral + 9dB	
High frequency waveform quality	fairly good
Midband intermodulation (1kHz + 1.5kHz 24	cm/sec) 3.5%
HF intermodulation (pulsed 10kHz, 24cm/se	cpeak)2.0%
Pink noise intermodulation,	
	2 20/ 6 50/ 100/

 12kHz, 16kHz, 20kHz
 2.2%, 6.5%, 10%

 Typical selling price inc VAT
 £46

 Replacement stylus cost inc VAT
 £35



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



Latest in an established range of 'VMS' series cartridges is the medium priced '3011 – incidentally, there never was a 'Mk I' VMS30. The 'll' designation refers to the body type. It comes fitted with a high compliance stylus assembly suited to low-mass tonearms only. The tip when examined proved to be a top-class line or extended-contact type, with a usefully fine minor scanning radius and excellent polish.

Providing a highly uniform charted response on the specified 47kohms/400pF electrical loading the output met very close ±0.5dB limits, 30Hz-20kHz. Separation was very good and channel balance fine, and when tested at 1.5g the trackability was very good; clearing the 'Supertrack' 300Hz band at just 1.2g. However, tracking was less confident on the higher frequency intermodulation passages, and the vertical linearity on high-level tones was just average. Output peaked at 25kHz, just outside the audible range, and the squarewave result shows this bandwidth limit, the mild overshoot reflecting the rapid rolloff above tip mass resonance.

Attaining a 'good' rating on the listening tests, sufficient for Best Buy status at the price, the VMS30 II was felt to somewhat flatten stereo depth, and on some records it also gave increased groove noise. Tonally it was neutral if slightly dulled in impact and dynamics, but conversely it gave a decent level of instrumental detail in a civilised and relaxed manner.

Cartridge type and weightir stimated dynamic compliance at 10Hz 34c pecified downforce: 1.0 to 1.6g Fresonance in test arm	nduced magnet, 5g u(× 10 – °cm/dyne) tested at 1.5g
(Mission 774, 5.5g me + cart) ensitivity at 1kHz Relative output (0dB = 1mV/cm/sec)	+ 10dB at 8.2Hz 0.87mV/cm/sec 1.3dB
Subjective sound quality Recommended loading: 47kohms plus 400pF Recommended arm mass	
Recommended arm damping	marginal .800ohms/600mH very good
inish and alignment	od, 55° cone angle etrical line contact
requency response, wideband (30Hz-20kHz) requency response, midband (100Hz-5kHz) tereo separation 100Hz 1kHz 10kHz	+ 0.5dB, - 0.5dB + 0.5dB, - 0.5dB
channel difference, 1kHz, 10kHz rackability, 300Hz vertical + 12dB	0.3dB, 0.6dB
rackability, 300Hz lateral + i8dB ('Supertrad vistortion, 300Hz vertical + 6dB vistortion, 300Hz lateral + 9dB	ck')1.2g 2.8% 0.8%
ligh frequency waveform quality lidband intermodulation (1kHz + 1.5kHz 24c IF intermodulation (pulsed 10kHz, 24cm/sec	fairly good m/sec)3.3% peak)1.4%
ink noise intermodulation,	2% 4% 6%

Tel (0734) 343621

Ortofon VMS30

Ortofon Ltd, Tavistock Ind. Est., Ruscombe, Twyford, Berks. RG10 9NJ

12KHZ, 16KHZ, 20KHZ	
Typical price (inc VAT)	£38 when reviewed, now £44
Replacement stylus cost inc VAT	£24.50



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Ortofon VMS20E I

Ortofon Ltd. Tavistock Ind. Est., Ruscombe, Twyford, Berks, RG10 9NJ Tel (0734) 343621



Although moderately priced, this new moving coil is a low-output device, needing a high-gain low-noise step-up transformer, or compatible pre-amplifier. A superb stylus tip was fitted. being a true elliptical of low mass with excellent shape and polish. The MC10 II possessed a medium compliance, and arms from 6-15g are well suited. The low-frequency resonance was such that arm damping could prove helpful.

Tested at a 1.6g downforce, this cartridge proved to be a capable tracker, even disposing of the 'Supertrack' 300Hz test at 1.5g! Distortion was exemplary on all tests, bar the high frequency noise section, while very narrow response limits of + 1.4, - 0.4dB were maintained from 30Hz to 20kHz, the graph showing a mild presence loss and a treble lift above 9kHz. Very good stereo separation was recorded over the whole range, and channel balance was also excellent. These are all hallmarks of a well made and designed cartridge, and are in fact rather better than for the outrageously-priced MC30, at least on the basis of samples we have tried.

Rated 'good' on audition, the MC10 II produced a mixed reaction from the panel, with some liking it greatly and others proving less enthusiastic. Providing a clean mid-band with good detail and depth both here and in the bass, it was less 'tidy' though still presentable in the upper treble, with a slightly 'glassy' effect, and mildly increased surface noise. It certainly deserves a hearing and is recommended.

Cartridge type and weightlow output moving coil, 7.0g Estimated dynamic compliance at 10Hz 16cu(×10⁻⁶ cm/dyne) Specified downforce: 1.3 to 1.8gtested at 1.6g

Tel (0734) 343621

Ortofon MC10

Ortofon Ltd, Tavistock Ind, Est., Ruscombe, Twyford, Berks, RG10 9NJ

(Mission 774, 5.5g me + cart)	+ 13dB at 11Hz
Sensitivity at 1kHz	0.02mV/cm/sec
Belative output (0dB = $1mV/cm/sec$)	- 34dB
Subjective sound quality	bood
Becommended loading:	10.500obme
Recommended arm mass	6 15g
Decommended arm dempine	
Recommended ann damping	
Cartridge coll resistance	
Induced hum level	tairly good
Stylus type fixed, naked, oriented ellip	tical, $8 \times 18 \mu m$
Finish and alignment both very good, \$	55° cone angle
Tip geometry8 x 18µm, excellent true e	lliptical stylus
HF resonance (tip mass/vinyl)	>40kHz
Frequency response, wideband (30Hz-20kHz) +	1.4dB, -0.4dB
Frequency response, midband (100Hz-5kHz) . +	0.4 dB, -0.4 dB
Stereo separation, 100Hz, 1kHz, 10kHz 300	JB. 37dB. 33dB
Channel difference, 1kHz, 10kHz	0.3dB. 0.2dB
Trackability 300Hz vertical + 12dB	0.60
Trackability 300Hz lateral + 15dB	1.00
Trackability 300Hz lateral + 18dB ('Supertrack')	1.50
Distortion 300Hz vertical + 6dB	2 0%
Distortion, 300Hz lateral + 0dB	0.190/
High frequency waveform quality	
High frequency waveform quality	Iairiy good
Midband Intermodulation (IKHZ + 1.5KHZ 24cm/s	ec) 1.5%
HF intermodulation (pulsed 10kHz, 24cm/sec per	ak)0.5%
PINK noise intermodulation,	
19kHz 16kHz 90kHz	1 80/ 10/ 80/

Typical price (inc VAT) £48 when reviewed now £55 Cartridge part exch. thro distrib C36 50



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



This model was also reviewed in Mark I version in the first issue, but did not achieve any particular distinction. The first '20E // tried here offered good but not especial separation. the generator axes showing a lack of mutual alignment, but a second sample (not selected) provided the improvement shown by the dotted trace on the graph; accordingly this sample was used for all subsequent testing. Two frequency responses were also charted to explore the criticality of loading, with the optimum dotted 400pF curve clearly the best. Without too great elaboration the VMS with a naked elliptical tip may be regarded as a improved version of the FF15E.

Measurement showed the VMS compliance to be a little higher than the '15, at 28cu, but trackability was significantly increased, the Supertrack needing just 1g. Most distortions were similarly good except for the 1/3-octave results which were much better than for the '15, while an excellent frequency response and channel balance were both charted, plus very good separation throughout.

On audition the '20E II appeared in the upper group which is an excellent result for the price paralleling the achievement of the ADC XLM III in this respect. Considered very slightly nasal and dull in tonal colour it was nevertheless sufficiently neutral to achieve close tape copying. Stereo imaging was reproduced with precision and depth, and the treble range was clean and clear even on complex passages; a musical and accurate sound with quiet surfaces.

The stylus report showed a naked 220µm round stock elliptical diamond to specification, with a 50° cone angle and good shape. The alignment was fine but polish poor.

In conclusion, the 400pF loaded VMS 20E II can be strongly recommended on the assumption that the second sample rather than the first was typical, but is best suited to low mass arms. In addition, a cartridge of this calibre should really have better stylus polish, which would 'complete' the otherwise fine diamond. 1kHz squarewave

Cartridge type and mass
Specified downforce: range 0.75g to 1.5g tested at 1.3g
LE resonance in test arm
(SME 111.60 me + cart) + 11dB at 8 9Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec)+ 2dB
Subjective sound qualityvery good
Recommended loading
Recommended arm mass
Recommended arm dampingmoderate
Cartridge coil resistance/inductance 800 ohms, 600mH
Induced hum level
Stylus type and spec detach, naked elliptical, 8 x 18xm
Finish and alignment
HE recompany (tip mass (vipy)) indicated at 19kHz
Frequency response 20Hz-20kHz
Frequency response 100Hz-5kHz $\pm 0 - 1$ dB
Stereo separation 100Hz 1kHz 10kHz 20dB 35dB 22dB
Channel difference at 1kHz 10kHz 0dB
Trackability 300Hz lateral + 15dB, + 18dB
('Supertrack')
Trackability 300Hz vertical + 12dB0.4g
Distortion 300Hz lateral + 9dB
Distortion 300Hz vertical + 6dB2.8%
High frequency waveform quality
Mid band intermodulation (1KHz + 1.5KHz)
HE INTERMODULATION, DUISED IUKHZ, 24CM/SEC DEAK

Pink Noise intermodulation. 12kHz. 16kHz, 20kHz Typical price (inc VAT) .£28when reviewed, now£34 eplacement stylus cost inc VAT £19.50



Frequency response, rel output and separation ref 0dB (1mV/cm/sec) (dotted curve 400pF: separation see text).



Osawa Mirage OS60L

J Osawa & Co (UK) Ltd, 10 Forge Court, Reading Road, Yateley, Camberley, Surrey Tel (0252) 879121



Built by Supex to Osawa's specification, the internal component parts of the *Mirage* do not in fact parallel the Asak as he has been rumoured, although there are certain similarities – for example, the aluminium alloy cantilever and elliptical diamond. The diamond fitted to the '60L measured $8 \times 18 \mu m$ with the scanning radius a trifle large, but the shape, polish and alignment were all very fine. Not surprisingly in view of its lower cost, the quality of assembly was not quite to the Asak standard.

We tried two samples, one with a slightly offset cantilever and the other exhibiting poorer separation than that illustrated on the graph. In frequency response, the '60L drooped by 2dB from 100Hz to 2kHz, then recovered gently in the treble range. Channel separation was potentially very good, though with the anomaly at 7kHz which is characteristic of Supex cartridges. Measured trackability was also fairly good, with distortion moderate. The fast squarewave risetime and clean cutter ringing confirmed the response measurements, showing a smooth output extension to beyond 50kHz.

Possessing a medium-to-low compliance, the '60L suited a wide range of arm mass, and damping would be an advantage.

Rated as very good on audition, this cartridge did to some extent sound similar to the Asak. Slightly richer, the bass lost something in definition while the treble was a trifle coarser, with poorer integration. Midrange detail and stereo depth were similarly good – hallmarks of the best products from the Supex factory.

With a mild reservation concerning possible quality variations, the *Mirage OS-60L* is warmly recommended, and it should be borne in mind that the more expensive *Mirages* may not necessarily offer a significant improvement over the 'musical' balance of this model. Cartridge type and weightlow output moving coil 6.8g Estimated dynamic compliance at 10Hz 15cu(× 10 -* cm/dyne) Specified downforce: 1.5 to 2.1gtested at 2.0g

 Typical selling price inc VAT
 £99

 Replacement stylus cost inc VAT
 £55

 * Some mistracking, 2% at 17cm/sec



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Pickering XV15/625E

Cambrasound Ltd, Britannia Road, Waltham Cross, Herts EN8 7EF Tel (0992) 716666



Highly rated in our first Cartridges issue over two years ago, this model is still popular and is fully retested here. An induced-magnet design of moderate compliance, it is fairly tolerant and robust, and will work with a wide range of arms. Strictly speaking some arm damping would improve the performance, but considering the price level involved this is something of a nicety. Tested at 1.4g, the results suggested a performance improvement if tracked at 1.6 to 1.8g, which is guite satisfactory in view of the $7.5 \times 18 \mu m$ stylus. The tip is in fact a pseudo-elliptical form of good finish, but offering little advantage over a spherical tip - and although the cartridge design is worthy of a better stylus, conversely, fitting a good spherical would enable a price reduction to be made.

Slightly rich and 'dull', the frequency response was nonetheless very smooth and a good standard of channel spearation was achieved, still measuring 25dB at 10kHz. Distortion levels were very low except at the highest frequencies where tracing geometry limited the performance, while trackability was also good as was the 26kHz tip mass resonance (considering the price), the square-wave showing a slightly 'slow' but well balanced characteristic.

On audition the panel were somewhat unenthusiastic and yet compelled to award decent marks in the absence of significant flaws in the reproduction. Mild stereo depth and detail loss were noted, plus a bland, 'sleepy' character with only average bass definition, and yet the sound was relaxed and vice-free. Set against price, the performance was thus good enough to warrant recommendation.

Cartridge type and weightinduced magnet, 6.0g Estimated dynamic compliance at 10Hz 15cu(\times 10 - $^{\circ}$ cm/dyne) Specified downforce: 0.75 to 1.5tested at 1.4g LF resonance in test arm
(Mission 774, 5.5g me + cart) + 14dB at 12Hz
Sensitivity at 1KHZ
Subjective sound quality
Recommended loading: 47K ohms plus 275 pF tested at 250 pF
Recommended arm mass
Induced hum level
Stylus type detachable, shank mount 'elliptical' spec. 8 x 18µm
Finish and alignment
Tip geometry
HE resonance (tip mass/vinvl) 26kHz
Frequency response, wideband (30Hz-20kHz) + 1.5dB, - 1.5dB
Frequency response, midband (100Hz-5kHz) + 0.5dB, - 1dB
Channel difference, 1kHz, 10kHz, 10kHz, 0.8dB, 0.6dB
Trackability, 300Hz vertical + 12dB1.0g
Trackability, 300Hz lateral + 15dB
Distortion 300Hz vertical + 6dB
Distortion, 300Hz lateral + 9dB0.28%
High frequency waveform quality
HE intermodulation (IKHZ + 1.5KHZ 24cm/sec) 2.8%
Pink noise intermodulation,
12kHz, 16kHz, 20kHz
Replacement stylus cost inc VAT



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

REVISED AND REPRINTED

HW International, Eccleston Road, Maidstone ME15 6AU Tel (0622) 59881

Having been disappointed last year with the performance of the 95EJ, we were pleased to find this 97-series model doing rather better this time. At the outset, however, certain problems are apparent: a moderately high compliance cartridge, it is unfortunately best suited to low-medium mass tonearms, which are likely to be out of its logical price-matching bracket. It also demonstrated a sharp resonance rise which was found to be little affected by the attached damper, it was fairly critical of electrical loading, with 250pF as the optimum value in our opinion. The output was however healthy, with good hum rejection. Despite its low price, the stylus could have been better, as examination showed it to be a relatively massive metal-shanked stone of just fair polish and alignment. Possessing a pseudoelliptical grind, the contact region was virtually spherical at a 18µm radius.

The frequency response was very smooth, falling gently with frequency to -2.5dB, 20kHz, while balance and separation were both reasonably good. At a 2g downforce there was a huge tracking reserve, and the compliance could therefore have been reduced to good effect, better suiting popular tonearms. The distortion at 300Hz lateral was a trifle high but the other results were all surprisingly good, considering the state of the stylus.

Rated a comfortable 'good' on the listening tests the sound was in fact exceptional for the price. Despite being on the dull and 'thick' side of neutrality, the cartridge nonetheless found favour; its tracking was secure, and stereo presentation reasonable, with clarity good and the overall sound unfatiguing. Detail loss over and above the 'rich' balance was apparent in the treble, but this was not too serious.

At the price the 97EJ can be recommended without hesitation. Despite its low price, the correct arm and electrical matching should be observed to obtain the best results, and if Shure were only to increase the damping

action, reduce the compliance and improve the tip, it could be even better!

Cartridge type and massmoving magnet, 6.4g
Estimated dynamic compliance at 10Hz 28cu(x 10 - ⁶ cm/dyne)
Specified downforce: range 1.5g to 3gtested at 2.0g
LF resonance in test arm
(SME111, 6g me + cart)+ 15dB at 9Hz*
Sensitivity at 1kHz0.85mV/cm/sec
Relative output (0dB = 1mV/cm/sec) 1.5dB
Subjective sound quality
Recommended loading
Recommended arm mass 3-10g
Description of a state

less effective than HE less effective than HE Induced hum level Stylus type and spec

	ciliptical, spec to x topin
Finish and alignment	both only fair
Tip geometry pseudo-elliptical, e	ffective contact 18 x 18µm
HF resonance (tip mass/vinyl)	indeterminate
Frequency response 30Hz-20kHz	+ 0.5, - 2.5dB
Frequency response 100Hz-5kHz	+ 0.5, - 1.5dB
Stereo separation, 100Hz, 1kHz, 10kH	Iz 23dB, 25dB, 26dB
Channel difference at 1kHz, 10kHz .	0.8dB, 0.1dB
Trackability 300Hz lateral ± 15dB	
Trackability 300Hz vertical ±12dB	0.7g
Trackability 300Hz lateral + 18dB ('S	upertrack')
Distortion 300Hz lateral + 9dB	
Distortion 300Hz vertical + 6dB	
High frequency waveform quality	fairly good
Mid band intermodulation	

 12kHz, 16kHz, 20kHz.
 1.4%, 3.5%, 8.0%

 Typical price (inc VAT)
 £26 when reviewed, now £30

 Replacement stylus cost inc VAT
 £16

 *1120R with stabiliser
 £16



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Shure M97 HE

HW International, Eccleston Road, Maidstone ME15 6AU Tel (0622) 59881



To some degree the models in the M97 series may be regarded as versions of the V15/V but without the high frequency anti-resonance damper in the cantilever assembly. The SC39 'professional' cartridge is also closely related. but has a stylus quard system substituted for the 97's damper brush. The version reviewed here carries the HE suffix which in Shure's terminology denotes a 'hyper-elliptical' stylus. the specification defining a form of line contact. As with the V15IIIHE (see summary review), the naked rondel stylus proved to be of good quality and finish with essentially elliptical radii 8 x 18um, although some sweeping of the major radius provided a little contact extension. The stone was however a little offset in its mounting on the cantilever. though the grind symmetry was better than for the V15 sample. Critical of electrical loading. 350pF was preferred. Low mass arms would be a necessity but for the effective damper brush.

The frequency response was very smooth if slightly 'rich' in balance and the good uniformity and high frequency control was shown by the well-damped squarewave response. Stereo separation was to a very good standard at all frequencies, while distortions were well-controlled and tracking exemplary.

Rated 'good' on sound quality, this was a fine result for the price and probably the best yet for a Shure cartridge in this publication. Criticised for a slightly dulled 'dead' frequency balance and a suspicion of hardness on string tone, the sound grew on many panelists during the sessions. It exhibited a generally clear and even performance with relaxed tracking, and coherent and precise stereo imaging.

At this price level the damper was felt to be a worthwhile accessory in terms of arm compatibility, and the overall performance — both technical and subjective — was very good.

Stereo separation was fine for a moving magnet design and would appear to correlate with the good stereo image depth we observed. Shure's price-v-performance equations are currently producing good results, and the 97HE can be recommended.

Cartridge type and massmoving magnet, 6.4g
Estimated dynamic compliance at 10Hz 35cu(x 10 - 6 cm/dyne)
Specified downforce: range 0.75g to 1.5g tested at 1.25g
LF resonance in test arm
(SME111.60 me + cart) + 10dB at 7.9Hz*
Sensitivity at 1kHz 0.9mV/cm/sec
Belative output (0dB - 1mV/cm/sec) = 10dB
Subjective sound quality
Becommended loading
Recommended arm mass 3.12a
Recommended arm domping
(recommended ann damping
(recommended)
Cartridge coll resistance/inductance 1550 onms, /00mH
Induced numlevel
Stylus type and spec detachable, Shure hyper-elliptic,
naked, spec 5 x line µm
Finish and alignment
Tip geometryessentially a well-formed elliptical,
contact 8 x 18µm
HF resonance (tip mass/vinyl)indeterminate
Frequency response 30Hz-20kHz+ 1, - 2.3dB
Frequency response 100Hz-5kHz±1dB
Stereo separation, 100Hz, 1kHz, 10kHz28dB, 34dB, 35(av)dB
Channel difference at 1kHz, 10kHz
Trackability 300Hz lateral ±15dB,0.9g
Trackability 300Hz vertical ±12dB0.8g
Trackability 300Hz lateral + 18dB ('Supertrack')1.25g
Distortion 300Hz lateral + 9dB0.5%
Distortion 300Hz vertical + 6dB2.9%
High frequency waveform quality
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec) 1.5%
HF intermodulation, pulsed 10kHz, 24cm/sec peak 0.25%
Pink Noise intermodulation.
12kHz, 16kHz, 20kHz,
Typical price (inc VAT)
Replacementstylus cost inc VAT £25

*6dB @ 9Hz with damper



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



physical compatibility represent strong points

Russ Andrews Turntable Accessories, Edge Bank House, Skelsmergh, Kendal LA8 9AS Tel (053 983) 247

in its favour.





Shure V15 V

Supplied to *Hi-Fi Choice* just in time for the complete auditioning and an emergency lab test the brand new *V* represents a major effort on the part of Shure to recapture a larger share of the 'quality' market. With a tip resonance at 38kHz (our estimate), moving mass has been reduced compared with the *V15 IV* by the use of a special 'thinwall' beryllium cantilever and smaller stone, the latter hyperelliptical but with improved 'Masar' polish over the contact region. Measuring $5 \times 18\mu$ m, the tip rated as a good-quality true elliptical.

A medium-compliance design, the V15 V obviates need for a low mass arm or for arm damping by the inbuilt stabiliser, similar to that used on the IV. The cartridge is claimed to be free from electrical loading effects, but this was not wholly true as may be seen from the response graphs. The trend was very flat to 10kHz, above which a significant rolloff occurred with a capacitance of 450pF. Using 150pF, the fall was more gentle but commenced at 5kHz, this clearly in agreement with the rounded squarewave response. The very good separation was maintained right across the band, along with the channel balance. As might be expected from past masters of the craft, the trackability and the complementary distortion results were very fine.

Auditioning using 300pF placed the V in the 'very good' category. Dynamics were well portrayed with a good sense of ambience and depth. It was highly controlled as well as secure, with consistently low surface noise, while instrumental detail and articulation were very good, with an absence of the traditional moving-magnet mid hardness. Slightly dulled in the treble, the V also lacked a touch of power and depth in the bass but neither aspect was considered serious. Its slight lack of precision and transparency was well countered by an easy, relaxed confidence, and it carries a firm recommendation.

	Cartridge type and weightmoving magnet, 6.5g Estimated dynamic compliance at 10Hz 27cu(x 10-6cm/dyne)
l	Specified downforce: 0.75 to 1.25gtested at 1.1g
l	LF resonance in test arm
l	(Mission //4, 5.5g me + cart) + 11dB at 9.0Hz
l	Sensitivity at 1KHZ
l	Relative output (UdB = Imv/cm/sec)
l	Becommended loading: 47kohme plus 250pE tested at 150pE
I	Recommended arm mass 4-14a
l	Recommended arm damping not required
l	Cartridge coil resistance/inductance950ohms. 330mH
L	Induced hum levelvery good
L	Stylus type detachable, naked, 'Hyper Elliptical' spec, 5 x 38µm
l	Finish and alignment both good, improved polish on
l	contact radii
l	lip geometry
	Frequency response wideband (30Hz, 20kHz) + 0.2dB = 3dB
,	Frequency response midband $(100Hz-5kHz) \rightarrow 0.2dB = 0.6dB$
)	Stereo separation 100Hz 1kHz 10kHz 28dB 31dB 28dB
t	Channel difference. 1kHz, 10kHz
\$	Trackability, 300Hz vertical + 12dB0.6g
1	Trackability, 300Hz lateral + 15dB0.6g
	Trackability, 300Hz lateral + 18dB ('Supertrack') 1.0g
l	Distortion, 300Hz vertical + 6dB
	Distortion, 300Hz lateral + 90B



Frequency response, rel output and separation ref (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



The 901 is reviewed here in its latest form with the 'vital' stylus. Although in the past it has been regarded as the 'weaker brother' of the range, the results from the tests on our latest samples suggest that its performance now surpasses that of the 900. Representing the high output version of the 900, the expression 'high output' relates only to moving coil' designs, and a fairly sensitive preamplifier (minimum 2mV sensitivity) will be required for full amplification.

The stylus achieved the same exemplary standard as the other Supexes, while the frequency response dip was held to just 1dB, and the treble lift to +2dB. A well-damped tip mass resonance is indicated by the minimal leading edge ringing on the squarewave, the clearly displayed cutter ringing merely demonstrating the cartridge's wide bandwidth. Stereo separation was outstanding and free of the 7kHz problem associated with low output Supexes, and at a recommended 2g downforce it almost managed the 'Supertrack', and held on throughout all the other tests, although the mid intermodulation was not far from failure.

Rated 'very good' on the listening tests, family similarities with the 900 were clear the rich down-tilted balance lending a 'weighty' impression (see also Koetsu). Stereo imaging was notably transparent with fine depth and precision, and despite the 'laid back' balance, detail was well presented with surface noise and clicks subdued. A hint of coarseness was however apparent on difficult end-of-side passages, and the extreme treble could sound a little thin and wispy.

The first sample of the 901 received exhibited poor channel balance — not an uncommon fault with the high output movingcoil models — and was rejected accordingly. But its relatively high price, and on the assumption that good 901s achieve the standards set by the second sample tested above, the cartridge is clearly worthy of recommendation; its versatile electrical and

Cartridge type and masshigh output moving coil, 9.5c
Estimated dynamic compliance at 10Hz 12cu(x 10-6cm/dyne
Specified downforce: range 2.0g to 2.5g tested at 2.2g
LF resonance in test arm
(SME 111 60 me + cart) + 11dB at 12 5Hz
Sensitivity at 1kHz 0.33mV/cm/sec
Relative output (0dB - 1mV/cm/sec) - 8.5dB
Subjective sound quality very good
Becommended loading 47Kohms plus uncritical p
Recommended arm mass 12-200
Recommended arm damping marginal
Cartridge coil resistance/inductance 80.0 hms negligible mH
Induced hum level
Stylus type and spec fixed naked oriented 'super elliptical'
stylus type and spee inced, naked, onented, super emptical
Finish and alignment both excellent
Tip geometry exemplary true swept elliptical 7 × 20.
HE recondence (tip mass/vinyl)
$\frac{11}{2} = \frac{1}{2}$
Stereo separation 100Hz 1kHz 10kHz 31dB 40dB 34dB
Channel difference at 1kHz 10kHz
Trackability 2004z lateral + 15dP
Trackability 200Hz lateral ± 100B,
Frackability 200Hz lataral + 19dP ('Supartrack')
Distortion 200Hz lateral + 10dB (Superflack)
Distortion 200Hz vertical + 50D
High frequency waveform quality
Mid band intermedulation (1kHz + 15kHz 24em/aco) 14%
VIII Danu Intermodulation (TRHZ + 1.5KHZ 24cm/sec) 1.4%
Pink Noise intermodulation
12KHZ, 10KHZ, 20KHZ

Typical price (inc VAT)£125 when reviewed, now £121 Replacement stylus cost inc VAT£91



Frequency response, rel output and separation ref 0dB (1mV/cm/sec) (dotted — undamped arm)



1kHz squarewave (ignore ultrasonic cutter ringing)

REVISED AND REPRINTED

Supex SD900EV Super

Russ Andrews Turntable Accessories, Edge Bank House, Skelsmergh, Kendal LA8 9AS Tel (053 983) 247



It now seems likely that the Supex designs may have gone through a 'sticky patch' some time a couple of years back, accounting for the problems Choice encountered in reviewing both the 900 and 901. Happily these difficulties appear to have been overcome, as the quality of the 900 models submitted this time was comparable with the superior performance of the original 'classic' sample of several years ago. A low compliance moving-coil design, the 900E is suited to medium-high mass arms, and slight damping could be beneficial. A superb naked oriented elliptical diamond was fitted, comprising a true swept-radius stone of effective contact $7 \times 20 \mu m$, the latter not unrealistic at a typical 2g downforce.

The very low effective tip mass was reflected by the HF resonance, which was estimated to lie above 45kHz. The midrange droop in frequency response was some 1.5dB, with the subjectively 'rich' balance corresponding to the gently rising response below 1kHz. The inevitable rise at 20kHz was held to +2.5dB, with fine channel balance, and with the exception of the 'glitch' at 7-8kHz (characteristic of low output Supex designs) the separation was very good. In common with many other cartridges, the 'Supertrack' and midband intermodulation sections both gave trouble.

On the revised rating system the SD900 scored 'very good' on sound guality (in relative terms this does represent a slight downgrading from the previous 'excellent'). While still showing its firm, stable character with very good stereo imaging and attendant depth, the balance tended to an 'overrich' quality which enhanced the bass at the expense of the mid/treble detail, and occasionally 'fizzy' effects were also noted in the extreme treble.

The costly 900, for so long a reference standard amongst moving-coils, continues to be a top flight cartridge, but is now somewhat ^o eclipsed by its close relative the Asak.

Cartridge type and masslow output moving coil, 9g Estimated dynamic compliance at 10Hz 11cu(x 10-6 cm/dyne) Specified downforce: range 2g to 2.5gtested at 2g resonance in test arm

(SME 111, 6g me + cart)+ 12dB at 13Hz	
Sensitivity at 1kHz	
Relative output (0dB = 1mV/cm/sec) (- 24.5 alone) + 0.2dB*	
Subjective sound quality	
Recommended loading, 20-500 ohms plus uncritical pF	
Recommended arm mass 12-20g	
Recommended arm dampingmarginal	
Cartridge coil resistance/inductance . 3.5 ohms, negligible mH	
nduced hum level fairly good	
Stylus type and spec fixed, naked, oriented, elliptical,	
spec 8 x 20xm	
Finish and alignmentboth excellent	
Fip geometry exemplary true elliptical, $7 \times 20 \mu m$	
HF resonance (tip mass/vinyl) , . , + 12dB at 745kHz	
Frequency response 30Hz-20kHz – 1.5, + 2.5dB	
Frequency response 100Hz-5kHz 1.5dB	
Stereo separation, 100Hz, 1kHz, 10kHz 26dB, >40dB, 20dB	
Channel difference at 1kHz, 10kHz0.1dB, 0.1dB	
Frackability 300Hz lateral ± 15dB 1.8g	
Frackability 300Hz vertical ± 12dB	
Frackability 300Hz lateral + 18dB ('Supertrack')	
Distortion 300Hz lateral + 9dB0.6%	
Distortion 300Hz vertical + 6dB 2.0%	
High frequency waveform qualityfair	
Mid band intermodulation	
$(1kH_7 \pm 1.5kH_7/20cm/spc)$ 3.7%	

HF intermodulation, pulsed 10kHz, 24cm/sec peak0.33% Pink Noise intermodulation,

Typical selling price inc VAT £144 £108 Replacement stylus cost inc VAT assuming 26dB step up



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



Successor to the EPC205 reviewed in the first edition, the '205111L shows that Technics have devoted considerable attention to refining their moving magnet cartridges. Available in headshell and universal forms, this design incorporated a hollow boron cantilever of very low tip mass, while the internal poles were precision aligned and manufactured from tape head ferrite. The cartridge proved especially insensitive to variations in both temperature and electrical loading, and its moderate compliance with adequate low damping means that a variety of low to medium mass arms will be compatible. A superb true swept elliptical stylus was fitted offering fine $6 \times 20 \mu m$ radii, while both polish and alignment were excellent.

The high frequency resonance was well controlled at 33kHz, and disregarding the cutter ringing the squarewave response was a textbook example of phase and frequency accuracy. This fully backed the measured frequency response which was remarkably uniform, while both channel balance and stereo separation were also very good. All distortions were low and trackability excellent at a 1.3g downforce - another textbook performance.

Rated 'very good' on sound quality, the 205 represented an almost ideal balance of gualities. Stereo presentation was stable and precise with good depth, the frequency balance sounded smooth and open, minimal coloration was noted, and the rendition of fine detail proved exceptional. Surfaces were well handled, and the model was never caught out on tracking.

A clear winner, this cartridge offered an almost ideal balance. Possessing a top class subjective performance, it sounded very neutral and was unaffected by loading or temperature. It also proved relatively unfussy about the choice of arm, and at the price is still virtually a 'steal'.

Cartridge type and massmoving magnet, 6.5g Estimated dynamic compliance at 10Hz 23cu(x 10 ⁻⁶ cm/dyne) Specified downforce: range 1.0g to 1.5gtested at 1.25g F resonance in test arm
(SME 111, 6g me + cart)+ 10dB at 10Hz Sensitivity at 1KHz0.54mV/cm/sec Relative output (0dB = 1mV/cm/sec)
Recommended loading
arringe coll resistance/inductance 500 onms, 240mH nduced hum level
Finish and alignmentboth very good Fip geometryexemplary true swept elliptical, 7 x 20μm HF resonance (tip mass/vinyl)+ 3dB at 33kHz
requency response 30H2-20kHz
Trackability 300Hz lateral ± 15dB,
Distortion 300Hz lateral + 9dB
Mid band intermodulation (1kHz + 1.5kHz 24cm/sec)1.5% HF intermodulation, pulsed 10kHz, 24cm/sec peak0.35% Pink Noise intermodulation,
IZKTZ, IOKTZ, ZUKTZ

Tel (0753) 34522

Technics EPC205 IIII

National Panasonic UK Ltd., 300-318 Bath Road, Slough, Berks



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)

Cenorel TMC10

Condor Electronics Ltd, Woodman Works, 204 Dunsford Road, London SW19 8AR Tel 01-947 9511



A modestly priced, Dutch-made moving coil from Tenorel, the '10 does not require a head amplifier. It has a moderate compliance, suited to many low-to-medium mass arms, for which damping is not required. The stylus was a well finished and shaped, shank-mounted elliptical, quite good for the price and possessing sensible geometry.

Overall the frequency response met tight ±1dB limits with excellent balance and guite good separation, especially at high frequencies. The overall frequency balance was however slightly 'rich', a common moving coil effeot, but this cartridge's main area of weakness was its moderate trackability, the degree of internal overdamping necessitating 2.4g to negotiate the 'Supertrack' section. It must however be conceded that other taxing sections were handled pretty well at the 1.8g test downforce, although noise intermodulation distortion was a little high at 20kHz. The squarewave confirmed the response downtilt and also the essentially smooth, wideband characteristic.

Subjectively the TMC10 rated as 'good' which was encouraging. The presentation was a trifle flat in depth but at the same time it was open, and neutrally balanced with good detail and consistent from bass to mid. On occasion the treble was a little hard with some emphasis on strings but this was well controlled and in view of its price, this new Tenorel clearly justifies admission into the 'Best Buy' category.

Cartridge type and weighthigh output moving coil, 6.5g Estimated dynamic compliance at 10Hz $20cu(\times 10^{-6} \text{ cm/dyne})$ Specified downforce: 1.4 to 1.8gtested at 1.8g LF resonance in test arm

(Mission 774, 5.5g me + cart)+ 6dB at 10Hz	
Sensitivity at 1kHzapprox 0.6mV/cm/sec	
Relative output (0dB = 1mV/cm/sec)	
Subjective sound quality	
Recommended loading	
Recommended arm mass4-12g	
Recommended arm dampingnone required	
Cartridge coil resistance	
Induced hum level	
Stylus type fixed, shank mount, elliptical	
Finish and alignment both good, 55° cone angle	
Tip geometry 6 x 18µm, well shaped, well finished elliptical	
HF resonance (tip mass/vinyl)around 40kHz	
Frequency response, wideband (30Hz-20kHz) + 1dB, - 1dB	
Frequency response, midband (100Hz-5kHz) + 1dB, - 1dB	
Stereo separation, 100Hz, 1kHz, 10kHz 27dB, 26dB, 22dB	
Channel difference, 1kHz, 10kHz 0.2dB, 0.1dB	
Trackability, 300Hz vertical + 12dB1.0g	
Trackability, 300Hz lateral + 15dB 1.8g	
Trackability, 300Hz lateral + 18dB ('Supertrack')	
Distortion, 300Hz vertical + 6dB2.5%	
Distortion, 300Hz lateral + 9dB0.4%	
High frequency waveform qualityfair	
Midband intermodulation (1kHz + 1.5kHz 24cm/sec) 2.8%	
HF intermodulation (pulsed 10kHz, 24cm/secpeak)0.6%	
Pink noise intermodulation,	
12kHz, 16kHz, 20kHz 1.2%, 1.8%, 8%	
1	



Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



1kHz squarewave (ignore ultrasonic cutter ringing)



This black-bodied moving-coil resembles a slimmed-down *Asak*, but differs from that cartridge in its use of a solid boron cantilever and pure silver coil windings – although the latter feature has not been proved to beneficially affect sound quality. Of line specification, the oriented naked stone tended to an elliptical shape but was well shaped and polished with a largish scanning radius of 7.5 μ m. Compliance was sensible at 15cu, and the cartridge is thus suited to a number of good arms. Arm damping is not required.

No data was supplied with the review sample, but the design is clearly a low impedance type. A suitable test downforce was found to be 1.9g. The graph showed very good and consistent channel separation with a highly uniform response to 8kHz, beyond which the output rose to +4dB at 20kHz, which is more than I would like. Even so, the design was a good one, returning impressive results for distortion, while trackability was also good, only just failing the highest level Supertrack. With a tip mass resonance well controlled at about 38kHz, the squarewave overshoot simply reflected the rising treble response and was otherwise good.

Subjectively, the sound was affected by the treble lift though not as much as expected and a very good rating was achieved. Occasionally sibilant and brash, the bass was firm, with the stereo stable and deep, demonstrating fine clarity. A candidate for treble cut, the Zenn could nonetheless work well in many good systems.

Cartridge type and weightlow output moving coil, 4.8g `
Estimated dynamic compliance at 10Hz 15cu(x 10 - 6 cm/dyne)
Specified downforce: none
F resonance in test arm
(Mission 774, 5.5g me + cart)+6dB at 12.5Hz
Sensitivity at 1kHz
Relative output (0dB = 1mV/cm/sec)
Subjective sound quality
Recommended loading:
Recommended arm mass8-15g
Recommended arm damping
nduced hum levelfairly good
Stylus typenaked, oriented, line type, fixed stylus
Finish and alignmentvery good for both, 55° cone angle
ip geometry \ldots 6.3 x 19µm fine shape, tending to elliptical
HF resonance (tip mass/vinyl)estimated at 38kHz
requency response, wideband (30Hz-20kHz) + 3.5dB, - 0.6dB
requency response, midband (100Hz-5kHz) . + 0.6dB, - 0.6dB
Stereo separation, 100Hz, 1kHz, 10kHz 29dB, 36dB, 27dB
Channel difference, 1kHz, 10kHz 0.2dB, 0.8dB
rackability, 300Hz vertical + 12dB 1.1g
rackability, 300Hz lateral + 15dB 1.5g
rackability, 300Hz later al + 18dB ('Supertrack')
Distortion, 300Hz vertical + 6dB
Distortion, 300Hz lateral + 9dB
ligh frequency waveform quality
Aldband intermodulation (1KHZ + 1.5KHZ 24cm/sec) 1.6%
IF Intermodulation (pulsed TUKHZ, 24Cm/secpeak)1.2%
rink noise intermodulation,
12KHZ, 16KHZ, 20KHZ
• • • • • • • • • • • • • • • • • • •

Zenn M

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Frequency response, rel output and separation ref 0dB (1mV/cm/sec)



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• "The Rotel RA-820 is a real winner. It has unbelievable punch and sharpness ... At its price, I know of no amplifier to touch it." **Chris Thomas — Practical HiFi** • "This Linn/Rotel/Monitor Audio combination is one of my personal favourite 'finds' of 1982." **Subjective Sounds** • "But the thing which really grabbed me was the foot tapping rhythm. Every time I listened on the Rotel I ended up tapping my feet to the beat. It just seemed to have so much ability to maintain structure and keep the original patterns intact." **Alan Mackay — Popular HiFi** • "The Rotel RA-840 is probably as good an amplifier as you can expect to get at the price, for I know of no better amplifier on sale for £100 or less." **Stan Curtis — HiFi for Pleasure** • "I am confidentthat Rotel have taken specific steps to develop a rewardingly auditioning, low price amplifier... The amplifier warrants a higher-thai, raverage score for value. My judgement of value therefore, taking all things into account, resolves to 4.2 marks out of 5." **Gordon King — HiFi News & Record Review** • "The 820 will provide tough competition for most amplifiers under £100, and maywell be the best at its particular price point." **Subjective Sounds** • "The most obvious ability of the Rotel is the way it allows the music to live and breath." **What HiFi** • "The Rotel RA-820 looks better built, and its sound quality was as close to the NAD 3020 as anything I have encountered in the last couple of years" **Jonathan Kettle — Popular Hi-Fi** • "The exciting new Rotel RA-820, an excellently made machine offering phenomenal value ... It definitely sounds good an at the ridiculously modest price it allows your budget to stretch that bit further." **Jimmy Hughes — Practical HiFi** • "I like these Rotel amplifiers a great deal. It seems perfectly clear that they are very nearly as good as can be bought for the price." **Alvin Gold — HiFi News & Record Review**



AMPLIFIERS AND RECEIVERS

The mass production of consumer electronics, amplifiers in particular, only became feasible some 20 years ago when the transistor took over from the thermionic valve and shook off its own teething troubles. At first germanium transistors were costly and slow acting, but soon transistor technology was racing ahead, and today the power amplification stages of an amplifier (that five years ago would have consisted of perhaps a hundred discreet components) can now be produced as one large integrated circuit. In relative terms amplifiers have never been cheaper, seemingly offering more watts and less distortion yearly.

An amplifier is the core of the hi-fi system, because it deals with signals and reroutes them, and because it pumps electricity to the loudspeakers. Amplifiers can be conveniently divided into three areas or stages. The preamplifier stage comprises the inputs and the circuits which immediately buffer or modify those inputs, equalisation or filter networks and of course the volume and balance controls. The pre-amp is also a switch box and can be arranged to connect up tape recorders for duplication and recording. Next section is the power amplifier. This receives its signal from the pre-amp, its job is to multiply this signal from the level supplied by the pre-amp to a sufficient level to drive the loudspeakers. The pre-amp will always deliver a common signal whatever the level of its input.

The third stage of the amplifier is the power supply which may be distributed throughout the pre-and power amplifiers circuits (though in some designs it is discrete circuitry in separate boxes): its job is to supply an unyielding source of electricity to the right places in the amplifier at the right time. In a good amplifier, a drain on the power supply when handling loud passages should not affect the pre-amp's power demands.

Receiver

The receiver is a tuner and amplifier complete in one box. This combination had great popularity but features less in manufacturer's catalogues today.

Pre-amp basics

Some pre-amplifiers lead a separate existence from their power amp while others are contained in a one-box

design. Whichever, they can be expected to accept a range of different electrical signals and to process and switch these to produce the one output suitable for amplification by the power amplifier.

Cartridge (phono) input

The phono input is tailored to the level of signal it will receive from a stereo cartridge. The most common cartridge being the moving magnet type which commonly produces 1 mV on a standard velocity signal recorded on disc. Most cartridges come close to this figure - the cartridge reviews earlier in this guide show their relative outputs. To economise on space and to overcome surface noise problems, discs are pressed with a signal which has been carefully 'pre-distorted' to have reduced bass and increased treble. The pre-amplifier needs to produce an overall flat frequency response from this cutbass/boosted-treble signal, so it applies an inverse amplification to boost the bass and cut the treble. This is done to an internationally accepted standard and is known as RIAA equalisation. Our amplifier reviews check how accurately this process is carried out.

To confuse the picture further there is another type of cartridge, the moving-coil type, which does not produce the level of signal that a magnetic model does, and requires a quite different electrical load. Some amplifiers contain circuitry to deal with these cartridges, providing about 20dB more gain, but sadly many of these input circuits are afterthoughts, and a separate step-up device (prepre-amp, head-amp or transformer) can often give better results, as it is designed to interface the moving-coil cartridge with the magnetic phono input.

The electrical load shown by some phono inputs can affect the magnetic cartridge's ability to produce a flat response, and this aspect is commented upon in the amplifier reviews.

Tape input/output

Tape recorders need two-way contact with the pre-amp to be able to replay their signal through them and to be able to access any other input to record it. The big problem is that there are two international standards for tapeconnections which are of course incompatible. The DIN standard is of German devising and is incorporated into many European machines while Japanese, American and other manufacturers use the 'RCA phono' plug and socket, but to confuse mattersfurther many amplifiers have DIN sockets fitted that require phono levels and matching impedances.

As most tape machines are best used through their phono sockets if they have them, and most amps have phono sockets, the best advice is that for phono standard signals they prefer to travel from one impedance to a similar or larger impedance (anything up to 100 times bigger), while the sensitivity of the input should be similar or a little less than the output.

The rule therefore is to use phonoto-phono or DIN-to-DIN connections except where DIN is disguised phono and then the rule is to avoid connecting phono outputs to DIN inputs and DIN outputs to phono inputs. Many tape decks have a level control facility to help with these matching problems.

The tape selector switch on the pre-amplifier is almost always a different switch from the main input selector, to allow off-tape monitoring with the more sophisticated cassette decks.

Additional sockets

Most amplifiers have sockets for the connection of a tuner and an auxilliary input both of which have the same level requirements as the tape inputs and can be interchanged. TV sockets are Aux sockets by another name, and will enable a suitably equipped TV to be connected through the hi-fi system to reproduce television sound (which is, incidentally, high quality FM mono). Duplicate tape sockets enable signal processing devices like graphic equalisers or noise reduction units to be coupled into the system. Compact Disc is designed to interface with your amp attape level and should be used into tape, tuner or auxilliary inputs not phono.

Volume control

The rotary control of fair size is ergonomically unsurpassed for the simple task of adjusting volume level. Many people think they can judge how powerful an amplifier is by how far round they turn the volume control. Other people subscribe to the idea that volume controls should never be anywhere other than half way on. Neither is true. The ideal volume control should give satisfying increments in volume without jumping or bunching. A muting switch can be used to extend the range of the volume control.

Balance control

This adjusts the balance between the two channels of information passing through the stereo pre-amp. it can be used to make some kind of allowance for sitting closer to one speaker than another or for the asymmetrical positioning of speakers in a room, not to mention compensating for a volume control which doesn't balance the the two channels it controls that well.

Again a balance control if properly designed should silence one channel when pushed or rotated to its extreme position. Moving the control from one extreme to the other should result in an even shift of signal from one speaker to the other again without bunching near the centre and jumping near the end of travel.

Stereo/mono switching

This switch can be considered a basic and essential feature as it enables troubleshooting the system to be done far more easily and can be used to reduce broadcast hiss, noise from old mono records (in particularly low frequency out-of-phase grumblings), or even to check the balance control to get a dead centre mono image.

Other inputs/outputs and features

A few amplifiers, noticeably those used in rack systems, are fitted with a microphone mixing socket for use both in conjunction with a tape recorder or just to talk over a system's loudspeakers.

Tone controls are one of the most requested and least used features on modern amplifiers. They offer cut and boost over a wide part of the audio spectrum and some feature switchable turnover points (the frequency at which the cut or boost begins to act). Some amps have midrange controls in addition to treble and bass.

What real use are the common tone controls? They are said to be fitted to enable the user to help compensate for room/speaker interactions, to overcome fequency imbalances in other equipment, or to compensate for badly balanced recordings or broadcasts. The treble control may be able to help in some small way with reflection/absorption treble pro blems with rooms and speaker but acts over rather too wide a range. The bass control is utterly inadequate to compensate for low frequency room/ speaker interactions.

It is not difficult to buy inexpensive equipment today which has a flat charted response. If a cartridge's response is not flat, far better to compensate for this by altering the pre-amp loading; cassette decks too are best used with the tape for which they are aligned and kept well cleaned and demagnetised rather than an attempt be made to get a flat response with the tone controls.

Few people realise how crude tone controls are. Tonal imbalance of the type which could be corrected by the application of treble or bass cut or lift is rearely encountered as a 'fault' on records or broadcasts.

The ears' sensitivity changes with level and frequency. That is to say that as the level of a flat signal is reduced it will appear to loose treble and bass frequencies to the listener who would try to boost top and bottom to keep the signal 'flat' at low levels. Some amplifiers have a loudness or contour control to compensate for this subjective loss of treble and bass at low levels but so often the curve chosen is one which can be easily obtained as a fixed value of the tone control circuits rather than one which takes the psychoacoustic curve into consideration. If the loudness control works inversely with the volume control, the chances are that the designer has given it some thought and it may just work well.

Rumble and scratch filters (otherwise called high-pass and low-pass filters respectively) show the same problems as do the tone controls. Their slopes are too shallow and their turnoverfrequencies often inappropriately chosen to enable them to remove low frequency rumble from disc or hiss from non-Dolby tape or FM stereo. If the filters have variable rates of attenuation of selectable turnover frequencies then they may be of more than cosmetic value. A badly designed steep filter can cause ringing problems; again it is better to look for well-designed curtailing of frequency extremes in the pre-amp stage. Disc equalisation can nowadays have an additional bass roll-off below 20Hz

Power amplifiers

The power amplifier's task is to handle the complex alternating voltage signal from the pre-amp and to step up its voltage to a sufficient level to enable the attendant current to drive the loudspeakers with the original music signal. Its problems in doing so are defined by the load presented by the loudspeakers in simple impedance terms and as a complex reactive load and by the amp's own distortion. Loudspeakers also produce a signal which returns to the amplifier and this the amplifier must take in its stride while driving the speakers. The chap-ter on Loudspeakers and Putting together a system both offer advice on how to match power amps and loudspeakers.

Outputs

Loudspeaker connections on amplifiers need to be able to handle fairsized stranded wire or perhaps the better type of gold plated spade terminal. Some designs have two pairs of loudspeaker outlets which may be able to be run together or only individually. Check on the amps capability into low impedance loads if you intend from the outset to buy an amp to drive a main set of speakers and an pair. Additionally extension the speakers should be of nominal 80hm design without significant impedance dips

By far the best idea is that adopted by Nytech and A&R Cambridge, in having one pair of directly coupled unswitched loudspeaker outlets, and two pairs of switched sockets. This offers the no-compromise solution for the audiophile and the switched convenience for the other customers

If your amplifier has only one pair of speaker outlets, beware before you add speaker switching boxes. The amplifier may not be able to drive the low impedance load presented by two pairs of speakers wired up together. Furthermore, the switch contacts may degrade the sound quality immediately or over a period of time.

Power meters

Power amps are being fitted with power output meters more and more. The needle-type VU meters are not usually fast acting enough to respond to peaks, and will only give an indication of the average power being delivered. LED, LCD orfluorescent meters can act quickly enough to give peak indication but are often given inappropriate sensitivities to let them 'show off' at low levels.

These meters are voltage-sensing devices and presume that the speaker acts like a pure 80hm resistor (which it doesn't). Check the scale on the meter if you use 4 or 60hm speakers. Power meters are of limited value but can help in keeping an amplifier below its clipping level providing the meters can act fast enough. Clipping indicators should never be allowed to light for more than the briefest peaks.

Measurements

The measurements fall into roughly two groups, the basic electrical parameters and the performance measures. The most basic electrical parameter is the power output, which is quoted for a range of impedance loads across the full audio spectrum and at low distortion. The amplifiers are also measured with one channel driven and at different frequencies (midband frequency of 1kHz). If the amplifier can produce more power when driving one channel, this implies that power delivery is being limited when both channels are driven. and suggests that the power supply may be running out of steam

Ideally an amplifier should be able to maintain its driving voltage and double its current into a halved impedance (40hms as compared with 80hms) and double the current output again into 20hms.

The burst power test indicates how well the amp goes into distortion when driven hard.

Damping factor is the ratio of the amplifiers own impedance to the loudspeakers and the higher the figure the better the amp is at controlling the speaker cones. The power bandwidth shows the highest and lowest frequencies at which the amp can deliver reasonable power cleanly; bandwidths of over 50kHz may cause problems. The Intermodulation Distortion graphs show the amp's ability to reproduce two similar frequencies while keeping them from interacting. The Crosstalk measurement is a measure of the breakthrough from one stereo channel to the next and it should exceed 40dB when it is incompared significant with the separation of cartridges, tuners and cassette decks.

AMPLIFIERS: SUMMARY REVIEWS

Amplifiers as a breed seem to have suffered most in recent years from the ever-shortening cycle of 'product improvements' pushed onto this market by Japan in an attempt to keep sales bouyant through a recession. For this reason many of the amplifiers that we reviewed in Issue 25 of Hi-Fi Choice have been discontinued in favour of new models. It has been difficult therefore to produce a strong reprint section of Recommended and Best Buy amplifiers. These summary reviews are taken from the models that were found to be worth considering in the last Amplifier issue, and are also taken from the findings on amplifiers published as part of Issue 27 which was concerned with Systems.

Looking back at the Best Buy models that are no longer available the list must be headed by the very popular JVC AX1 which has now been discontinued in favour of a model designated the AM-10; this model has not yet been tested as part of the Choice programme though the older model will certainly be a bargain if found at the discount prices likely to be applied to 'end of line' stock. The modular Crimson 510/520 pre/power amp combination has been discontinued and replaced by the 600 series models which have much improved cosmetics though further recommendation for the new models cannot be made in the absence of a current review

There are bright hopes on the amplifier horizon however with a revised version of the very popular NAD 3020 shortly to become available with circuit improvements and a worthwhile addition in the shape of a moving coil input stage. The recent price increase of the NAD 3020 has taken it some way out of the reach of the first-time buyer on a limited budget but its price increase has opened the way for a down-market successor which is rumoured to be in development but is not yet ready for the market - we expect it to be called the 3015. The existence of the 3020 and the performance it offered at the price caused many manufacturers to think long and hard about what they were offering with their own budget amplifiers. First company to offer a true 'NAD beater' in Rotel were perhaps the shape of their RA-820; though not yet tested in Hi-Fi Choice its gathering reputation suggests that personal audition is a must. It should certainly be interesting to review this amp in the next issue of Choice.

ingtheirmuchrespected **A75 Series 3** and **A100** amplifiers, no longer in production. There may still be individual amplifiers out in the market and at their current price they could be looked on as prime bargains. Other UK amplifier manufacturers have made changes to their ranges since the publication of the last Amplifier *Choice;* Quad have recently launched their much rumoured Series 2 version of the 405 amplifier which has received good reviews when partnered with the new model 34 preamp, the low-facility version of the 44, replacement for the older model 33.

The passing away of the very popular Nytech receiver has been noted elsewhere, although this has been replaced in the market by the new range of Nytech electronics based on the CA252 amplifier. Personal audition leads me to suggest that the new electronics range is indeed much

improved over the old. Summary reviews

The frighteningly expensive Amcron SA2/DL2 pre/power amp combination (approx £3000) impressed the reviewers in terms of power delivery although the preampwas not to taste. The extravagent complexity of the £1380 DL2 preamp seemed to compromise sound quality while not offering some useful facilities like variable capacitance on the magnetic input or variable impedance on the moving coil stage. Furthermore, the volume control was found difficult to use. The SA2 power amp delivered a very high 280 watts per channel with low distortion but only average figures for hum. Overall it was felt that the combination was not suitable for domestic use but that in specialist applications, where price was no disincentive, it could well be worth considering. The £1518 power amp was felt to be more competitive on price.

The Bryston 2B/3B power amplifiers are imported from Canada by the London dealer KJ Leisuresound but are also available to other dealers. The2Bdelivered60wattsinto8ohms on test and showed generally good power delivery into low impedances Bandwidths of both amps were wide but not excessive, while distortion and noise were well down. The 3B gave a similarly high standard of technical performance with a power rating of approximately 130 watts (or double the 2B) perchannel. Listening tests indicated a bass which was a little 'fat' and 'heavy' while the 2B sounded a little harsher than the 3B. Further casualties include the Rogers range of electronics includDynamics and imagery were good but with some loss of detail. Choice of partnering preamp would be important but at £299 and £399 respectively the 2B and 3B delivered plenty of 'high quality' power at a not unreasonable price.

The £144 **Denon PM510** had a reasonably generous power output for an amplifier at this price. Power was well maintained into 4 ohmsthough somewhat curtailed into lower impedances. The inputs appeared fine though the input capacitance of the magnetic input could cause compatibility problems with some cartridges. Theoretically, the user of this amp would be restricted of moving magnet cartridges to designs from Ortofon, Shure, Grado and Technics, compatible with this input. The sound was reasonably well controlled and detailed though with some 'shrillness'.

The **Denon PM540** seemed to audition less well than the cheaper 510 although the lab performance of the £190 amp was favourable, showing a significantly higher power output of 95watts into 80hms. Personal audition is strongly recommended. **Dual's CV-1150** amplifier did well

in the context of the Best Buy Dual System 2 reviewed in Issue 27. This is a basic slimline amp offering connection for one pair of speakers only, although two tape decks can be accommodated one with phono and one with DIN sockets. Unusually the phono input had switchable sensitivity. The only feature which was criticised was the needlessly high level of cut and boost offered by the tone controls. 36 watts were delivered on test which is only a medium/ low output but the amp proved capable of being driven nearly flat out without sounding 'harsh'. Shortly to be replaced; at £90 however this amp can still be recommended.

The **Exposure** amplification system was tested at a time when the VII preamp was just coming out into production; this unit is available in various configurations with a single power supply or with a dual power supply. Most of the review was conducted using the integral power amp supply feeding the VII preamp. The power amp delivered a promising 80watts plus on test but fuses prevented low impedance drive for any period, though power delivery into real low impedance loads looked promising. The new preamp showed improvements in cross-talk and RIAA tracking although noise figures were only average. In the context of specialist audiophile products this combination is not expensive (£230 plus £290) and would seem to offer pretty good subjective performance though the power amp is perhaps the strongest part of the combination.

The £75 Hitachi HA-2800 amplifier was reviewed as part of the Systems book in the 2800VS system. This slimline model offered 36watts on test but had only limited hook-up facilities. Though only tape record/ replay, phono and tuner inputs were provided there were two pairs of speaker outlets, surprising in view of the amp's limited ability to drive low impedance loads. With suitably efficient, easy to drive speakers (such as the KEF Codas used in the test programme) the Hitachi turned in an above average subjective performance.

classic Hitachi MOSFET The power amplifier configuration is still available as part of the CA/HM7500/ II pre/power amp combination. This was an attractive and beautifully finished combination with fine presentation and generally sound technical performance. It was however, considered expensive for the power offered and for its severely restricted delivery into low impedances. In effect this means that speakers need to be chosen with care to take proper advantage of the 100 watts per channel8ohm power available. Great care should be taken in selection if two pairs of speakers are to be used together. Although listening impressions were above average, positive and consistent they were felt to be unexceptional at the £390 asking price.

The Lentek amplifier from a specialist UK manufacturer offers a rare combination of function, beauty and good styling. The finish being typical of the standard set by Japanese manufacturers and rarely matched in the West. Functions are deliberately limited although two tape decks, and both magnetic and moving coil cartridges can be accommodated. Both phono inputs have great flexibility over sensitivity and capactive/impedance match to ensure optimum cartridge performance. Despite the weight of the amp the power delivery was not very great at around 70 watts but the fact that this is maintained into 40hm loads suggest that the power supply is both generous and well-controlled. Although lab results were very good, listening tests were inconsistent with a rating only a little above average; the most positive attribute being a unusual neutrality in the important midband region. The Lentek was considered expensive at £750 (now £785) for the power produced. When value for money is not a prime consideration the reassuringly solid build and neutral performance clearly show it to have a place in the market.

The **Marantz PM310** came in for a fair amount of criticism but the amp was considered to have acquitted itself reasonably when examined as a whole, having an overall rating marginally below average in the Amplifiers Issue, though being rated higher in the context of the Marantz 310 rack system reviewed in Systems *Choice.* Both reviewers found the sound a little coloured and muddled;

this being more noticeable when the amp was driven hard which suggests it is best partnered with sensitive loudspeakers. The overall sound was quite balanced, if short on detail, and aggressive tendencies were 'mercifully slight'. To give of its best, the PM310 must be suitably partnered, which accounts for the less than enthusiastic welcome in Amplifiers. On the tightest budgets this£69 amp can be recommended however. The slightly more expensive **Marantz PM350** offering 50 watts on our tests for £90 is also worth considering.

The **Mitsubishi DA-U640** is a neatly designed unit offering above average power (66 watts) forits price (£125). In addition to full tape dubbing for two tape decks the amp offers terminals for two pairs of speakers which can be driven independently or together. Though overshadowed by failings elsewhere in the Mitsubishi System 3, in which the amp was tested as a separate unit, it is certainly worth considering.

Reviewed as part of the X330 system, the **Pioneer SA-420** may still be available as a separates component at around £60. unusually styled the amp proved surprisingly good at delivering power into low impedances. Though a lowish power of 28watts was meaured into the test80hm load, 42watts were delivered into 40hms — odd therefore that Pioneer have not offered the facility to run both pairs of speakers simultaneously with this amp. Auditioning showed the amp to be slightly muffled but at the price the performance was felt to be good.

The Pioneer A7 was too close in price to its Recommended A8 brother to merit Recommended status itself. The A7 was however competently engineered and rated well on the listening tests, offering a smooth if not spectacularly exciting sound. It was happily free of the fatiguing effects of many other designs auditioned. Power output was more than adequate though not as generous as can be expected from Japanese amps in this price bracket. All in all the A7 didn't offer the price/power balance offered by the A8 at £60 more, though it is certainly worth considering in its own right.

The Quantum 102/207DA pre/ powerampcombination(£325) came within an ace of recommendation in the Amplifiers issue. Of the Quantum range of amps this offered the best overall package, and appears to give a good combination of power and sound quality at the price. There was plenty of reserve to drive low impedance loads although the power supplies were felt to be a little 'loose' output was 80watts into the 80hm test load. Preamp inputs were usefully flexible though the disc RIAA response was not as flat as the reviewers would have liked. Crosstalk was poor and limited by the preamp which also turned in adequate figures only for noise and hum. The verdict was 'promising but in need of tidying up' though 'potentially good value for money'.

By conventional standards the **Rotel RC/RB 1010** pre/power amp combination gives you quite a lot of amplifier for your money (£300) but

listening tests were not especially encouraging. There was plenty of power available from the power amp with well-maintained delivery into 40hm loads though lower impedancescouldcause hiccups. The preamp showed a disturbingly high input capacitance on the magnetic input which restricts the use of this preamp with all but a small range of cartridges, notably the Grado and Glanz designs which are unaffected by such high capacitance. High output moving coils could be considered in an attempt to circumvent this problem. on test the sound was quite liked when the amp was playing softly but when any real power was being demanded the sound was felt to deteriorate, particularly in the lowfrequencies when control was quickly lost. This combination's inclusion here is in acknowledgement of its value for money rather than in respect of its overall achievement on test.

The Sigma drive Trio KA-1000 was rated a sound enough performer but no bargain at £540 (it should not be available at a more typical price of £485). The power amp section proved powerful, offering 128watts per channel into the standard test load but with some limitation on low impedance delivery and a 'soft-clipping' effect on 20hm loads. So while overload on this design would not be unpleasant, higher impedance speakers would be a more suitable match than those with low impedance dips. The main feature of this amp is the Sigma four-wire drive which enables the loudspeaker cables up to the speaker terminals to be included in the amplifier's negative feedback loop, thereby further reducing distortion in the system. The Sigma drive cables offered a general improvement in stereo imagery and 'tautness' of sound in the listening tests. The moving magnet input of the preamp section proved commendably flat although the mc input had a distinctive falling response. This is a very competent design but one which is perhaps a little over elaborate. The Sigma drive worked well but a premium is paid for the 'non-magnetic' design, an elaboration which is perhaps questionable.

The Yamaha A560 (£99 when tested though now selling for £139) was a difficult amplifier to sum up because the technical performance and power available were very good for the price and the unit does have the added benefit of a moving coil input. However, the listening tests showed a dislike for the sound of this amp; the main point of criticism being the loose bass and lack of detail and definition. The disagreement of the listening panel suggests that personal audition is essential as these findings may be fallible. 80watts a channel was measured at 80hms, with well-maintained delivery into the 40hm test load, and into the 20hm load. This amp is most unlikely to have any problems driving any loudspeakers. The preamp section was competently designed with good RIAA, perhaps a little bass shy, while distortion and noise figures were excellent. Check this one out for yourself.

Marantz UK Ltd., 15/16 Saxon Way Ind. Estate, Moor Lane, Harmondsworth, Middx. UB7 OLW. Tel 01-897 6633



Presentation, facilities etc

Originally marketed as part of the Marantz *Esotec* brand, the *PM5* is joining the top of the regular range now, with a welcome £100 price reduction. This large integrated model has a gold-coloured fascia which stands proud of the case proper, for console mounting, and is decorated with a large range of features. One quite unusual facility is that the power amplifier may be switched to operate either in Class A or in Class B modes: in theory Class A is considered to be superior because it eliminates 'crossover distortion' which may be caused when switching from one output transistor to another, though in practice any benefit is far from proven, and also 'wastes'

Marantz PM5

The copious facilities include tone controls which operate independently on each channel. elaborately scaled light-type 'power' meters, a five-position mode selection switch, selection for two sets of speakers plus a headphone socket. and monitoring and dubbing for two tape recorders. Provision is made for both moving-coil and moving magnet cartridge types, and front panel switches also operate a loudness function. a subsonic 'rumble' filter, and a tone control bypass switch, the latter rather obscurely labelled 'straight DC'. The layout of the front panel knobs and switches has a pleasing symmetry, though this does not assist in finding the volume control easily, nor is it complemented by the inevitable Marantz confusion of logo typefaces scattered hither and thither. All inputs and outputs are on phono sockets. When in use, particularly in Class A mode, the unit naturally gets guite warm, so some care needs to be taken to ensure adequate ventilation.

Lab performance

The significant heat output from this model was noted, causing a continuous 'ticking' from the heat pipe which is used to cool the transistors. Power delivery comfortably exceeded the 80/20 specification, though why the power meters are scaled to 200/50 watts/80hms remains obscure. A significant though not excessive difference between single and duel channel drive power outputs may be seen in Class B mode, but the power delivery into low impedances was generally well maintained, so choice of accompanying loudspeakers should not be criticial.

Bandwidths show sensible curtailment at the frequency extremes, but the disc input frequency responses do show a mild low frequency 'bump' of about 1dB, sufficient to be audible and introduce a measure of tonal coloration though unlikely to be considered offensive. More worrying perhaps is our measured input capacitance of 370pF on the moving magnet input; although it could be argued that this can help control ultrasonic spuriae from modern wide-bandwidth cartridges, the fact remains that it will also have an undesirable effect upon the high frequency audio band response of a significant number of models, particularly with the typical extra 150pF provided by the turntable's pickup leads. The discrepancy between our finding and the 150pF measured for a similar amplifier (Colloms: Hi-Fi News May 1981) remains unexplained. In other respects the inputs and outputs show well chosen values that should cause no compatibility problems.

The other measured technical performance parameters were to a competent standard, with the crosstalk better than 50 dB across most of the audio band, noise figures a little below average, while the intermodulation spectrum shows no specifically identifiable sidebands, though there is a rise in noise related to the test signals.

Listening impressions

The listening tests gave generally positive results, with the overall ranking well above average, albeit with occasional dissent. Most criticisms were directed at a rather 'bright' treble, and little difference was noted between Class A and B operation. Some informal auditioning was also undertaken with the related *MA5* mono power amplifiers, which showed a slight improvement, and also a slight change between modes when driven from a high quality component pre-amp.

Conclusions

This was definitely considered amongst the more lively, dynamic and informative integrated amplifiers, and gave a well balanced subjective performance for the price. Some reservations nevertheless remain concerning the moving magnet input capacitance and the perhaps unnecessarily elaborate arrangements (cooling etc) needed to provide the Class A option.



GENERAL DATA

Power stage	Class B
Both channels 20Hz/1kHz/20kHz	
8 ohms, 0.1% dist	.99.4/100/98 Watts
o/p level ref 2.83V=0dB	
Single channel 8/4/2 ohms	
1 kHz, 0.1% dist	. 113/182/237 Watts
o/p level ref 2.83V=0dB	20.5/19.6/17.7dB
Single cycle power 1 kHz, 8/4/2 ohms	. 156/276/380 Watts
o/p level ref 2.83V=0dB	21.9/21.4/19.8dB
Dynamic headroom (IHF)	1.05dB
Power stage	Class A
Both channels 20Hz/1kHz/20kHz	
8 ohms, 0.1% dist	25/25/25 Watts
o/p level ref 2.83V=0dB	14/14/14dB
Single channel 8/4/2 ohms	
1 kHz, 0.1% dist	26/44/65 Watts
o/p level ref 2.83V=0dB	14.1/13.4/12.1dB
Single cycle power 1kHz, 8/4/2 ohms.	29/48/81 Watts
o/ p level ref 2.83V=0dB	14.6/13.8/13dB
Dynamic headroom (IHF)	0.24dB
Bandwidth (-3dB below half power)	
Disc in – power out	5 Hz – 51 kHz
Disc in – pre out	
)isc in – tape out	4Hz – 175kHz
lux in – power out	3Hz – 46kHz
nputs Type Sens (mV) Ir	np(ohms) Cap(pF)
Disc MM Phono 2.5	54k 370
isc MC Phono 0.25	74
uner/Aux Phono 180	39k
ape 1 & 2 Phono 180	39k
)isc overload MM	39dB
Disc overload MC	38dB
Dutputs (5.0 mV disc input) Type Le	vel (mV) Imp (ohms)
ape 1 & 2 Phono	325 600
leadphones (8 ohms)	70
(2 kohms)	2.5V
loise (ref 1 Watt, 8 ohms)	
ero volume	82dB
ux ref volume	78dB
M disc ref volume	78dB
//C disc ref volume	74dB
Other	
amping factor	77 (Class A, 64)
HD performance	excellent
lum performance	average
Dimensions(W x D x H) 161/2(42) x 141	2(37) x 6(15) ins(cms)
Veight	
vpical purchase price	£400



Crosstalk, mm disc input, note baseline reference (10 dB per division)

A8 Pioneer Pioneer High Fidelity (GB) Ltd, Field Way, Greenford, Middx. UB6 8UZ Tel 01-575 5757



Presentation, facilities etc

This middle model of Pioneer's 'big three' is difficult to distinguish from the cheaper A7. The fascia is divided into three full height sections finished in gold, black plus lights, and gold respectively. The right hand section is dominated by a huge volume control with an attendant muting button. A neatly indented row of large pushbuttons select the inputs: these are attractively engraved but not easy to read, while the light show next door only identifies them in hieroglyphics.

A hinged and retractable panel covers the left hand section, with just the tone control knobs peeking through (whv?) When retracted a confusion of nine little buttons is revealed, to switch mm/m-c disc, speakers A and B, 'line straight' tone bypass, mono/stereo, subsonic filter, loudness, high/low mm and m-c loading, the latter giving 200/400pF mm options and 33/100ohm m-c alternatives.

Two extra rotary controls adjust balance and sort out tape recorder switching, allowing any input to be recorded independently of the main signal playing, and organising cross-dubbing. In the centre the 'light show' gives a graphic and hard-to-ignore display of the signal routing through the amplifier. This does help to overcome ambiguities in the switch labelling, but the absence of any dimming/off switch and the use of three lurid colours makes this a difficult item of equipment to ignore. Adding further muscle to the display is a vertical 'power' meter, while the main power switch is tucked away almost as an afterthought, black on black with only a red blip to attract attention.

Lab measurements

Power delivery follows a similar pattern to the A7. offering about 1 dB of extra level. Delivery was quite well maintained into 4 ohms, though somewhat curtailed into 20hms, so a little caution is necessary when choosing loudspeakers particularly if wanting to use two pairs together and loudly, though the 'minimum 12ohms' instructions under these conditions on the back panel is quite impractical. Single/dual channel drive difference is on the large side.

The bandwidths show a measure of control, though with a certain randomness, and no LF rolloff has been incorporated. Although the intention was presumably to improve upon the A7, as it turned out the measurements were marginally poorer overall, though pretty good nonetheless. Once again distortion was vanishingly small, while the IM test shows some 'noise modulation effect', but no distinct sidebands to speak of. The tone control circuits should be switched out unless really (?) necessary, since they adversely affect the distortion and noise performance. The provision of alternative disc input capacitances is usually useful, but the values we measured are 10% higher than specification, and the 200/400pF spec would have been much more useful as 100/300pF in any case. So despite these alternatives some care needs to be taken with turntable and cartridge selection, though mismatches are likely to be minor. We cannot see the 450pF+ setting proving to be much benefit at all, unless it helps control the input bandwidth at high frequencies.

Listening impressions

Listening test results were not entirely consistent,

but the overall rating was comfortably above average in spite of this, and some listeners responded quite positively towards this amplifier. The extreme bass seemed unusually well controlled, and was quite powerful with reasonable detail and definition. A slight preference was made for moving magnet over moving-coil inputs, and there were occasional touches of 'brashness'. but by and large the dynamics were quite liked and the amplifier did not seem to become too distressed when driven loud.

Conclusions

This appears to be a soundly engineered amplifier with few if any criticisms, albeit with fairly conservative power ratings for the price. Listening tests gave encouraging though not entirely consistent results, and the technical niggles were few and slight. Ergonomics are guite good, but the Star Trek presentation might not suit everybody.

GENERAL DATA

Power stage

8 ohms, 0.1% dist
0/p level ret 2.83V=0dB20.1/20.4/20dB
1kHz, 0.1% dist
0/p level ret 2.83V=0dB21/19.9/15./dB
o/n level ref 2 83V=0dB 21 6/20 6/15 9dB
Ovnamic headroom (IHF)
Sandwidth (-3dB below half power)
Disc in – power out DC Hz – 75kHz
Disc in - tape out
Aux in - power out DC Hz - 90kHz
nputs Type Sens (mv) Tmp (onms) Cap (pr)
Disc MC Phono 0.25 33/100
Juner/Aux Phono 150
Tape Phono 150
Tape Phono 150
Disc overload MM
Disc overload MC
Jutputs (5.0 mV disc input) Type Level (mV) Tmp (onms)
Tape 2 Phono 235 3k
Headphones (8 ohms) 65
(2 kohms) 2.5V
Noise (ref 1 Watt, 8 ohms)
Zero volume–89dB
Aux ret volume
MC disc ref volume
Other
Damping factor
THD performance excellent
Hum performance
Dimensions (W x D x H) $16\frac{1}{2}(42) \times 16\frac{1}{2}(42) \times 5(12)$ ins(cms)
Weight 29 lbs
Ivpical purchase price £330



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear: vert. range 90dB)

102

Tandberg 3000 series

Tandberg UK Ltd., 81 Kirkstall Road, Leeds LS3 1 HR. Tel (0532) 774844



Presentation, facilities etc

This combination of pre- and power amplifier is most attractive, with a standard of finish the equal of anything around, and a design that has distinct touches of Scandinavian flair, while sensibly not flying in the face of current fashion. Of the two units, the power amplifier is perhaps the most interesting in appearance, with the sculptured louvres through the case looking quite dramatic.

The large rotary control on the pre-amp (naturally) adjusts volume, and alongside are two smaller rotaries for balance and input selection. Two more rotaries further along adjust bass and treble, while at the other end another controls the output to the headphone socket, driven independently of the power amplifier. One pair of pushbuttons switch mono and loudness, the next pair subsonic filter and tone defeat, a group of four give tape monitoring and cross-dubbing, while the one on its own switches power. Apart from the attractive metalwork, the power amplifier is almost featureless (as it should be?), with its matching power switch and two LEDs indicating peak clipping. The rear panels use phono throughout, which is a bit of a break from European tradition, but not unwelcome. Inputs are provided for both moving-coil and moving magnet cartridges, with switching for variable impedance (100/47/33 kohm) and variable capacitance (20/120/350pF) beside the sockets. Incidentally, a matching tuner is also available, as well as a most interesting (and expensive) piece of modern furniture designed specially to house the units along with other equipment.

these units were capable of a whacking 180 or so watts both channels driven, though the increase of 12% under single channel drive is a little high, so the power supply is not perhaps quite as 'stiff' as we would have liked. The power delivery is very well maintained into low impedances, showing a voltage drop of only 3.2dB into as low as 2ohms. Obviously this amplifier will drive any loudspeakers without problems, although there was slight current limiting into the lowest impedances.

Bandwidths show reasonable curtailment at the frequency extremes (or at any rate an avoidance of excess), the RIAA equalisation is very flat and nicely tailored, and the moving magnet impedance/capacitance variations are accurate and usefully flexible. The moving-coil input impedance is higher than usual, though we would be surprised if this made any significant difference. Distortion is quite low (if not quite as low as the latest Japanese amplifiers), and the noise and hum performances were not quite as good as we expected. One curiosity is that the gain matching through the pre-amp is not quite right, so that it is not difficult to clip the output section with modest level inputs when the volume control is set high. This may not matter in practice as there is plenty of volume at the control mid position with a typical input, and here the overload margin is high. But it does represent a chink in the armour of this otherwise impressive system. The IM spectrum showed the slightest sideband, and was noticeably free of the 'noise modulation effect'.

fiers, so it was pleasant to find that this expensive model did seem to deliver the goods subjectively, and was placed consistently high in the listening tests. The sound was considered 'open', 'clean' and commendably clear of confusion, if a trifle lacking control at high frequencies and not entirely well-defined at low frequencies. Generally quite 'busy' sounding with plenty going on, it nevertheless lacked the full dynamics and 'focus' of the best audiophile amplifiers.

Conclusions

This is an expensive combination, but one which did consistently well throughout the tests. As an amplifier for the music lover who would rather avoid the occasional eccentricities of the audiophile market, and who rates style and engineering quality above simplistic value for money, the Tandbergs stand up extremely well, and are a welcome surprise from this tape recorder specialist

GENERAL DATA

Power stage Both channels 20Hz/1kHz/20kHz 8 ohms, 0.1% dist 175/181/178 Watts o/p level ref 2.83V=0dB.....22.4/22.5/22.5dB Single channel 8/4/2 ohms 1kHz, 0.1% dist 205/315/386 Watts o/p level ref 2.83V=0dB..... 23.1/21.9/19.9dB Single cycle power 1 kHz, 8/4/2 ohms ... 225/378/400 Watts o/p level ref 2.83V=0dB......23.3/22.8/20dB Dynamic headroom (IHF)0.4dB Bandwidth (-3dB below half power) Disc in - tape out7Hz - 77kHz Inputs Type Sens (mV) Imp (ohms) Cap (pF) Disc MM Phono 33/48/98k 34/131/ 22 334 Disc MC..... Phono 0 16 1k 48k Tuner/Aux Phono 150 Tape 1..... Phono 150 48k 150 48k Tape 2..... Phono Power amp Phono 1.1V 10k Disc overload MM..... 42dB Disc overload MC 41 dB Type Level (mV) Imp (ohms) Outputs (5.0 mV disc input) Tape 1..... Phono 300 1k Tape 2..... Phono 300 1k Headphones (8 ohms) 300 max (separate (2 kohms).... 17V max control) Noise (ref 1 Watt, 8 ohms) Other THD performance excellent Hum performance very good Dimensions(W x D x H) ... 17(43.5) x 15(38) x 6.5(16) ins(cms) Weight 35lbs Typical purchase price£850



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear; vert. range 90dB)

Lab performance

Belying its compact dimensions (if not its price),

Listening impressions

Tandberg have no recent track record for ampli-

Panasonic UK Ltd., 107/109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 27516



Presentation, facilities etc

The *SU*-*V*7 delivered to us was pleasingly finished in a dark, neutral matt-brown, with the panel lettering in a complementary lighter colour, an alternative version is available with a silver fascia. The front is divided horizontally into two sections, the top part featuring the most used volume and selector controls. Showing the way fashions change, the volume control has a nice continuous smooth action without discrete steps, and the 'power' meters fitted to the cheaper *V*3 have been dispensed with.

Iechnics SU-V7

By and large the facilities provided appear to have been carefully chosen. Moving magnet or moving-coil type cartridges may be accommodated, recordings may be made from any source irrespective of the source being listened to, and a full tone control bypass switch is fitted. Switching also controls speaker selection, mono/stereo, high and subsonic filters and loudness. There is a smattering of indicator lights as well as Technics' traditionally tasteless illuminated 'new class A synchro bias' panel. These niggles aside it is a pleasantly unassertive design which is easy to use. Phono sockets are used throughout on the back panel, with DIN duplication of one tape set.

Lab performance

The power output is very generous for an amplifier at this price level, and delivery is well maintained into 40hm loads. However, the 20hm load tests actuated the protection relays and also showed some limitations under our single cycle burst conditions, so some of the most awkward speaker loads might be best avoided, and a little care may be needed if driving two pairs of speakers hard.

at a party for instance. One curiosity which we found was that after the protection had operated, if the amplifier was switched off and then on again immediately, the maximum power available was reduced by 2 dB until the amplifier had been left off for a considerable time: this may be a useful extra measure of protection or a sample irregularity, but regular party givers might take note. There was virtually no difference between the power outputs with one or both channels driven, which is a good point.

The disc frequency responses were commendably flat, and the measured bandwidths showed some attempt at control, with no excessively high frequencies present. Inputs and outputs showed sensible values throughout with no potential matching problems; the headphone output had slightly greater attenuation than usual, though this may well be no bad thing. The intermodulation test showed better than average results, but the background noise spectrum did not appear quite as 'clean' as other amplifiers under these conditions. Measured noise figures, harmonic distortion performance and hum performance were all fine. Overall this is clearly a very competently and cost-effectively designed amplifier.

Listening impressions

The results of the various listening tests were both consistent and favourable, the sound being described as generally'lively' and 'open', perhaps a little presence/treble 'bright', but with good overall coherence and reasonable dynamics. Some misgivings were made of a lack of real 'power' at the bass end and a rather 'grainy' effect on the sound as it was driven harder, but stereo and separation were both well liked. The consistency of these comments was unusually good, so we feel reasonably confident in presenting them, and confirming a solid above-average rating for this model.

Conclusions

This is a pleasantly styled amplifier which consistently gave above average results on both the technical and the listening tests. The price is quite modest, the power quite generous, and there is very little ground for criticism, so we can do little but endorse its obvious merit.

GENERAL DATA

Power stage

8 ohms, 0.1% dist								
o/p level ref 2.83V=0dB 19.8/19.8/19.8dB								
Single channel 8/4/2 ohms								
1kHz, 0.1% dist 102/170/Relay Watts								
o/p level ref 2.83V=0dB 20/19.3/Relay dB								
Single cycle power 1 kHz, 8/4/2 ohms 107/200/224 Watts								
o/p level ref 2.83V=0dB 20.3/20/17.5dB								
Dynamic headroom (IHF)0.12dB								
Bandwidth (-3dB below half power)								
Disc in - power out								
Aux in a new or out								
Aux III - power out								
Disc MM Phone 2.9 47k 162								
Disc MC Phono 0.190 215								
Tuper/Aux Phono 170 61k								
Tape 1 & 2 Phono 170 64k								
Tape 2 DIN 210 64k								
Disc overload MM								
Disc overload MC								
Outputs (5.0 mV disc input) Type Level (mV) Imp (ohms)								
Tape 1 & 2 Phono 300 530								
Tape 2 DIN 32 77k								
Headphones (8 ohms) 22								
(2 kohms) 800								
Noise (ref 1 Watt, 8 ohms)								
Zero volume87dB								
Aux ref volume								
MM disc ref volume80dB								
MC disc ref volume77dB								
Other								
Damping factor								
THD performance excellent								
Hum performance								
Dimensions (W X D X H) 17(43) X 14(36) X 5(12) INS(CMS)								



Disc frequency response, note expanded vertical scale (2dB per division) (m-c above, mm below)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Pechnics SU-V3

Papasonic UK Ltd. 107/109 Whitby Road, Slough, Berks, SI 1 3DB, Tel (0753) 27516



Presentation, facilities etc.

This is a reasonably compact and slim amplifier. with a very well finished satin-silver fascia. The control layout is neat and unobtrusive, apart from the light-type 'power' meters which are a little garish. The volume control is sensibly large and distinguishable, and function switching is delegated to three rotary controls, controlling speaker selection, tape recorder selection, and main amplifier input/output respectively; this arrangement permits tape recording to be made from any input whatever source has been selected for listening at the time.

Subsidiary controls are relegated to the bottom third of the fascia, and include bass, treble, and balance controls, and switches for low and high filters, 'loudness', and meter range. Sadly there is no mono switch, an unfortunate omission for owners of old and treasured recordings, as in such cases this helps to reduce surface noise and rumble. Phono inputs are used throughout. though there is DIN duplication on one tape position. Certain claims for operating principles such as 'new Class A synchro-bias' and 'DC' circuitry are made with unnecessary vigour on the front panel: such features are of nebulous benefit in themselves (the whole being greater than the sum of the parts), their main purpose being to give the copywriter or salesman something to talk about.

Lab performance

We are accustomed to excellent laboratory results on Technics models, and the SU-V3 is no exception despite its comparatively modest price. Indeed it is somewhat encouraging to note that Technics

and quality in an attempt to meet a particular commercial price target. Power delivery is generous for the price, and well maintained into low impedances, so selection of partnering loudspeakers is uncritical. However the difference between single and dual channel capabilities approaches 20%, indicating some limitations in the power supply 'stiffness', though this is by no means unreasonable for a modestly priced amplifier.

Most of the points one can raise concerning the technical performance are in the nature of guibbles rather than criticisms. The hum performance only rated average, and the disc input bandwidth might have been curtailed an octave below the measured 70kHz with advantage. Inputs and outputs have been sensibly chosen. so no matching problems are likely. Crosstalk measured quite well, rising to a reasonable -42dB from a very good low frequency -68dB. The intermodulation spectrum shows no specifically identifiable sidebands, though the noise floor did rise somewhat with the application of the tests signals on either side of these. The normally measured noise figures were however verv good.

Listening impressions

Listening test results were consistently in the average and above average class, which is very encouraging for a model in this price class. Most descriptions included the adjectives 'bright', but in a 'forward' or 'open' sense rather than indicating aggressiveness. A somewhat 'powerful' sounding bass was felt by some to be slightly less well controlled than the best amplifiers. Detail and do not seem prepared to sacrifice performance information presentation was generally praised

for an amplifier in this class, and it managed the far from easy feat of sounding guite lively and generally well-controlled at the same time. Amongst non-moving-coil models, it was clearly one of the top performers.

Conclusions

This is clearly a very competent design, which is modestly priced but has made few compromises to this end. Certainly there are some indications that the power supply has to work fairly hard but then this is part of what cost-effective engineering is about. The auditioning gave consistently encouraging results, which suggest that this is amongst the leading budget designs in terms of sound quality (something which we would have been reluctant to say about earlier Technics models). And if this alone is not enough, the power delivery is also generous for the price. Our only regret is that the choice of features is very much consumer- rather than audiophile-oriented. and it would have been nice to have had a moving -coil cartridge input instead of flashy power meters, mono and tone-bypass switches instead of speaker switching.

GENERAL DATA

Power stage

S

ç

Both channels 20Hz/1kHz/2	20kHz		
8 ohms, 0.1% dist		. 50. 5/54.6	/54.6 Watts
o/p level ref 2.83V=0dB.		17.0/1	7.4/17.4dB
Single channel 8/4/2 ohms			
1kHz. 0.1% dist			5/112 Watts
o/p level ref 2.83V=0dB.			6.8/14.5dB
Single cycle power 1 kHz, 8/4	/2 ohms	78.7/13	6/195 Watts
o/p level ref 2.83V=0dB.			19/18/17dB
Dynamic headroom (IHF)			0.07dB
Bandwidth (-3dB below ha	alf power	r)	
Disc in - power out		10	Hz – 70kHz
Disc in - tape out		11	Hz - 57 kHz
Aux in - power out		5H	lz – 104 kHz
nputs Type Se	ens (mV)	Imp (ohm:	s) Cap(pF)
Disc MM Phono	2.5	47 k	160
funer/Aux Phono	140	86 k	
Tape 1 & 2 Phono	170	78k	
Tape 2 DIN	170	78 k	
Disc overload MM			36dB
Outputs (5.0 mV disc in put)	Type	Level (mV)	Imp (ohms)
Tape 1 & 2	Phono	260	550
Гаре	DIN	28	78 k
Headphones (8 ohms)	Jack	68	
(2 kohms)		2.5V	
Noise (ref 1 Watt, 8 ohms)			
Zero volume			–90dB
Aux ref volume			–84 dE
MM disc ref volume			–80dE
Other			
Damping factor			
THD performance			excellent
Hum performance			average
Dimensions(W x D x H)	17(43) x	13½(34) x4	(10) ins(cms)
Weight			16lbs
Typical purchase price			£120



Disc frequency response, note expanded vertical scale (2dB per division)



Crosstalk, mm disc input, note baseline reference (10dB per division)



Intermodulation distortion spectrum (horiz 0-25kHz linear: vert. range 90dB)

A&R A60 /T21

A&R (Cambridge) Ltd., Denny End Industrial Centre, Waterbeach, Cambridge CB5 9PB Tel (0223) 861550



Presentation, facilities, etc.

A&R's A60 amplifier has been fundamentally unchanged for some years, though the company policy is one of continuous detail improvement. It has acquired a good reputation for sound quality at its price, which tended to be confirmed in the recent Choice: Amplifiers book. The T21 tuner is a more recent introduction, and uses A&R's expertise in designing LED displays for the professional market. These are amongst the slimmest units in the book – stacked together they would still be dwarfed by some of the single units in this survey and are attractively discrete, with black faces and wooden cases.

The tuner has five presets on the back panel in addition to the normal tuning knob on the fascia, and all may be selected by front pushbuttons which also switch mono and AFC. Centre-tune, stereo and signal strength are displayed; the back panel accepts both aerial types, and also offers variable signal output. The amplifier offers fairly basic traditional facilities, but in addition one or two which are less common. These include alternative speaker terminals which allow direct or via headphone connection, so switching in the output signal path may be avoided by those who so desire; comprehensive alternative components are available from the manufacturer to optimise cartridge matching; the DIN disc input uses a spare pin to power A&R's head amp, an optional extra for those using moving-coil cartridges. Overall an attractively finished unusual design with particular appeal to the enthusiast.

Lab performance

 \square Lab performance \square A little on the expensive side for the measured

power, this was nevertheless well maintained under the various measurement conditions, and is probably limited by the size of power supply that can be fitted into the very slim case. The disc input bandwidth is nicely limited, and cartridge loading flexible, while the crosstalk shows a welcome 20dB improvement over that measured in Choice: Amplifiers. Though using DIN sockets, the equipment should interface without problems with either standard. Performance characteristics were generally fine, but with hum performance below average.

The tuner absolute sensitivity measurement was not exceptional, but the more important 50dB stereo figure was well above average, as were all the measurements apart from distortion.

Subjective impressions

In a repeat of our *Amplifiers* findings, the A&Rs consistently appeared in the top group in audition, being described as coherent, integrated, smooth and quite 'lively' on disc and FM. The LED tuning scale did not hold much appeal for our radio enthusiast, who found it irritatingly imprecise, but he also rated the performance highly.

Conclusions

Our familiarity with these models makes dispassionate evaluation difficult, but our findings still indicate that by dint of well balanced design compromise without fancy aspirations they simply deliver the goods, and may therefore be confidently recommended as offering good value in the medium price class.

New mother board in A60 gives onboard MC facility and MM loading at no extra cost.



LG HZ

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AMPLIFIER

Power					
Bandwidth (-3dB ref max	powe	r, disc).		11H	z–43kHz
Both channels 20Hz/1kHz/2	0kHz(8 ohms, ().1% dist).		30 Watts
Single channel 8/4/2 ohm	s (1 kH	z. 0.1%	dist)	. 43/74/2	28 Watts
Burst power 1kHz, 8/4/2	ohms .			. 57/92/2	29 Watts
Inputs	Type	Sens	(mV) Ir	np (ohms) Cap
Disc MM	DIN	2	.0	48k	240pF
Disc MC		head	amp optio	nal extra	1
Tuner/aux	DIN	1	00	100 k	
Таре	DIN	1	00	48k	
Disc overload 1kHz					37dB
Outputs (5mV disc)		Type	Level (r	nV) Imp	o (ohms)
Таре		DIN	165		50k
Headphones (8 ohms)		Jack	70		
Noise (ref 1 Watt, 8 ohm	s)				
Zero volume					81dB
Aux ref volume					75dB
Disc ref volume					82dB
Other					
Damping factor					44
THD performance					good
IMD performance					. average
Hum performance				below	average

TUNER

RF Performance 30dB S/N Ratio. mono sensitivity. 2.00...V IHF 30dB S/N Ratio, mono. 2.00 uV Muting level 3.00 uV Limiting level, -1 dB 2.00 uV 1.5dB Capture ratio Image rejection 78dB Audio Section Distortion, stereo 20%/100% modulation 0.55/1.00% Pilot tone suppression-55dB Crosstalk, LkHz. -42dB

GENERAL

otal size (W	(xDxH)		1734(45)	x 10(25)	x 4 ³ / ₄ (12) in(cm)
Approximate	weight					19lb
vpical retail	price	f_{190+f}	173 when	reviewed.	now £19	9 + £190



CAPTIONS (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms) 1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.

Meridian 101/105/104

Boothroyd Stuart Ltd., 13 Clifton Road, Huntingdon, Cambridgeshire PE18 7EJ Tel: (0480) 57339



Presentation, facilities, etc.

The largest of the Boothroyd-Stuart designed module systems, this uses the same pre-amp and tuner as the other two systems reviewed on the previous pages, but this time with two entirely separate and much more powerful 'double module' mono power amplifiers (one for each channel). In all, this is the equivalent of six small modules, but the power amplifiers' doubled width precludes straightforward vertical stacking, though the system remains flexible.

To re-iterate, the tuner operates via six screwdriver-set presets on FM only, the rather cramped tuning scale doubling as centre-tune meter. Aerial signal is supplied via a 75 ohm socket, and stereo beacon and stereo-plus-mute/ mono-without switch are also fitted. The system signal interconnections are via DIN socketry, and European-style mains plugs link the items so all are switched on from the 'master' pre-amp volume/ balance/on-off potentiometer. Internal circuitry is based on module systems to permit upgrading without full replacement in case of future technical improvements, and enables precise matching to a variety of pickup cartridges, including m-c and m-m models. To avoid signal path switching and processing, tone controls and alternative speaker and headphone outputs are omitted. In summary, an audiophile system of extreme elegance which is very simple to use, and which has achieved something of a 'cult' reputation for good sound quality.

Lab performance

The very generous power output to some extent

justifies the very high price, while the power delivery is superb into low impedances and under 'burst' conditions, the separate modules ensuring that there are no inter-channel effects. The disc input bandwidth is sensibly restrained, with the tested module offering sensible capacitance (alternatives available), while the frequency response conforms to the new IEC bass rolloff recommendations and suggests a slightly bright character. The DIN inputs and outputs do in fact match phono standards, and should be used accordingly. Performance parameters were generally good, with IM distortion performance rating average.

The tuner measurements were generally pretty good, with very good sensitivity and pilot tone suppression, about average results for noise, AM rejection and RFIM, and lower selectivity than most.

Subjective impressions

Consistently superior listening test results were only really to be expected, the overall marks being the best of the lot, with particular praise for the bass performance, general integration, and power, but also with mild criticism of slightly fatiguing high frequencies; FM was also considered well above average. Though hardly a dial-twiddler's delight, the tuner was quite liked in use in spite of the tiny meter, with good tune indication and muting and stereo thresholds, plus good response to weak stereo signals, albeit with some sensitivity to multipath distortions.

Conclusions

Although expensive, the consistently good subjective results and excellent power delivery dictate recommendation to those with the aspirations and good enough ancillaries to feel the benefit.

New retro-fit output module and double input/EQ module (for mc cartridges) now fitted as standard. Power amps now S modified with feedback loop taken around protection circuitry. Preamp significantly revised in late 1982, now designated 101B.

AMPLIFIER

ower					2011 50111
andwidth (-3dB ref max	powe	r, aisc).	• • • • • •		20Hz-30kHz
othchannels20Hz/1kHz/20	nchannels20Hz/1kHz/20kHz(8 ohms, 0.1% dist) 100/106/100 Watts				
ingle channel 8/4/2 ohms (1kHz, 0.1% dist) 106/169/212 Watts					
urst power 1kHz, 8/4/2	ohms.			. 160/2	89/475 Watts
nputs	Type	Sens	(mV)	Imp (ohms) Cap
Disc MM	DIN	1	2.7	47	7k 125pF
Disc MC		variou	s modu	les avai	lable
uner/aux	DIN	1	90	32	k ?k
ape	DIN	9	50	32	k ?k
oisc overload 1kHz					34dB
Outputs (5mV disc)		Туре	Leve	l (mV)	Imp (ohms)
ape		DIN	2	205	6k
loise (ref 1 Watt, 8 ohms	s)				
ero volume					89dB
ux ref volume					79dB
Disc ref volume					84dB
Ither					
Damping factor					141
HD performance					good
MD performance					average
lum performance					excellent

TUNER

RF Performance		
30dB S/N Ratio, mono sensitivity0.90uV		
501B S/N Ratio, mono/stereo sensitivity1.50/23uV		
IHF 30dB S/N Ratio, mono 1.10uV		
Muting level 1.3uV		
Limiting level, -1dB 0.9uV		
RFIM		
Capture ratio		
Selectivity		
IF rejection		
AM suppression		
Image rejection		
Audio Section		
S/N ratio 1mV i/p, mono/stereo		
Distortion, mono 20%/100% modulation		
Distortion, stereo 20%/100% modulation0.10/0.24%		
Pilot tone suppression		
Crosstalk 1kHz -43dB		

GENERAL

Fotal size (W x D x H)	11(28) x 13(33) x 6(15) in(cm)
Approximate weight	
Typical selling price	\dots £600+£225 when reviewed,
	now $£723 + £259$

CAPTIONS (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms) 1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod). 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.



Meridian 101/105/10
NAD 3020/4020

NAD Sales, Cousteau House, Greycaine Road, Watford WD2 4SB Tel (0923) 27737



Presentation, facilities, etc.

NAD's 3020 amplifier has already acquired something of a cult reputation in a surprisingly short time, featuring as it does some quite advanced circuitry ideas from some of America's leading designers; rather less Press attention has been paid to the matching 4020 tuner which is included in this review.

The tuner is a basic FM-only model, with switched muting and mono, and light indicators for stereo and centre-tune. The rear panel accepts 75 and 300 ohm aerials, and offers switchable 25/50/75 us de-emphasis. The amplifier has ample facilities without excessive frills, with four phono inputs and DIN duplication on tape, simple tone controls with loudness and muting, pre/power break socketry, a single set of speaker sockets and a headphone output. The rear socketry is conveniently accessible on a horizontal panel. The amplifier features a selectable 'soft-clipping' circuit, which is intended to allow the unit to exceed its rated power on short peaks without audible degradation. Both matching units are reasonably slim, and discretely dark coloured with matt finish.

Lab performance

The limited power is nevertheless respectable for the price, and the delivery under various conditions The 4020 tuner is now available only in the 4020Awas quite reasonable, with the usual single/dual MW/FM form. FM performance should be channel differences, and fair performance into low unchanged. impedances, marred a little by the 'burst' figure on 2 ohms. The special 'soft clipping' switch appeared to have the desired effect, though it also reduced the available power by some 50%, and might therefore be better left out of circuit for normal listening. The disc input had a sensibly limited

bandwidth, with capacitance that can be matched to all cartridge/arms, though the frequency response characteristic might mislead by exaggerating detail, and crosstalk was below average. Other inputs/outputs are fine. Performance measurements were generally good, but with hum only average.

The tuner gave consistently average or better than average results, with pilot tone suppression very good.

Subjective impressions

The listening tests gave significantly above average results, though not entirely consistently, with descriptions of impressive 'solidity' and integration, slightly lacking in 'punch', but not aggressive. FM was felt to be a little 'bassy', but again above average. In use, the sensitivity did not seem very high, calibration showed a slight consistent error. there was some multipath sensitivity, and muting and stereo thresholds were set a little high.

Conclusions

The generally fine performance and good auditioning results at a modest price dictate firm recommendation, though the tuner leaves some room for improvement.

AMPLIFIER Power

Single channel 8/4/2 ohm Burst power 1kHz, 8/4/2	s (1 kH ohms	lz, 0.1%	dist) .		5 Watts 6 Watts	DE
Inputs	Type	Sens	(mV)	Imp (ohms)	Cap	15.
Disc MM	Phone	o 3	.4	47	60pF	
Disc MC		-		Reference of		4 50
Tuner/aux	Phone	2	30	14 k		11 34
Таре	Phone	2	30	15 k		0.
Таре	DIN	2	30	15 k		
Disc overload 1kHz					38dB	
Outputs (5mV disc)		Туре	Leve	I(mV) Imp	(ohms)	DB
Таре		Phono	2	00	6k	
Таре		DIN		55	70k	
Headphones (8 ohms)		Jack		85		88.
Noise (ref 1 Watt, 8 ohn	ns)					
Zero volume					92dB	8
Aux ref volume					81dB	
Disc ref volume					89dB	
Other						D
Damping factor					60	-
TUD					excellent	
IHD performance					V- / V- V- 11 V- 11 V	
IMD performance						88.

TUNER

RF Performance
0dB S/N Ratio, mono sensitivity
0dB S/N Ratio, mono/stereo sensitivity 2.25/32uV
HF 30dB S/N Ratio, mono 1.50uV
Muting level
Limiting level, -1dB 1.0uV
RFIM
Capture ratio 1.5 dB
Selectivity
F rejection
AM suppression
mage rejection
Audio Section
S/N ratio 1mV i/p, mono/stereo
Distortion, mono 20%/100% modulation0.40/0.30%
Distortion, stereo 20%/100% modulation
Pilot tone suppression
Crosstalk, 1 kHz

GENERAL

Total size (W x D x H)	8 ¹ / ₄ (21) x 10(25) in(cm)
Approximate weight	
Typical selling price £8	86 +£86 when reviewed,
	$1000 \pm 98 \pm 598$



NAD 3020/4020

25.6

CAPTIONS (1-6 top to bottom rt. hand column, all at 1 watt/8 ohms) 1) Aux i/p white noise frequency response. 2) IM distortion (19kHz, 20kHz aux i/p). 3) Tuner distortion (1kHz, 20% mod), 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.

Revox B780

F W O Bauch Ltd 49 Theobald Street Borehamwood Hertfordshire WD6 4RZ Tel: (01) 953 0091



Presentation, tacilities, etc.

This beautifully finished Swiss heavyweight has probably more comprehensive facilities than any other model in this book. Typically Revox with its blue-grey and silver finish, this is a big unit with Lab performance massive heatsinks, though little apparent wasted space - indeed it effectively combines the company's separate amplifier and tuner in a case the size of one of them.

section features full frequency synthesis with frequency band, plus some eighteen 'memory' presets, which are preserved when power is selection: switching for de-emphasis, noise reduction, high-blend, mono, muting, and stereo only; and socketry for 75 and 300 ohm aerials, plus 'scope feed' and a 'blank', intriguingly labelled 'ant contr', which will perhaps permit automatic control of aerial rotation? On the amplifier side, socketry is phono, but with DIN on Tape 2 and pre/power, Subjective impressions and with a front panel 'pre-out' jack. Headphones and two sets of switchable speakers (one DIN) are reasonably consistent, with comments concerning provided. Switchable tone controls cover bass. presence and treble, and other switches cover loudness, mono, -20dB muting, and one of three of the performance near and into clipping. FM was filter positions (low, high, and the appallingly also liked, and had a good bandwidth. Users named 'low high'). Electronic switching permits confronted with this device were normally slightly any input to be fed to 'record' while any input is overwhelmed (*ie* 'wow'), and started reading the playing. Though it is hard to think of anything manual. Once mastered (?), RF performance was omitted, the control layout is a trifle fussy and exemplary though a slight asymmetry of response cluttered, and the ease of use is only marginally (or error of reading) was detected. The final plea improved by a small and awkward folding flap, that from our consultant was for an AM version.

leaves plenty of superficial controls still on display. The quality of construction inspires considerable confidence.

Conclusions

AMPLIFIER

Power

Innuts

Other

TUNER

RF Performance

Audio Section

GENERAL

6) Tuner frequency response/crosstalk.

value-for-money endorsement.

3.8

190

190

100

200

70

15

Type

Phone

DIN

Disc overload 1kHz.

Damping factor

Disc MM Phono

Tape Phono

Tape Phono

Tape DIN

Headphones (8 ohms) Jack

Disc MC

Tuner/aux

Таре

Noise (ref 1 Watt, 8 ohms)

Outputs (5mV disc)

The high power output of this model comes expensive, shows very good stability between single and dual channel drive, but is rather restricted into low impedances (a pity, as the mass The microprocessor-controlled FM only tuner and heatsinking suggest this may not be necessary). Disc input bandwidth was unnecessarily wide complex mechanisms for dialling and scanning the (with aux, restricted at 70kHz), capacitance wellchosen, and a frequency response that perhaps conformed to the IEC recommendations, but was disconnected by backup batteries. Indicators are less flat than desirable. Other inputs/outputs seem provided for signal strength, stereo and centre- fine, and performance parameters reasonable. tune, variable thresholds for station and stereo though the well below average IM distortion performance could have been better.

Ouite outstanding tuner measurements were recorded throughout, the measurements being highly consistent, often testing the limits of the test gear, and imparting considerable confidence.

Well above average listening test results were a slightly 'thick' sound, though with praise for good general control, definition, and power, but criticism



Sugden A48II/T48II

J. E. Sugden and Co. Ltd., Valley Works, Station Lane, Heckmondwike, W. Yorks, WF16 0NF Tel: (0924) 404088/9



Presentation, facilities, etc.

One might be forgiven for an Oldenberg-inspired shock when first seeing this unusually styled combination from the well established Yorkshire firm: "It looks furry" being one reaction. In fact, the exterior is in the very durable Nextel finish. which has a suede-like appearance; the lack of reflections and tastefully chosen two-tone brown makes this an appropriately well-domesticated product. Construction is reassuringly 'solid', though placed side by side (the obvious configuration), the units will take up a fair amount of shelving.

The FM-only tuner uses six rotating pushbuttons for preset station selection, the only indicator being a stereo beacon (though rear sockets enable a multi-meter to be connected to assist accurate tuning). Different push-buttons operate the other functions, but their rather unusual nomenclature may take a little getting used to: the 'mute' button merely cancels the output; 'squelch': operates interstation muting; 'filter' is a 'highblend' facility: AFC and stereo/mono are also proprovided. The amplifier feeds two sets of switchable speakers and a headphone jack, with inputs on DIN socketry including three sensitivity positions for disc. Traditional tone controls are supplemented by switches for stereo/mono, mode, tape monitoring and cross-dubbing, loudness (labelled 'quiet'), low and high filters, the latter being particularly comprehensive, with six alternatives. In summary, this is an interesting and refreshingly domestic design, soundly constructed, and with plentiful facilities.

Lab performance

The modest power output for the price is perhaps explained by the 'solidity' of delivery, with no difference between single and dual channel outputs, and with reasonable delivery into low impedances (the HF constriction being distortion limited. and not serious). The disc input bandwidth is well constrained, frequency response reasonable, though impedance and capacitance resisted our measure (findings in *Amplifiers* suggesting no problems). The DIN socketry is best used as such. Performance parameters were average, with hum excellent.

The tuner showed (possibly unrealistically) high sensitivity, but below average AM rejection, capture ratio and crosstalk: generally rather good results were found overall.

Subjective impressions

Steadily above average listening test results were recorded, with common descriptions of a smooth. powerful sound, with good 'integration', but a little gentle', and perhaps slightly fatiguing when loud. The tuner was felt to sound well above average, a vided. A 75 ohm socket and 300 ohm terminals are little 'bright' but with good perspectives and coherence, and very gentle noise. The absence of a tuning scale might give some qualms, but our 'enthusiast' consultant found this tuner a joy to use, with good performance and sound quality, and nice muting circuitry, though the thresholds were set a little low.

Conclusions

With decor that is attractive to live with and generally good ergonomics and facilities, the respectable sound quality and technical performance give reassurance that implies recommendaSugden A48II/T48I

tion. A built-in head-amp would have been a useful addition

AMPLIFIER Power

Bandwidth (-3dB ref max power, disc).....21Hz-30kHz Both channels 20Hz/1kHz/20kHz (8 ohms 0 1% dist) 41/41/34 Watts Single channel 8/4/2 ohms (1kHz, 0.1% dist) 41/52/60 Watts Burst power 1 kHz 8/4/2 ohms 52/78/90 Watts Sens (mV) Imp (ohms) · Cap Inputs Tvde Disc MM DÍN Var Disc MC Tuner/aux..... DIN 1501 170 Tape DIN 170 150 k Outputs (5mV disc) Type Level (mV) Imp (ohms) Таре DIN 100 46k Headphones (8 ohms) Jack 50 Noise (ref 1 Watt 8 ohms) Other THD performance average Hum performance..... excellent

TUNER DE Desformente

0dB S/N Ratio, mono sensitivity0.50uV
0dB S/N Ratio, mono/stereo sensitivity
HF 30dB S/N Ratio, mono 1.50uV
futing level
.imiting level, -1 dB 1.5 uV
xFIM
Capture ratio
electivity
F rejection
M suppression
mage rejection
Audio Section
/N ratio 1 mV i/p, mono/stereo
Distortion, mono 20%/100% modulation
Distortion, stereo 20%/100% modulation
ilot tone suppression
resstalk 1kHz

GENERAL

Total size (W x D x H) 22¹/₄(57) x 11¹/₂(29) x 5(13) in(cm)* Typical selling price \dots £250+£150 when reviewed, now £269+£161

CAPTIONS(1-6 top to bottom rt. hand column, all at 1 watt/8 ohms) 1) Aux i/p white noise frequency response. 2) IM distortion (19kHz. 20kHz aux i/p), 3) Tuner distortion (1kHz, 20% mod), 4) Tuner crosstalk distortion ref (3). 5) Disc i/p frequency response/crosstalk. 6) Tuner frequency response/crosstalk.



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LOUDSPEAKERS

The loudspeaker's job is to convert the electrical energy which corresponds to the music signal from the amplifier into acoustical energy - ie sound. Sound is transmitted by vibrations in the air and a loudspeaker is designed to mimic the specific vibrations that correspond to the musical event encoded in the audio signal. The vibrations in which we are interested vary in frequency from around 20 times a second (20Hz), which is perceived as the deepest bass, to around 20 thousand times a second (20kHz), which may not be perceived at all by some listeners. Only the highest harmonics of treble notes lie near this frequency.

Designers are faced with very specific problems; with loudspeakers you need a large drive unit to move enough air at the low frequencies to produce enough power, while at the top end of the audio spectrum you need a small lightweight driver to produce and disperse the short wavelength high frequencies. Using two such units helps overcome the additional problem when drive units tend to focus their high frequency output into a beam which can spoil the stereo effect and produce a loudspeaker which sounds very different a little way off its axis than it does when heard from in front. The control of the dispersion pattern of a loudspeaker has become more important over the years as the bigger problems with frequency response, etc, have been ironed out.

The simplest speaker of hi-fi pretensions therefore uses two movingcoil drivers, one for mid and bass frequencies commonly called a woofer (though this term should relate more specifically to a true bass driver only) and a high frequency unit to handle the treble called a tweeter. The big problem is to avoid bass signals arriving at the tweeter and causing it to burn out. The simplest solution which is adopted by many companies is to use a protection capacitor across the tweeter which acts as a filter to roll-off bass frequencies from the tweeter but to allow past the treble frequencies for which the tweeter is designed. This is the simplest form of crossover through the natural progressive inability of a woofer to handle ever higher frequencies acts a a crude mechanical roll-off. If the rate and characteristic of the roll-off curves need to be modified then a series of tuned electrical circuits can be built into the speaker to filter and tailor and response of the drive units at the extremes.

Drive units

There is more than one mechanical principle around which drive units that convert electrical energy into movement can be built. The most common is the already-mentioned moving-coil driver where the audio signal is passed through the voice coil of the speaker which is attached to the back of a suspended piston or cone and is free to move back and forward in the gap of a ring magnet. Like a motor, the loudspeaker will move its coil in and out of the magnetic gap with changing current. The movement is imparted to the cone of the speaker which in turn imparts this movement to the air where it can be heard as sound.

The art of drive unit design and production is to choose the right materials and adhesives for consistent manufacture as well as to choose the right shape for the cone, the right 'flex' of its suspension, the right power handling and heat dissipation, and a strong enough basket which holds the thing together and by which it is mounted into the loudspeaker enclosure.

There are other exotic principles used to convert electricity into sound, electrostatic elements (as used by Quad), flat plate etched coil tweeters (once used by Wharfedale) ribbons, piezo electric crystal tweeter, ionisation and plasma tweeters. It still seems that the moving-coil reigns supreme.

There is much talk about the materials used in the cones of moving-coil drive units so a quick run down of materials, their benefits and drawbacks follows. Paper was one of the first materials to be used for drive unit cones; being light and reasonbly stiff, it offered efficiency but with only fair distortion performance. Paper cones were treated with plastic dopes to improve what is known as their breakup characteristic, this reduced their efficiency due to increased weight but improved their distortion figures.

Plastics became all the rage after research by the BBC in this area. Bextrene was used in BBC designed and derived speakers like the LS3/5A and the Spendor BC1 to great effect. This plastic material has reasonable self damping showing less distortion than paper cones but with some sacrificed efficiency. But when designers began to dope bextrene cones to improve them further as had been done with paper, speaker efficiency dropped to an all time low.

A replacement plastics material came from the BBC's labs again polypropylene. This was lighter and stronger than both paper and bextrene and suffering less from a characteristic 'quack' colouration said to be exhibited by bextrene units. Yet being well self-damped avoided the need for doping and lower efficiency. Polypropylene is used in some of the best low colouration designs on the market today, but the use of any one of these materials doesn't guarantee performance. As ever applications and techniques are as important as the material itself.

Cabinets are not just boxes

The loudspeaker's woodwork is not just a convenient package for two or three drive units, it plays an integral part in the performance of the loudspeaker. When a drive unit rushes forwards to produce a positive pressure wave at the front of its cone it also produces a negative wave behind. If these meet they will cancel each other out. Drive units used to be mounted on big boards to keep these back waves behind but the size of board required to keep the waves from cancelling each other out at bass frequencies (ie, long wavelengths) was so big as to be domes-tically unsuitable. The back waves of a drive unit were first absorbed in a closed box by Acoustic Research in what they called an acoustic suspension or infinite baffle speaker. The back waves go into the sealed box and are dissipated into the structure and the damping material in the box.

Some sealed box designs use the cabinet's response to enhance the response of the loudspeaker system, other manufacturers insist that this is lost information and go for the stoutest most massive box they can build for the money. More recently manufacturers like KEF and B&W have mounted their drivers on resilient washers and grommets to avoid them passing too much energy too soon into the cabinets in an attempt to reduce colouration.

There are other methods of dealing with the back waves off drivers. The reflex port tunes these back waves and returns them into the listening room to extend the response of the bass driver. Auxiliary Bass Radiator (ABR or drone cone) designs close the port off with a motor-less driver tuned to the response of the bass driver to achieve the same effect. Transmission lines of great length are built into some cabinets to tune this back wave into the room. Again it's not which design that is used but the skill with which it is applied.

Loudspeaker characteristics

Hi-Fi Choice reviews include material taken from listening tests conducted on the speakers and from a physical inspection of the materials and engineering in each design. Additionally a considerable number of measurements are made. This section is to explain simply what these measurements tell us.

Frequency response

These curves show how, when fed with a constant level signal which changes only in frequency, speakers do not produce an even loudness at every frequency. This gives us vital information on how a speaker will change the tonal balance of a neutral or tonal signal. Unlike amps and even cartridges, speakers do not measure perfectly flat from low bass through highest treble but this measurement does give a basis for comparison.

With reference to the most recent reviews the Forward Characteristic Response curve shows the forward radiating character of the loudspeaker across the audible frequency range. The dashed and dotted curves show the response above and below and side to side of the main axis. The second curve shows an averaged response for the loudspeaker measured from the listening position. To provide both an accurate representation of the low frequency response and to set a reference level against which distortion could be checked, all loudspeakers were further measured with sine wave material (not the 1/3 octave noise used in the first tests) at 1 metre.

The first curves should show an even and wide response falling within 3dB limits from 80Hz to 15kHz. The 45° axis curve should show a smooth fall-off with increasing frequency. The listening room curves should not be expected to give a perfectly flat response. There will inevitably be some irregularities at low frequency due to the characteristics of the room in which they were mesured. There is a hump in most plots at around 60Hz but the ideal speaker should be fairly upto5kHz above which the response should fall evenly.

Colouration

This term describes the 'character' that a speaker can add to a sound. A gentle change in response alters the tonal balance of a loudspeaker but a rapid dip or peak over a small band will give a speaker a particular character. A range of adjectives are used to describe the particular character of a loudspeaker - you'll come across words like 'boomy', 'chesty', 'nasal', 'gritty', 'fizzy', 'hard', etc, throughout this chapter. Briefly, colourations occur because of rattles in the mechanics of the speaker or vibrations in its cabinet. Some occur because obstructions lie in the way of the even distribution of certain frequency and many designs show colourations when used with their grilles fitted, the grille frames acting as tunnels, traps or diffractors for sound

Impedance

This refers to the electrical impedance presented to the amplifier which is driving a given speaker. The concepts behind this are difficult to explain and as hard to grasp but suffice it to say that when the impedance drops this makes greater demands on the amplifier's ability to supply power (the product of voltage and current). The impedance determines the ratio of volts to amps that a speaker draws and this is important in matching speakers to power amps and amps to speakers.

Additionally speakers present complex electrical loads to amplifiers, some demanding that the voltage and current be supplied out of phase with each other. Some amps can do this but can't without getting hot or blowing fuses. Each review discusses not only the impedance character of the speaker but also explains if it will be difficult to drive, ie, showing out-of-phase conditions at an impedance dip. The target that designers aim for is to produce a nominal 8 ohm design which means the speaker shouldn't present less than say 6ohms more than once or twice.

Efficiency and sensitivity

Efficiency is an attempt to measure the actual conversion of electricity into sound and is referred back to a constant electrical input. More relevant to the consumer is the measure of sensitivity which is based on a fixed distance from the speaker by a mike 'listening' to the midband of the speaker. (Low impedance speakers draw more current and use more power so can be expected to show greater sensitivity.) Sensitivity is a useful measure of how loud a speaker will go in a domestic setting though it must be looked at alongside other performance parameters as some designs trade off high sensitivity against early bass roll-off. Sensitivity is covered under the heading How to make your amp sound twice as loud in the chapter Putting together a system.

Matching amps and power handling

Offering sensible, consistent advice on the minimum power required and the maximum power handling of a pair of loudspeakers is a very difficult task. First what one listener would call loud, another would call deafening. Also the room you are using to listen in may be full of soft soundabsorbing furniture which will also affect the perceived loudness.

The dynamic range of the music being played is important too. The relationship of the peaks to the mean level is important. While the mean power level will be that which heats up the drive units and will damage them if they are underrated, the peaks will determine the size of the amplifier as they should be within its capabilities without it generating distortion that damage drive units, tweeters in particular. A500watt amp may just tootle along with 10 watts on most programme but will be able to deliver hundreds of watts cleanly on peaks. Even a speaker rated at 75 watts can handle a *clean* 300 watt peak for a short space of time.

It is most important to use an amplifier within its capabilities with a given pair of speakers rather than match numbers between amp and speakers. Our reviews give minimum and maximum amplifier power ratings, the lower figure takes the speaker's sensitivity into account, the upper limit is based on listening experience and tests on measurement with the speakers.

Stereo

The idea that stereo means bass out of the right speaker and treble out of the left is surprisingly prevalent some quarter of a century after stereo was commercially launched. Stereophony refers to the possibility of recreating a solid image of the recorded sound field by using two loudspeakers. To capture this sound field coherently requires the use of two micophones, rather like stereo pair photos requiring two lenses and two negatives/ prints.

More heavily produced records use the separation possibilities of stereo by recording an instrument in mono (1 channel) and then placing it at any point between the speakers in the stereo image by manipulating the levels in the two stereo channels. This is really multitrack mono and even classical music producers use spotlight miking of some instruments to reinforce their 'image' in an otherwise simple stereo stage. In assessing loudspeakers for stereo performance we have chosen to use a good proportion of simply miked material.

Other models worth considering

Because of the long product life of many loudspeaker designs the current edition of *Hi-Fi Choice – Loudspeakers* has a pool of some 150 models from the three previous issues on which to draw. This explains the profusion of Best Buys and Recommended models.

Some old favourites are no longer produced and it is sad that the **Mission** range containing the Best Buy and Recommended **700**, **727** and **770III** models has been discontinued and the replacements are as yet unreviewed in *Choice*. These older models could well be available now at bargain prices. The same fate befell the **Chartwell PM310** which was one of the shortest lived Best Buys being discontinued in favour of the new **Rogers LS7** which is as yet unreviewed.

The Acoustic Research AR18S was considered to offer good sound with careful choice of matching equipment but this model has been discontinued though still sells in many outlets at reduced price. The ARC050 (£200) was on balance not a bad loudspeaker but was merely considered less successful and relatively less value for money than the bigger 101.

The **Audio Pro4-14** and **B240** subwoofer received Recommended status in the original issue but have not been included here on account of their high price (now £1058) and because of some uncertainty over current distribution plans.

One cheaper speaker the **Tannoy Stratford** (£110) was felt to hold promise though its performance on commercial recorded stereo material was not outstanding.

Other models which were included in this category of product worth considering are the **JBL L112** (now £845) which due to colouration problems couldn't be recommended at this price despite fine engineering. The **Gale GS401A** (£500) is another expensive model which missed recommendation though this design will shortly be superceded by a less coloured 402 model.

Linn's £190 baby Kan speaker faired poorly unless used in the context of the Linn front end and with Naim amplification. Also given 'worth considering' status were the Acoustic Research AR90 (£690), the Mitsubishi DS32B (£240), the Pioneer HPM500 (£170) and the Revox Triton satellite with woofer system (£850).

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It is hard to remember that the LSI is a £150 design-I have judged it by standards almost irrespective of price...overall performance is well above the standard of its class. DAVID PRAEKEL - JANUARY 1983, PRACTICAL HI-FI

The LS5 (loudspeakers) showed themselves to be easy, open and dynamic sounding speakers ...having a sparkling top end performance on percussion without ringing or harshness. DAVID PRAEKEL-JANUARY 1983, PRACTICAL HI-FI

> Both the LS5 and LS7 have a smooth, clean, well-integrated, 'seamless' kind of sound...Clarity is good and notes start cleanly and sharply with little apparent hangover or smearing. JAMES HUGHES-JANUARY 1983, HI-FLANSWERS

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Acoustic Research AR48S

Acoustic Research, High Street, Houghton Regis, Bedfordshire LU5 5QJ. Tel (0582) 603151



For what it is worth, the origins of the AR48 can be traced back to an earlier three-way model, the AR5. Both use similar sized enclosures and a common line up of 250mm bass, 100mm mid and small soft-dome tweeter, which in the case of the '48 comprises a 25mm dome unit. However, while the '5 was American-orientated and suited to bookcase mounting, with asymetrically placed drivers, the AR48 uses a vertical in-line array for optimum stereo performance, and its specification also advocates the use of open stands to give low coloration.

The enclosure contains a 38 litre volume sealed-box loading the integrated pulp cone bass driver which operates to 400 Hz. A new and very highly damped pulp-cone midrange is fitted. employing a translucent plastic termination surround and back-loaded by a cylindrical cardabove which the ferro-fluid soft-dome takes over tweeter exhibited distortion at around the 1%

components are used in the crossover, with the unusual series/parallel configuration resulting in a saving of one inductor.

The cabinet is constructed of synthetic veneered chipboard, with no panel damping or special bracing, and input connections are via the usual AR screw down terminals, around which bare wires have to be securely wrapped. As with the budget AR18, the grille is no acoustic plus point; its 14mm unrebated thickness does little for stereo imaging or the response. In the past AR used to fit vastly superior open cell foam grilles. but these appear to have gone out of fashion.

Lab performance

Some untidiness was apparent on the reference 1 metre sinewave frequency response, which was partially emphasised by the grille. However the latter was not responsible for the lumpy tendency in the 400Hz-3kHz region, suggesting that the mid unit was not working as well as AR would have us believe: as pair matching was good (typically within 1.5dB overall), the effect was clearly not an isolated one.

Inspecting the forward characteristic, the 1.5kHz to 2kHz trough can be seen to be axis dependent, suggesting a mild phasing problem between the driver bands. The low frequency range was well damped, providing a 40Hz -6dB point, and a +/-3dB range of 50Hz to 20kHz. While fairly good consistency and integration was demonstrated by the forward response, the off-axis fall-off at higher frequencies was greater than usual.

The sensitivity was usefully higher than claimed at 88dB/W, but amplifier loading was classed as average in view of an impedance dip to 4.3 ohms, 700Hz (a high power region). In fairness, however, AR do rate the '48 as a 6 ohms model. Its power handling was estimated at 100W, and a generous 106dBA maximum level is theoretically possible. with 15W per channel producing a satisfactory 96dBA

A moderate 0.6dB of compression was noted on 100W pulses, with distortion at the 1% level. 500 Hz. Moving up to 5kHz the compression was negligible, but distortion had increased to 7.0%, 2nd, 3.0% 3rd, and 0.3% of 5th (the latter usually negligible). Drive beyond this level appeared unpromising. On steady state distortion 3rd harmonic was generally guite low at around 0.6% mid band, with 2nd harmonic at similar levels. and with low frequency distortion well controlled. board enclosure. This driver works up to 2.5kHz, As with the AR18, however, above 6kHz the to above audibility. Only seven good quality level even at 90dB, though this had relatively

harmless second order content.

The averaged room characteristic demonstrated some promising features, notably the relatively even and extended low frequency range, plus well controlled and near correct energy fall above 10kHz. However, a prominance around the upper mid 400Hz-1kHz band measured some 4dB above adjacent regions, and this could with advantage be lower.

Sound quality

On the live tests the panel were not convinced of this model's true accuracy, finding it fairly coloured. But it achieved guite a high score as its faults were fairly innocuous. A degree of 'hollowness', 'boxiness', and 'hardness' were apparent, with some loss of clarity, but the overall balance was fairly neutral, with a reasonable bass extension showing an even character. The bass sounded a little 'nasal' and 'thinned', but the speaker could withstand considerable peak inputs of up to 200W of electric bass guitar without serious overload.

This picture was similar for the stereo sessions also, with the speaker sounding a trifle 'old fashioned' in terms of coloration levels, but at the same time considered easy on the ears. Lateral stereo presentation was to a good standard. although some loss of depth and 'see-through' ambience was experienced by most panelists. The midband was also a touch resonant on piano. for example, and loss of 'crispness' was felt on some transient signals.

Summary

If the above does not sound too encouraging, in fact the numerical scores attained by the '48 indicate Best Buy rating at the price. It provides a competitive package offering good power handling and sensitivity, plus a pleasantly relaxed sound while demonstrating a good standard of both stereo and bass reproduction. It is certainly one of the most civilised AR speakers at popular price levels that Choice has tested for some time now, and it therefore deserves recommendation with only minor reservations.

GENERAL DATA Si



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF. dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, shows stop point at 96dB).



Impedance (mod Z).

ARC 101

(partly re-assessed)

ARC Ltd., Horton House, 2 Urmston Lane, Stretford, Manchester M32 9BP Tel 061-865 6494



ARC

101

British made and designed, the ARC models are newcomers and possess some interesting design and operating features. Subscribing to the philosophy of high cabinet rigidity, this sealed box enclosure of some 28 litres is reinforced by two massive circumferential internal braces with double layer bitumen and fibre-board damping. A low diffraction foam grille is fitted to conceal the two drive units: the bass/midrange is handled by a rigid pulp cone 200mm driver with special modifications including doping, while a 25 mm MB soft fabric dome tweeter completes the vertical lineup. The two are integrated by a reasonable quality five element plug-in crossover which is located on the outside rear of the cabinet. This is done deliberately so the user has the option of 'active' operation, via separate power amplifiers and a special electronic active crossover. (The British electronics firm Nytech have worked closely with - electronics firm Nytec - ARC in this respect.)

The design includes a tapered low frequency response to account for placement interactions, the recommended position being on stands backed against a wall. We found 0.2m to be the optimum gap between speaker and wall.

Initial tests on our first samples showed signs of an out-of-phase tweeter, and although we corrected this a second pair was requested for checking. These exhibited no such fault and were an improved version bearing a A/P designation.

Lab results

These relate to the first sample, and the published curves should be viewed with caution as they are not very representative of current production. The phase cancellation was clearly apparent at the 3.5 Hz crossover point before we reversed the tweeter leads, but this anomaly aside the characteristic response above 200Hz was quite even and well balanced, with indications of good dispersion. The low frequency rolloff will be augmented by its recommended location close to a wall, improving the -6dB at 60Hz point to a little below 50Hz.

Fine third harmonic distortion results were obtained at 96dB, though second harmonic reached 3.3% around 2kHz, possibly from a damped breakup mode in the midrange driver. Driven to 100W on tone pulses little additional distortion was recorded at 500Hz and 5kHz. though some dynamic compression was noted (respectively -0.3 and -0.5 dB). Rated as 'good' on amplifier loading the 101 was a true 8 ohm design, with low reactive effects $(30^{\circ} \text{ max at } 2\text{ kHz})$ and at the same time showed a reasonable 88dB/W terminal sensitivity at 1m. With a 150W power ceiling, respectably high 106dBA sound levels are available in a typical room, while the pair match was very close (even so far as the notch depth of the first incorrect samples was concerned!) The grille introduced negligible change.

Sound quality

These results relate to the second and improved pair. Scoring 'average' on the live sound comparisons the 101 was a trifle coloured with a slightly middy and wooden effect. Detail was good however, giving a lively result without excessive brightness. Bass power handling was also fine with 60W average (200W peaks) accepted from electric bass guitar, producing an even and well differentiated output.

The results improved on stereo programme. The balance tended to be slightly thin and forward, but

with good smoothness and fine driver integration. Found to be a touch 'reedy' on organ, and also slightly aggressive, it was also agreeably transparent and direct; stereo imaging was to a good standard, with promising depth and ambience where appropriate. The bass was notably firm and even, though it was lacking in extreme bass energy; dynamics were well reproduced.

Update summary

The ARC 101 showed that specialised pulp cone technology can result in a compact system of above average sensitivity, offering a transparent and relatively neutral sound coupled with good stereo imaging. However, when used as recommended near a rear wall, the stereo is inevitably degraded though the frequency balance is improved. The ARC 101 has now been developed into two models, a no-expense-spared version, the 102, and the 101 Series II which features new Medite cabinets, bass unit modifications but with surface mounted, rather than rebated drivers. Facility for simple active conversion is retained.

Size (H, W, D)
Weight
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)15–150W
Recommended placement
Frequency response within ±3dB(2m)150Hz-20kHz*(2nd sample)
Low frequency rolloff (-6dB) at 1m60*
Voltage sensitivity (ref 2.83V. ie: 1 watt in 8 ohms) at 1m 88dB
Approximate maximum sound level (pair at 2m) 106dBA
Distortion (96dB at 1m)
Distortion (100W peak)
Impedance characteristic (ease of drive)
Forward response uniformity
Typical price per pair £320 when reviewed, now £295
*see text



Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB. Sinewave dotting shows later samples. Middle: Impedance (modulus)

Bottom: Frequency response, 2m '3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal: dotted 15° vertical).



B&W Loudspeakers Ltd., Meadow Road, Worthing, W. Sussex, Tel (0903) 205611



After neglecting the market below £100.00 for some years, B&W have recently re-entered this highly competitive field with their new DM10. Utilising a die-cast alloy chassis from an earlier and highly successful model (the DM4), this time B&W have fitted a lightweight pulp cone of good flare with an applied surface coating for damping. The diaphragm assembly is fairly lightly suspended on a half roll surround, and the stiffness is appropriate for a reflexed enclosure such as this, as it can dramatically improve power handling (an aspect which was borne out on test).

The 25mm soft-dome treble unit is also of B&W's own manufacture, and the two drivers are integrated via a five-element crossover network (including one resistor). Reflex loaded by a small 5cm diameter/7cm deep port, the 19 litre enclosure is built from plain 12mm chipboard with no panel damping, which is understandable at the price; a foam lining helps to reduce internal resonances. Since the 12mm thick grille frame

has no rebate for the side-directed high frequency signals, this could contribute some diffraction irregularities. Although a modicum of driver decoupling is provided in the form of rubber arommets under the bass driver fixings, unfortunately on our samples at least the degree to which they were tightened was likely to reduce the effectiveness of this technique.

A synthetic walnut veneer covers the enclosure. which is fitted with the usual 4mm screw terminals suited to wire or banana plug connection. B&W offer a comprehensive and closely toleranced specification, and can also supply a matching base called the STAV22 for floor standing use.

Lab performance

While the main axial response trace is uncorrected at low frequencies and applies with the grille on, the dashed trace shows the true low frequency response, while the dots illustrate the considerable improvement in smoothness resulting from removal of the grille. In the latter condition B&W's +/-3dB limits were met from 68Hz to 20kHz. A suggestion of prominence at 100Hz in the bass and 15kHz in the treble was also given by the traces. We found a usefully high 88dB/W sensitivity, plus a moderately extended bass (55Hz, -6dB).

Moving on to the forward characteristic responses, the 15° above axis curve showed some phase loss around the 3.5kHz crossover frequency, so the suggestion is for use close to or slightly above ear level. Another finding was that an off-axis listening position of about 20-25° resulted in a flatter treble characteristic, and the DM10 was found to image well when over-angled inwards by this amount. Overall the forward responses were well integrated, though a bass prominence of 3dB or so at 100 Hz was apparent.

Rated as an average amplifier load, the impedance dipped to almost 50hms, 7kHz, but this should embarass very few amplifiers these days. Distortion levels were very good at 96dB, but at 90dB some 0.8% of 3rd harmonic was present at 5kHz, together with an isolated 2.5% peak of 2nd harmonic at the secondary diaphragm resonance of 15kHz. Very good 3rd harmonic results were obtained on the 100W pulse tests, the system demonstrating a good power handling, so a comfortable 100W programme rating is suggested by the tests.

The averaged room responses illustrate a respectably uniform characteristic, only slightly marred by a mild mid prominence around 700 Hz and a premature bass rolloff below 60 Hz.

Sound quality

On the live sounds the DM10 gave a good impression, and survived close comparison with several percussive sounds. The output was a trifle coloured, with comments of some 'boxiness' and 'nasality', and an 'edgy' quality in the upper treble. But on the plus side, it was also considered lively, clear and adequately 'sharp' on transients. Driven hard in the bass the lowest notes were absent, but the upper register was more even than the anechoic response would suggest. It withstood considerable bass inputs of up to 150W with only mild chuffing and buzzing.

On the recorded sessions it was less well received, though the results were still creditable at the price. Coloration was again noticed, particularly of the 'wooden' and 'boxy' kind, while a clouding of detail linked with mild aggressive tendencies in the midrange gave an impression of reduced transparency as well as adversely affecting the impression of stereo image depth. However lateral imaging was very good, particularly with the grilles removed, and the overall balance was quite satisfactory despite the curtailed extension at low frequencies.

Summarv

While not the best of the budget models in this issue, the DM10 nonetheless sets a fine standard by offering a lively neutral frequency balance, a useful sensitivity, and good power handling, plus low distortion and fairly high maximum sound level at a competitive price. Such performance undoubtedly merits a Best Buy rating, but it is worth auditioning the DM10 to see if its particular blend of appearance and performance suits a proposed system. For the best results the grille should be removed and the speaker should be vertical (even though B&W suggest sideways bookshelf mounting as a viable option), and a cartridge used which has a 'kind' upper treble, such as the ADC XLM or a Shure M97ED or HE.

GENERAL DATA

Size (h x w x d)	
Weight 6.6kg	
Recommended amplifier power per channel	
(for 96dBA per pair at 2 metres minimum)(15)-100W	
Recommended placement stand	
Frequency response within ± 3dB (2m) 62Hz to 20kHz	
Low frequency rolloff (-6dB) at 1m	
Voltage sensitivity	
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m	
Approximate maximum sound level (pair at 2m)	
mpedance characteristic (ease of drive) average	
Forward response uniformity	
Typical price per pair inc VAT	



2m. dotted 15° vert., small dash 30° lateral, long dash 45° lateral)



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without arille).



96dB, dashed 3rd90dB, chain-dashed 2nd 90dB.





Impedance (mod Z).

B&W DM12 B&W Loudspeakers Ltd., Meadow Road, Worthing, West Sussex Tel (0903) 205611





In terms of driver complement and physical size, the DM12 could perhaps be regarded as a successor to the DM5, but in terms of sophistication and performance, it is closer to the longlived DM4. A high power compact, it parallels the KEF R101 in several respects, notably in its use of resilient driver decoupling to reduce cabinet resonance excitation, its electronic protection circuit which guards against abuse or amplifier faults, and also in the third order method for low frequency alignment, which is employed in both DM12 did not fare too well compared with live models, using a series capacitor element.

The bass/mid driver uses a massive ceramic magnet mounted on a die-cast 185 mm frame and is fitted with a 150mm bextrene cone. The high quality 10-element crossover incorporates protection against thermal overload and DC amplifier faults. The high frequency band above 3kHz is covered by B&W's own T26 fabric dome tweeter.

110

It had a foam-lined grille offering good diffraction characteristics and the well finished 12 litre sealed box enclosure is constructed of 12mm chipboard with bituminous panel damping.

Lab results

As expected the composite grille did smooth the response, particularly in the 5kHz region; but it also attenuated it, for example, by 2dB at 17kHz. The pair match was excellent to 5kHz, above which the output differed by 1-2dB at several points; a worst case 4dB was recorded at 20kHz. Sensitivity was marginally higher than claimed at an average of 86dB.

An elevated midrange region around 1kHz was a feature of the response - a point not properly brought out by the low resolution factory curves which accompanied these samples. On a relative basis the presence band was mildly depressed before the treble energy output recovered to a mild prominence around 13kHz. On the lateral axis the dispersion was clearly good, and the 15° vertical response taken above axis showed that the speaker should in fact be at or slightly higher than ear level in order to produce the most uniform frequency response (shelf or high stands location is suggested).

As claimed, the impedance was that of a good 8 ohm design, and while phase angles of up to 45° existed, these were at harmless higher impedance points. Appropriate for the size and sensitivity, the -6dB point rolloff point was noted at 60Hz. Driven to 96dB (a high level for its size) good distortion results were obtained, although inevitably with rising third harmonic towards the low frequencies: however, a figure of 3%, 100 Hz for the latter was still good. The 100W pulsed distortion test was passed with flying colours. exhibiting negligible extra compression or distortion (less than 0.1dB).

Sound quality

When mounted fairly high on a stand (0.4m) the sounds. The reproduction was considered 'boxy' and 'thickened', while a treble band unevenness was also noted with odd sibilants on speech. Some nasality was also present, and the mid prominence was obvious to the panel. However for its size the bass power handling was very good, with the speaker tolerating an average of 40W of electric guitar. While the upper bass sounds were clearly

delineated, the low bass was deficient in power.

On the stereo sessions the speaker sounded 'large' for its size, though bass notes were still subdued. Coloration was moderate with some midrange bias and 'boxiness', plus a slightly 'dulled' treble, this countered by a degree of extra zip in the higher ranges, which tended to bring out surface noises and clicks a little. The image quality was in fact quite good, with respectable depth, and the general sound quality was certainly well above average.

Summarv

The subjective performance of this model was uneven, mainly due, we feel, to the charted response trends. However, the results were good for the size of enclosure and in relation to its price of around £200. Construction and appearance were both very good, and the protection provides a further plus point, so a recommendation is clearly indicated.

Size (H, W, D)
Weight
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)
Recommended placement
Frequency response within ±3dB (2m)
ow frequency rolloff (-6dB) at 1m
Voltage sensitivity (ref 2.83V. ie: 1 watt in 8 ohms)
Approximate maximum sound level (pair at 2m) 102dBA
Distortion (96dB at 1m)
Distortion (100W peak) very good
Impedance characteristic (ease of drive)
Forward response uniformity
Typical price per pair inc VAT £200 when reviewed, now £239



Top: Frequency response, 1m sinewave, plus 2nd (solid) an 3rd (dashed) harmonic distortion @ 96dB Middle: Impedance (modulus)

Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial; thick dashed, 30° horizontal; thin dashed, 45° horizontal: dotted, 15° vertical).



B&W Loudspeakers Ltd., Meadow Road, Worthing, W. Sussex, Tel (0903) 205611

DM14



The price of the DM14 must be seen in the context of the complete system, which includes an elaborate integral steel and wood stand intended to be screwed securely to the base of the speaker. The '14 is essentially a version of the previously reviewed DM12, stretched vertically to accommodate a second bass/mid unit, and with the sealed box internal volume increased from 12 to 25 litres. In toto three drivers are employed, namely two 18 cm B&W bextrene cone bass/mid units, and the B&W 25mm soft dome tweeter. Both bass drivers have die-cast frames. and are slightly decoupled from the enclosure by fairly stiff grommets. This technique reduces the transmission of driver frame resonances into the enclosure where they might selectively resonate 7 and a typical impedance of 10 ohms. with panel modes to produce coloration.

As with the DM12, comprehensive electronic circuitry is inbuilt, with overload actuating a disconnection relay and illuminating a warning lamp on the front panel. The crossover board

carries a complex array of high quality components, and reflects B&W's 'fully engineered' approach to speaker design. As with the '12, the DM14 uses a third order technique for low frequency loading, which offers an improved bandwidth/sensitivity compromise at low frequencies, without adding the coloration which often occurs with ported systems. Furthermore, very good power handling may be obtained (as demonstrated effectively on test).

The substantial chipboard cabinet is reinforced by a massive circumferential brace located between the main drivers with thick bituminous pads plus foam plastic lining and wool filling used to damp panel resonances as well as internal modes. The grille is fitted with a foam edge liner adjacent to the high frequency unit to reduce diffraction effects.

Lab performance

The axial sinewave response showed a generally good characteristic, with a slight downtilt from 100 Hz to 2kHz followed by a somewhat 'lumpy' elevated treble. An average sensitivity of 86dB/W was indicated, with a satisfactory bass extension to 46 Hz, -6 dB, and pair matching was held to a good +/-1 dB overall.

Assessed in third octave bands at 2 m, the main anomaly concerned a mild 3dB high treble plateau from 9-15kHz. This improved greatly on the 30° off-axis lateral trace and in fact a 25° angle-overangled inwards to the listener-gave the smoothest subjective results as well as fine stereo. The 15° above response showed loss in the 2-4kHz presence range, and a listener position close to the mid/treble axis is to be preferred. which is possible with the supplied stands provided that the listener is not too tall. On the whole the forward characteristic responses were well integrated.

The power handling was excellent, 100W pulses defined with negligible compression or spurious distortion, while on steady state drive at 96dB the distortion was commendably low above 120kHz, and more than satisfactory below this. At 90dB, 1.0% 2nd harmonic was present from 6-12kHz, though this was considered to be of little significance, the design thus giving a fine overall distortion performance. Rated as a good amplifier load, it was easy to drive with a minimum value of

Assessed by room averaging, the output fell below 50Hz and showed a neutral overall balance up to 7 kHz, but was then slightly let down by the lack of a continued rolloff in the treble, illustrated by the 'corner' at 12kHz.

The tests indicate a sensible maximum amplifier rating of 200W, though more still is possible, and substantial 104dBA sound levels were achieved with 200W per channel inputs in our listening environment

Sound quality

The DM14 proved to be a significant improvement over the DM12. Subjectively coloration was lower, the frequency range more extended and the balance better. On the live comparisons it fared much better than the '12 and was considered lively, open and dynamic, with only mild criticisms of a 'boxy' coloration as well as a tendency to treble 'scratchiness'. The upper registers were judged to be a trifle excessive. although two keen-eared listeners in fact correctly identified a lack of extreme treble energy. The bass was fairly deep, and showed fine power delivery plus an even character and essentially low levels of both coloration and distortion

Good results were also obtained on the stereo sessions, where the coloration levels were considered to be relatively low though with some mid congestion and clouding of detail, as well as a degree of 'boxiness' and 'thickening'. The treble showed a touch of 'fizz' and 'abrasiveness', and could do with being a little smoother, while some loss of instrumental detail was also noted as well as a lack of excitement. The stereo presentation was however quite good, with satisfactory rendition of depth and ambience.

Summary

Allowing £40.00 or so for the price for the stands. the distinctively styled DM14 has undoubtedly done well. While not the most neutral speaker in its class, it offers an essentially clean sonic balance with remarkable dynamic range and power capacity, sounding at its best when overangled by some 25° to cross in front of the listener, as noted above. Distortion is low and with large amplifiers it can attain genuinely high sound levels. The system is well engineered and finished and comfortably offers sufficient value for a Choice recommendation.

GENERAL DATA

GENERAL DATA	
Size (h x w x d)	
Recommended amplifier power per channel	
(for 96dBA per pair at 2 metres minimum)(20)-200W	
Recommended placement away from walls on supplied stands	
Frequency response within ± 3dB (2m) 50Hz to 20kHz	
Low frequency rolloff (-6dB) at 1m	
Voltage sensitivity	
(ref 2.83V, re: 1 watt in 8 ohms) at 1 m	
Approximate maximum sound level (pair at 2m) 104dBA	
Impedance characteristic (ease of drive)	
Forward response uniformity	
Typical price per pair inc VAT £300 when reviewed, now £335 inc.	
stands	



Forward characteristic response (1/3-octave @ 2m. dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without arille).



96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB ○ shows stop point at 96dB).



B&W Loudspeakers Ltd., Meadow Road, Worthing, W. Sussex. Tel (0903) 205611



In the past B&W have repeatedly shown themselves capable of producing a broad and diverse range of speakers. The *DM16* is a distinct departure from the ordinary, using a costly and superbly finished enclosure with strongly sloped front panel. Massive stands are supplied; a far cry from the usual steel framework, they have matching veneer and grille work and might perhaps be more correctly classified as 'bases'.

This speaker was one of the heaviest it has ever been my misfortune to have to carry about, and once established in a listening room it is not likely to be moved far! However, due to the front panel slope and the incorporation of a very generous (and hence low coloration) rear chamber for the midrange driver, the internal volume loading the bass unit is not particularly large at 45 litres.

The speaker comprises a three-way sealed box system, with slightly decoupled driver mountings for the bass and mid units. A vertical in-line driver array is adopted for optimum lateral stereo

symmetry, and the low frequencies are handled by a 280mm bextrene-coned driver fitted with a massive magnet assembly and built on a die-cast frame. The mid unit is exclusive to B&W, using a woven polyamide cone doped with a damping/ stabilising coating, and the HF is handled by B&W's own 25mm soft fabric dome tweeter. A sophisticated crossover is employed, consisting of third order bass-loading elements and full electronic protection. High density 20mm chipboard is used for the enclosure, which has a thick wool filling, bituminous cladding on the walls, and extensive bracing, and the deep contoured grille avoids diffraction problems by using a costly welded steel frame of negligible acoustic obstruction.

Lab performance

Producing a notably smooth axial characteristic, the reference response did however demonstrate some interesting features. The balance appeared to drift slowly downwards from a gently humped bass region at 100Hz, and within this trend the 1.5 kHz to 3kHz region showed mild depression. The low frequency range possessed a moderate extension to 44Hz, -6dB, and the rolloff was slow – a plus point – although sensitivity at 85dB/W was below average.

At 2m the characteristic response showed very good integration and uniformity, and the system has clearly been aligned (as it should be) for the forward axis and not for 15° above; the latter, though closer to the physical baffle axis in fact demonstrates an inferior response. At 30° and 45° laterally, the traces were very flat, and this system could well be used without any need to swing the enclosure inwards to face the listeners as is often done.

In common with other B&W systems the *DM16* happily soaked up 100W pulsed inputs, demonstrating negligible compression and low distortion levels (typically0.8% 2 nd and 0.2% 3 rd order at both 500 Hz and 5 kHz). This picture was reflected in both 90 and 96dB steady state levels, with 3rd harmonic at the low frequencies never exceeding 0.9%, and 2 nd at a harmless 1–2% level below 250 Hz.

Ultimate power handling fell below that of the *DM14*, and 150W seems a fair figure, providing a satisfactory peak sound level of 102dBA in a listening room. A minimum amplifier power of 20W per channel would also appear appropriate. The impedance rating was average, dipping to 5.3 ohms, 100Hz, but few amplifiers are likely to be bothered by this.

In overall shape the integrated room response

from 50Hz to 16kHz was commendable, corresponding closely to the required result, although a slight forwardness in the 5kHz range was apparent, together with a curtailed extreme bass.

Sound quality

The DM16 performed consistently well on both live and recorded sessions. During the former the bass was felt to be a trifle 'rich' and upper range dominant, while when deep bass was present it was recessed a little. Certain colorations were noted: a trace of 'chestiness' or 'fullness' on speech was described with some 'hardness' or 'boxiness' in the midrange, and a comment of a slight 'off axis effect' in the treble was also made which is appropriate enough in view of the baffle slope. Spectrally the sound was felt to be well balanced with clear and clean transient definition.

On the stereo programme the sound was promising with a good sense of space and ambience, and while some loss of transparency was apparent, frontal detail was fine. Occasionally some coloration was noted, but mild in degree. On piano some 'hardness' and 'ringing' was present in the midrange, and the lower mid/upper bass was also described as slightly 'hollow' by two panelists; in the fact the bass could have done with more 'tautness' and precision.

Summary

While this speaker is clearly not 'Best Buy' material, it is nonetheless recommended, setting a high standard in several respects. A consistent, reliable performer, distortion is very well controlled, the balance neutral, and coloration fairly low; the whole is superbly engineered and finished, and cannot be damaged by excessive inputs. It possesses a more 'furnished' appearance than most models, and the price is not excessive in view of the massive bases supplied as standard.

GENERAL DATA

Size (h x w x d)65 x 33.5 x 42cm
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)(20)-150W
Recommended placement away from walls on supplied stands
Frequency response within ± 3dB (2m) 52Hz to 20kHz
Low frequency rolloff (-6dB) at 1m
oltage sensitivity
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
Approximate maximum sound level (pair at 2m)
mpedance characteristic (ease of drive) average
Forward response uniformity very good
Typical price per pair inc VAT £550 when reviewed, now £595 inc.
abada



2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without arille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, o shows stop point at 96dB).



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Castle Clyde

Castle Acoustics Ltd. Shortbank Boad, Skipton, N. Yorks, Tel (0756) 5333



This diminutive speaker has a Richmond-like specification, and at £80.00 a pair, the price is even comparable with that of a *Richmond* some five vears ago! Castle take a pride in building the majority of the components for their systems themselves, the Clyde being no exception, and the Castle designer has shown great skill in tailoring his speakers to give relatively uniform frequency responses irrespective of size or cost.

Possessing a 9.8 litres internal volume, the system is reflex-loaded by a small ducted port. 28mm long by 37mm in diameter, which does more for the power handling than the bass extension. Both drivers are made by Castle; the lightweight pulp-cone bass/mid unit is built on a 130mm frame, and is partnered by a unique 30mm plastic cone/dome tweeter using a phasecorrected diaphragm. The undamped chipboard cabinet is also made by Castle themselves. having a fully finished teak veneered exterior with alloy trim, plus an acoustically favourable

foam grille. A 4-element crossover is titted with fuses for each driver accessible through the bass unit aperture

Flush-mounted spring clip terminals are used for electrical connection, and an acoustic foam lining provides absorption within the enclosure. If Castle are true to form, the system should be fairly sensitive as well as capable of decent sound levels for its size.

Lab performance

The test samples showed a good pair match measuring typically +/-1 dB: a fine result for a speaker in this price category. Sensitivity was indeed high at 89.5dB/W. and was uncompromised by the impedance/amplifier loading the latter rated as 'good' and averaging 9 ohms. As expected the low frequency range was somewhat curtailed with a -6dB point at 64 Hz, but the axial reference response was inspiring, meeting fine +/-2.5dB limits overall, and showing a promisingly even balance.

Under ¹/₃-octave analysis at a 2m measuring distance the output was excellently uniform and integrated; in this respect the system illustrated almost a textbook performance. However the tonal balance showed a gentle rise in output with increasing frequency, with a mild but discernible hump in the treble region centred on 15kHz.

The high sensitivity allowed steady state distortion measurements to be carried out over the whole range at both 90 and 96dB. Above 150Hz. aside from isolated peaks at 1.8kHz and above 10kHz, distortion held to below 0.3%. While a 100W pulse at 500 Hz was approaching overload. with 4% 2nd and 8.0% 3rd harmonics: this in fact represents some 108dB, which is a very high sound level. At 5kHz the 100W pulse gave no trouble at all, with a typical value of 1% for both 2nd and 3rd harmonic.

The averaged room response in energy terms did suggest some mid prominence between 600Hz and 1.5kHz, but the overall trend above 1.5 kHz was very good, and close to the theoretically ideal characteristic. While the low frequency range had some depression coupled with an early rolloff below 50Hz, it was otherwise fairly uniform.

With comfortable sound levels achieved on as little as 10W per channel, this speaker will happily accept 50W unclipped programme without blowing fuses, thus allowing up to 102dBA sound levels, which is quite loud considering the box size. At some penalty to the stereo imaging, it will also in fact perform quite well on an open shelf or bookcase, and does not become too 'rich' or 'boomy' in such a location.

Sound quality

The Clyde achieved good scores on the live comparisons. Although it was felt to sound a little 'small' with a degree of 'forwardness' in the midband, negligible accompanying 'loudness' or 'shout' was apparent, and the general effect was smooth and well integrated with good detail and natural tone colour. On occasion the treble could sound a little 'sibilant' and 'edgy', while some coloration was also identified mainly of the 'hoxy' kind

Promising scores were also obtained on the stereo tests, where the imaging was found to be clearly defined with some depth and good lateral precision over a wide listening angle. Low bass notes were lacking in power, but the balance was surprisingly good if tending to be slightly 'light' and 'middy' in character, and the overall effect was almost as smooth as the remarkable responses indicate. Note however that the latter are of course unable to show the mild 'boxy' coloration and slight upper treble 'tizziness' that we experienced.

Summarv

Once again we find a Castle speaker in the Best Buy category. This tidy little box packs a surprising 'punch' in terms of a clear even and lively sound. offering a high sensitivity, easy amplifier load. high dynamic range and moderate distortion. plus fine finish and engineering. At the price and size one can hardly quibble with the lack of deep bass, and the Clyde compares well with some of the best miniatures ever made at any price.

Undate

A new full length grille has now been fitted, dispensing with the allov trim.

GENERAL DATA

Size (h x w x d) 37 x 21.5 x 22cm
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)(10)-50W
Recommended placement open stand
requency response within ± 3dB (2m)75Hz to 20kHz
ow frequency rolloff (-6dB) at 1 m
oltage sensitivity
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
opproximate maximum sound level (pair at 2m)102dBA
mpedance characteristic (ease of drive) good
orward response uniformityexcellent
ypical price per pair inc VAT £80 when reviewed, now £95



2m. dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



at listening position



Reference sinewave response (1 m on axis, 2.83 V input shows sensitivity) (dashing corrects for chamber LF. dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB. dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB



Impedance (mod Z).

Castle Conway II

Castle Acoustics Ltd., Shortbank Road, Skipton, North Yorkshire Tel (0756) 5333



This rather bluff enclosure measuring some 63 cm(H) by 35 cm(W) and 37 cm(D) conceals a larger than average internal volume of 52 litres, and this, taken together with Castle's good track record on low frequency design, promised a worthwhile bass performance. Our samples were teak veneered on all surfaces with a glossy lacquer finish, the grille being of black Declon foam with some ribbing to lighten the appearance.

A three-way system with crossover points at 750Hz and 4kHz, the dividing network is of good quality, comprising 13 elements. The three drive units are Castle's own, namely a 210mm doped pulp cone bass on a diecast frame, reflex loaded by a 53mm diameter tunnel port; a 80mm doped pulp paper-cone mid unit, also with a die cast frame, and finally, the Castle cone/dome mylar tweeter, nominally 30mm in diameter.

The cabinet is rigidly constructed in high density board with beam bracing and a foam lining. A universal connector provides DIN and 4mm socket connections. Curiously, the three protection fuses are located inside the enclosure on the crossover board beneath the bass driver; however, as the units were not damaged and the fuses remained unblown with up to 300W program per channel, this should not prove any sort of a problem.

Lab results

The match illustrated by the review pair was very good and generally to within 0.5dB throughout. The sensitivity was fairly low at 86.5dB/W, although the speaker was quite easy to drive, and is in fact marginally more efficient than the typical plastic-coned systems of the same dimensions. The -6dB LF point was well extended at 38Hz.

Rated as very good on third harmonic distortion. 3% was noted at 50Hz, reducing to 0.3% by 100Hz and holding typically to that level throughout, bar minor lapses to 1%. 1.5kHz and 0.5% in the treble. The Conway also demonstrated fine power handling, coping well with all program particularly live electric bass guitar. Slight port chuffing was noted at around 20W input, but the audible failure did not occur until beyond 60W, and on wide range program up to 250W per channel was gracefully accommodated. The impedance dipped to just under 60hms between 100 and 150Hz implying an 'average' amplifier loading, although the Conway is elsewhere easy to drive with the values at nominally 90hms.

At 1m the reference trace illustrated a fine +2, -3dB characteristic from 45Hz to 20kHz, being essentially even and well balanced. Minor dips were present at 1.6kHz and 2.4 kHz, plus a small irregularity above 15kHz.

The smooth frequency response was maintained at 2m, meeting fine +1, -2dB limits overall. The set of characteristic forward responses were excellent, showing fine uniformity and integration on all measured axes. Thus the *Conway* is relatively uncritical of listener position and does not 'beam' in the forward plane.

Sound quality

Living up to the promise indicated by its lab performance, the *Conway* acquitted itself well in the live sound comparisons. While not entirely free of boxy effects — noted on male voice for example — the general quality was open and clear, with fine, well controlled and powerful bass.

With the more complex stereo programme the results were even better, the speaker gaining a top class rating for stereo imaging, with depth, precision and ambience all well conveyed.

Driven to high levels it did not sound 'loud' in the fatiguing sense, and performed well on solo piano and heavy rock program alike. Mild criticisms centred around a slightly 'fizzy' HF register, plus a trace of mid 'wiriness' and hardness; overall the panelists were favourably impressed.

Summary

Once again Castle have come up with a very strong competitor, and like its smaller brother the *Richmond*, the *Conway* has done well in our exhaustive tests. Relatively easy to drive and of normal sensitivity, it proved quite uncoloured and showed good dynamic range and stereo, plus fine detail rendition, with a clean extended bass and low distortion. Dispersion was excellent.

A new version of the *Conway*, designated *IIA*, has recently been added to the range. Featuring an integral stand and styling changes, it is claimed to be acoustically identical and is a little more expensive. Both new and current models feature a revised and improved tweeter, and may be confidently recommended. The Conway IIA price does not compare directly with the previously quoted price of £290 which related to model II only.

Size
Recommended amplifier power per channel (for
96dBA per pair at 2 metres minimum)
Recommended placement on stands clear of walls
Frequency response within ±3dB (2m)63Hz to 20kHz
Low frequency rolloff (-6dB) at (1 m)
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms)
Approximate maximum sound level (pair at 2 metres)
Third harmonic distortion (96dB at 1 metre)
50Hz-3%, 100Hz-0.3%, 1.5kHz-1%,
6kHz-0.5%, typically 0.3%
Impedance characteristic (ease of drive)average
Forward response uniformity
Typical price per pair inc. VAT IIA £425 inc stands



Axial sine wave reference response, 1m (0dB=90dB sensitivity; dashing corrects chamber anomalies.)



Impedance vs frequency (mod Z)





Ditton Works, Foxhall Road, Ipswich, Suffolk IP3 8JP. Tel (0473) 73131



Celestion 100

The latest Celestion model, the 100 is an ultracompact, sealed-box design, with a 7 litre internal volume loading the 170mm bass/mid driver. This is built on a pressed steel frame using an unusual flared pulp cone of advanced design, which is light enough to offer a usefully high sensitivity even though only a modest magnet is involved. The treble register is covered by a new version of Celestion's 2.5mm soft-fabric dome, which it is claimed has benefitted from laser analysis in improving its performance. A good quality 4-element crossover is employed, with spring-loaded clip terminals.

The enclosure is a conventional chipboard box constructed using the cost-effective mitrefold technique and finished in a good quality synthetic veneer. The driver panel looks good with the grille off, which is fortunate since the speaker sounds better that way. 12mm rebated board is used for the driver baffle but the proximity of the port to the treble unit can give rise to possible undesirable diffraction effects. One would expect that boxes of this size would be suitable for shelf mounting, and the midrange characteristic of the 100 indicates that this should indeed be the case.

Lab performance

At 1 m measured on the nominal mid/treble axis under anechoic or free field conditions, the 100 showed a dip 6dB deep at 7kHz. However removal of the grille did wonders for the response, as shown by the dotted line, and clearly this is one speaker crying out for a sensible foam grille. With the grille removed, the response met +/-2.5dB limits 90Hz-18kHz, which is not bad at all for a budget model. The sensitivity checked out at slightly above the average at 88dB/W, though the bass response was restricted, measuring 6dB down at 76Hz.

At 2m, the ½-octave characteristic showed evidence of a loss in output around 6kHz, the overall curve having a 'humped' appearance with prominences located at 130Hz, 2kHz and 14kHz. (In practice however the response is a little better than this, since these measurements were taken with the grille on.) The off-axis curves suggest that the speaker output is well integrated and not over-critical of listener axis.

During the distortion tests, the 100 happily survived a 100W power input at 500Hz and 5kHz, with minimal amplitude compression and harmonic distortion levels of 5.0% 2nd and 0.8% 3rd at 500Hz, 2.8% and 1.1% respectively at 5kHz. Moderate levels of distortion were present over much of the band at both 96 and 90dB sound levels steady state. Second harmonic was typically 1.0% and third 0.4%, these increasing to 3.0% below 250Hz.

The impedance curve demonstrates a rather high 100 Hz system resonance, and an average rating for amplifier loading which stems from a dip to just above 5 ohms, 6kHz, a region of high programme energy. However a satisfactory maximum sound level of 100dBA could be achieved in a listening environment with inputs up to 50/W channel.

Assessed by ¹/₃-octave averaging in a listening room, the *100* was judged a trifle 'forward' in the midband, with the steep rise from 300Hz to 600Hz part of this effect. Bass fell significantly below 80Hz, and the extreme treble was also deficient, though not seriously so.

Sound quality

The 100 fared quite well on the live comparisons. The bass output was clearly curtailed in the lower registers, with a slightly 'nasal' quality resulting from emphasis of the harmonics of the fundamental notes. While the sound was quite lively with a good impression given on sharp transients, the midband was described as 'boxy' with some 'hardness'. Overall the effect could have been smoother.

On the stereo sessions it was not so well regarded, although in view of its budget price the grading was reasonable. The upper treble was considered a trifle prominent, while the sound lacked 'weight'. Although it gave a reasonable impression of ambience, and the stereo presentation was quite good, it often sounded 'louder' than expected, which is not a good sign so far as mid smoothness and balance are concerned.

Summary

This small and inexpensive speaker is quite presentable, particularly when used without the grille. At \pounds 80.00 it justifies a recommendation on value grounds and is worth trying. On the debit side the frequency balance was none too even, distortion was poorer than average and the bass response was rather limited. But it possessed a lively character, was capable of good rendition of detail, and also worked quite well when wallmounted.

GENERAL DATA

Size (h x w x d)	x 21 x 18.5cm
Weight	4.4kg
Recommended amplitier power per channel	
(for 96dBA per pair at 2 metres minimum)	(15)–50W
Recommended placement	open shelf
Frequency response within ± 3dB (2m)8	35Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	76Hz
Voltage sensitivity	
(ref 2.92)/ iou 1 watt in 9 abma) at 1 m	00 40/14/

(Ter 2.00V, /e. 1 watt mo oning) at tim.	
pproximate maximum sound level (pair at 2m) 100dBA	
npedance characteristic (ease of drive) average	
orward response uniformityvery good	
ypical price per pair inc VAT £70	



2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis, 2.83 V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without arille).





Impedance (mod Z).

Harbeth HL1 III

Harbeth Acoustics, 2a Nova Road, West Croydon, Surrey CR0 2TL Tel 01-681 7676

Harbeth HL1

(revised and reprinted)



Since its introduction the *HL1* has been subject to small detailed improvements culminating in the latest Mk III version reviewed here. We experienced some quality control and consistency problems with earlier models, but happily these now seem to be behind the company, with current review samples showing good matching and agreement with the designer's target specification. In particular, recent improvements have concerned the need for greater low frequency power handling.

A 50 litre enclosure reflex tuned by a large 62mm diameter tunnel port, the cabinet is of thin wall high quality veneered plywood, with bituminous panel damping and extensive seam battening. Front and back panels are well screwed down and a sculptured foam grille improves the cabinet diffraction. An exclusive polypropylene 200mm covers the bass/midrange, and a 25mm Audax soft dome tweeter the high frequencies, with a good sibilance, with an apparent emphasis in the treble

quality crossover dividing the input at approximately 2kHz. Provision has been made for sensible matching of mid and HF using an auto transformer to aid consistent frequency balance.

Lab results

A useful above average sensitivity of 87.5dB was recorded, which is on target and not compromised by the impedance, which was judged to be a good amplifier load. Typically of the order of 8 ohms, a 6.6 minimum was recorded, and while some high phase angles were apparent (for example 70° at 2kHz) the impedance was substantial enough at these points to avoid censure. The -6dB rolloff point was noted at 46Hz, and with a 100W per channel amplifier limit, a good maximum sound level of 102dBA should be possible in a typical room.

The axial response at 1 m was fairly uniform and ignoring the 5kHz notch, met \pm 3dB limits, 55Hz-18kHz. Third harmonic distortion levels were also very well controlled at 96dB, typically measuring 0.5% or better above 150Hz. The less annoying second harmonic content peaked at 8% around 100 Hz, and this might be audible on sustained bass notes. The system fared less well on a diet of 100W pulses despite the low 2Hz repetition rate. Although perfect at 500 Hz, a +0.3 dB expansion occurred at 5kHz generating 5% of second and 1.8% of third harmonic distortion. Crossover saturation is the probable cause at this equivalent 100W programme level.

Examining the forward ¹/₃-octave responses at 2m. distinct trends were apparent. The bass region was mildly humped around 100Hz, above which the output rose gently to 700Hz before a trough 2dB deep appeared to 2kHz, the latter an intended design feature. The treble range was more or less level and matched to the midrange, while the offaxis curves can be seen to be very uniform, indicating excellent forward dispersion.

Sound quality

Designed as a monitor, the HL1 gave a very good performance when compared with live sounds. In general terms it was clear and low in coloration. and sustained a modest 20W average (100W peak) of bass guitar, providing a fairly even and deep bass register.

On the stereo sessions it was not quite as highly favoured, though it still did well. Vocal lines were clear if slightly 'chesty' and exhibited some occasionally lending a slightly 'metallic' effect. The bass was also judged a trifle 'soft'. Stereo imaging was quite good with promising depth sounded displaced from the midrange – a function zontal; dotted, 15° vertical). of the system's frequency balance perhaps?

Top: Frequency response, 1 m sinewave, plus 2nd (solid) a 3rd (dashed) harmonic distortion (a 96dB Middle: Impedance (modulus) Bottom: Frequency response, 2m 13-octave averaged (solid ambience, but sometimes the treble region axial; thick dashed, 30° horizontal; thin dashed, 45° hori-

Summarv

The standards of clarity and workmanship together with the low levels of coloration set this speaker apart from the common crowd, and it continues to maintain its position in the recommended listings. Possessing a fine overall sound quality, it offered an easy to drive impedance and above average sensitivity.

Size	nches)
Weight	(lbs)
Recommended amplifier power per channel (for	
96dBA per pair at 2 metres minimum) 15-	100W
Recommended placementon stands away from	ı walls
Frequency response within ±3dB (2m) 63Hz to	18kHz
Low frequency rolloff (-6dB) at (1m)	46 Hz at 1 m
Approximate maximum sound level (pair at 2 metres)10	2dBA
Third harmonic distortion (96dB at 1 metre)	. good
65Hz-2%, 100Hz-1%, 200Hz-	0.2%.
500Hz-0.35%, typically	0.3%
Impedance characteristic (ease of drive)	. good
Forward response uniformity	. good
Typical price per pair£395 when reviewed, nov	w£343

Typical price per pair	£395	5 when reviewed	, now £34.
*Check text			



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Hevbrook HB2

Mecom Acoustics, Knighton Hill, Wembury, Plymouth, Devon Tel (0752) 863188



British made and designed using French Audax units, the compact HB2 speaker is intended to be unobtrusive when mounted on light stands about 0.5 m away from the back wall of a listening room. This is a design showing great attention to detail; for example, the reflex port – a tube 105mm long by 28mm diameter – would be expected to suffer from audible distortion due to its small size, but by locating it on the cabinet rear and damping the exit with a soft foam ring, this is in fact kept to a minimum. The 12 litre braced chipboard cabinet is heavily damped by bituminous pads as well as a thick foam lining. The 25 mm soft dome and 160mm bextrene cone drivers are mounted vertically in line behind the acoustically transparent low diffraction grille.

The good quality and complex crossover comprises some 13 elements including resistors, and is described as including phase compensation for the

drivers to provide a smooth amplifier load.

Lab results

Very good pair matching was exhibited with the discrepancies barely greater than the linewidth on a B&K chart. The lab sensitivity was rather low at 84dB/W suggesting a minimum of 30W/channel; with a 100W ceiling, a modest maximum sound level of 96dBA is possible in a typical room. The low frequency rolloff was nominally at 60Hz. -6dB, but some extension to 40Hz was apparent on the axial sinewave curve and this would be present in normal room conditions. Limits of ± 4 dB were required to contain the sinewave response which was otherwise reasonably uniform.

Subjected to ¹/₃-octave analysis the response may be seen to elevate by 2dB or so above 500 Hz; if referred to the lower level, the bass extension is good for the box size. Around the 3kHz crossover point the same unevenness was present, and the tendency to a loss in output here was exaggerated on the '15' above' vertical response. This speaker should be more or less at ear level for the best results. On the lateral axis the responses were good, and furthermore showed that the most neutral subjective balance will be obtained with the speakers over-angled inwards.

96dB was quite a high level for this box size, and vet the crucial third harmonic distortion was reasonably low until below 90Hz. Second harmonic values were also acceptable at 2.5%, 400Hz and around 2%, 5-10kHz. However the 100W pulsed input caused some problems, for while the 0.2dB compression was slight at 500Hz. 4% of second harmonic distortion was also recorded: fortunately at 5kHz the behaviour was near perfect. With an average value of 10 ohms, the HB2 was considered a good amplifier load. despite the rapidly falling impedance above 10kHz (tapering to below 4 ohms, 30kHz).

Sound quality

Rated consistently at 'good' throughout the listening tests, the HB2 clearly did well for its price. The bass was plausible if lacking in power on the live comparisons: 60-80W of peak bass guitar could occasionally 'crack' it. The light and open balance suited live percussion sounds, and coloration was low

On commercial programme stereo imaging was good, with a fine representation of space and depth. Again the bass was more than satisfactory if

balance tended to openness with light sibilance. but in a smooth and acceptable manner.

Summarv

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Although possessing a restricted maximum level and power handling, the HB2 was a refined low coloration performer of compact dimensions. It gave a good overall sound quality as well as a consistent character throughout the frequency range, and is undoubtedly worthy of recommendation. This was Heybook's first venture into the commercial world, and it represents a welcome addition to the market.



(revised and reprinted)

Hevbrook HB2

Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial: thick dashed, 30° horizontal: thin dashed, 45° horizontal; dotted, 15° vertical).

Heybrook HB3

Mecom Acoustics, Knighton Hill, Wembury, Plymouth, Devon. Tel (0752) 863188



The HB3 has been available for some time now in different development stages, all showing good potential so far. Two pairs were in fact supplied for this review, and the first were fully measured before Heybrook contacted me explaining that, while these incorporated a late improvement to the subjective performance, in fact the lab results would be suspect, as indeed they were. With some burning of the midnight oil Heybrook resubmitted in time for the listening sessions a version hopefully satisfying both subjective and results have been updated.

A sturdy three-way system of some 37 litres bass enclosure capacity, the HB3 is built to a standard reflecting great attention to constructional detail and finish. A light oak veneer on the sion, plus 5.0% of 3rd and 1.2% of 2nd order carcase contrasts with the two contoured foam distortions; 5kHz resulted in no problems howgrilles, which are separated by a horizontal alloy ever, with 1.2% of 2nd and 0.25% of 3rd; and the bar. The enclosure is rigidly constructed of

127 18mm chipboard, and is double-braced by a full

circumferential section and a heavy duty pyc cylinder from front to back, the latter forming the midrange rear cavity. Substantial bitumen cladding is used for internal panel damping, and the interior is lined with absorptive foam; the mid cavity uses wool as well. Intended for mounting near to a rear wall, special floor stands are supplied complete with self adhesive fixings.

The three drivers are all SEAS units, comprising a shallow-flare 250mm bass and 100mm midrange, both with doped-pulp cones, and a 20mm plastic dome tweeter. A vertical-in-line driver array is used, with the 'line' offset on the baffle to generate a directivity pattern which should improve stereo when wall-mounted. The substantial and good quality crossover is rather inaccessibly located on the inside upper surface of the cabinet top, and heavy duty wiring is used throughout. Allen bolts secure the drivers, on whose tightness Heybrook lay great emphasis, but in fact on our samples the bass units had been secured so firmly that it was beginning to crack the front frame edge.

Lab performance

On the axial reference curve taken at 1 m we have a glimpse (dotted) of the output from the first pair. the solid line is that generated by the second samples. The step down below 500 Hz is intentional, and relates to taking account of the energy transition/augmentation resulting from near to wall mounting. The upper band was well behaved, meeting +/-2.5dB limits 300Hz-16kHz, and the reference sensitivity was a little above average at 88.5dB/W. The system resonance lay at 50Hz, providing a -6dB rolloff at 49Hz, which is not very extended for the enclosure size, though it will be somewhat improved near a wall (shown as an estimated dashed line in the characteristic response at 2m). Whilst in the main the off-axis curves are pretty uniform, a phasing effect is seen on the 15° above (dotted) curve. suggesting that the driver integration was imperfect in this region and that the listener should not be above the axis of the treble unit.

Classed as a 'difficult' load requiring a tolerant objective test standards; where possible the test power amp, a 3.5ohm dip was recorded at 1 kHz, with an average impedance of 5 ohms; this will compromise the sensitivity somewhat.

Using 100W peak input at 500 Hz, the HB3 was close to overload with a noticeable0.3dB expansteady state distortion results were also satisfactory. (Although the graph looks unpromising,

in the main it is composed of relatively harmless 2nd harmonic.)

Two room responses were generated, wall mounted as directed, and one on slightly higher stands in free space. More bass is undoubtedly generated at 60 Hz on the wall, but I do not regard the overall result as superior, as the wall-generated irregularities are guite strong over several octaves from 80Hz to 1kHz. Positioned in open space, a mild loss of bass was present, but this proved to be less of a disadvantage in our ' location.

Sound quality

While not top-ranked, the HB3 did consistently well on all the listening tests when open-stand sited. Low frequency reproduction was not its strongest point, and although it could sustain a massive peak input of close on 500W, the bass seemed a trifle 'slow' but did possess some extension. On the live sessions the extreme treble appeared to lack 'sparkle', and the midrange had a unique tonal character different to most other models, but plausible nonetheless. It also demonstrated a tendency to excessive 'openess' a well as a 'cold' slightly 'metallic' effect.

On the stereo sessions the image precision was fine, with good presentation in the lateral plane. Some depth loss was apparent partly because of the 'forward' presence range, but clarity was to a high standard, and despite the forwardness it reproduced a surprising amount of spatial ambience.

Located near to the wall, the sound was less coherent, the stereo lost some central focus and was spread over a wider area.

Update summary

Anticipated refinements have now been incorporated to produce a true Series II model. A Medite baffle has been introduced, the treble and mid units transposed and the crossover improved. The crossover is now removeable for eventual active use. The matter of wall versus open stand mounting still needs to be resolved; an intending buyer should keep an open mind about this, trying both and some intermediate compromises. He must also remember to match the HB3 to a tolerant 4 ohm-capable amplifier.

GENERAL DATA

Size (h x w x d)..... .62.5 x 33.5 x 31 cm Recommended amplifier power per channel

(for 96dBA per pair at 2 metres minimum)(15)-200W Recommended placement on supplied stand near rear wall Voltage sensitivity

(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
Approximate maximum sound level (pair at 2m) 106dBA
Impedance characteristic (ease of drive) difficult
Forward response uniformity
Typical price per pair inc VAT



Forward characteristic response (1/3-octave @ 2m. dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic responses in room at listening position. Above against wall, below clear of boundaries.



Reference sinewave response (1 m on axis 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, shows stop point at 96dB).



Harman Audio UK Ltd., Mill Street, Slough, Berks SL2 5DD. Tel (0753) 76911



50A

В

Previously reviewed and recommended, the L150 now carries an A suffix denoting the substitution of a new and improved treble unit, distinguished by a protection grille, and further crossover refinements. An imposing structure just over a meter high, the vertical-in-line driver array comprises a 305mm auxiliary low frequency radiator of exceptional throw, plus a high power 305mm bass unit fitted with a rigid coated-pulp cone and built on a die-cast frame. A high linearity ceramic magnet system is employed. The traditional 100mm pulp cone mid unit is positioned above the bass driver and is followed by a 25mm aluminised dome tweeter, the latter a hardened phenolic linen structure. The crossover possesses good power handling with low loss components. and the mid and treble level controls are now marked with an 'O' 'flat' position in addition to boost or cut. (JBL used to deny the existence of a flat curve, preferring to let the customer choose it for himself in the final listening position).

The internal volume is large at 110 litres, with the massive and rigid enclosure built from high density chipboard fitted with extensive bracing and a fibreglass acoustic absorption fill. Externally the American walnut veneer was of the highest quality.

For the new review the speaker was fully auditioned and substantially re-measured. While the 2 metre and distortion curves refer to the previous version, they are still relevant, the only exception being the treble lift above 15 kHz which on the new version is now replaced by a gentle rolloff.

Lab performance

The new axial reference curve was remarkably similar to the previous samples right up to 6kHz, beyond which the slightly ragged character plus oft-criticised peak at 19kHz has been replaced by a smoother trend, plus a gentle hump at 15kHz, rolling off thereafter. The sensitivity remains high at 89dB/W, and the drive characteristic with a minimum impedance of 5.5 ohms was rated as average, and should embarrass very few amplifiers.

As the existing forward characteristic shows, the L150A is a very well integrated system, especially considering its size. The low frequency response was superbly extended to a -6dB point at 32 Hz, gently tapering below 200 Hz to improve the room energy balance (which tends to augment the lower frequencies by a few dB or so). It is essentially well balanced as the reference response indicates, +/-3dB limits sufficing for a 33Hz to 19kHz range, even sinewave measured.

At 96dB distortion levels were very low throughout the range, typically around 0.4% and remaining well below 0.3% at 90dB. Fed 100W peak power pulses the system exhibited negligible compression at both 500Hz and 5kHz, while a mild 3.0% 3rd harmonic was recorded at the lower frequency; elsewhere the remaining measured harmonics were consistently low, which is indicative of a fine dynamic range.

With 500W peak power handling, the 150A is capable of a hall-filling 111dBA, and should satisfy all but the most insensitive disco fan. Room averaging showed an interesting interaction, with the 100Hz to 5kHz range exemplary at $\pm/-2dB$, although above 5kHz the rolloff should have been smoother and slower. Below 100Hz the strong low frequency output of this model produced an elevated response right down to 40Hz, and by implication a touch of low bass cut on an accompanying amplifier may be necessary in some situations.

Sound quality

The *L150A* continued to set a high subjective standard throughout the listening tests. On the live comparisons it showed some mild colorations, and was inferior in this respect to the smaller classic BBC designs; 'boxiness', 'nasality', slight 'sibilance' and 'hollowness' were all noted. But on the plus side the frequency balance was highly neutral, with a well-defined and crisp, clear rendition.

On stereo programme the speaker gave a 'big' sound, partly as a result of its physical height and its wide bandwidth. The bass was superbly clear and unusually extended, if slightly excessive, while 1000W of electric bass guitar was handled without knocking or distortion. Stereo imaging was to a good standard, with fine detail, well articulated vocals, and promising depth. Overall the effect was a trifle 'hard', which suited rock programme best, but results were impressive on all material, with plenty of information reproduced.

Summary

Continued refinements have helped to maintain the competitiveness of this model, and despite its high UK price it provides a sufficiently good standard of sound quality to deserve continued recommendation. Its particular merits include low distortion, a wide dynamic range and exceptional power handling, plus above average sensitivity, clear articulate sound with great bass extension, and an essentially neutral frequency balance. Finally the system is relatively easy to drive, and is superbly engineered and finished.

GENERAL DATA

Size (h x w x d)
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)(10)-500W
Recommended placement on floor clear of walls
requency response within ± 3dB (2m)
ow frequency rolloff (-6dB) at 1m
oltage sensitivity
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
pproximate maximum sound level (pair at 2m)111dBA
npedance characteristic (ease of drive) average
orward response uniformityvery good
vnical price per pair inc VAT £1000 when reviewed now £1250





Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).





Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion at 96dB.



Forward characteristic response (γ_3 -octave @ 2m, solid axial, thick-dash 30° horiz, thin dash 45° horiz, dotted 15° vert.).

KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP. Tel (0622) 672261



KEF

Coda

In recent years KEF have been noted for some of the more costly 'reference' speakers on the market, but they have now reaffirmed their interest in the budget class, with this substantial two-way model retailing at around £80.00 a pair.

The Coda comprises a 19 litre sealed-box tuned to a 3rd order low frequency alignment by a series capacitor of computed value. The bass/midrange is handled by a 200mm flared pulp cone driver, whose cone is light enough to offer useful sensitivity without excessive magnet expenditure (the latter is surprisingly small but sufficient to properly damp the low frequency response). The treble unit is the Audax 25mm fabric dome which is already used by KEF in their successful Celeste/Concord series. A fourelement crossover of high power capacity marries the units around 4kHz.

The enclosure is simply constructed of chipboard with a rather dull synthetic walnut covering. No panel damping is used, but some internal absorption is achieved by a polyester blanket fill. Electrical connection is *via* rear flush fitted spring clip terminals, and the driver panel is well finished which is fortunate in view of our recommendation that this model should be used with the grilles removed! The grille is a plain unrebated panel 12mm thick which had surprisingly severe effects on the speaker's frequency response and stereo image properties, as well as causing a smaller but noticeable change in subjective smoothness. Having discerned these effects early on, the listening tests were done with the grilles removed, and this should be borne in mind by the prospective purchaser.

Lab performance

The sensitivity was higher than claimed at an above average 88.5dB/W, and KEF's frequency response was substantially met (they specify with the grilles removed in any case!) At 2m the characteristic curve showed a very fine set of offaxis results, with the evidence suggesting that 25° should give the flattest result and provide the most pleasant tonal balance as well as good stereo imaging. The range 80Hz-2kHz was remarkably smooth for such an inexpensive system.

Good dynamic potential was shown by its handling of the 100W pulsed inputs, with a mild 0.2dB compression at 500Hz accompanied by 3.8% 2nd and a modest 0.55% of 3rd harmonic distortions. At 5kHz, there was 0.6dB of compression as well as more distortion, namely 4.5% 2 nd and 1.0% 3rd, though neither was considered serious at this high 108dB spl. 3rd harmonic distortion was low at both 90 and 96dB steady state, rising above 1.0% only below 100Hz, and measuring only 3.5%, 50Hz 96dB. The printed graph was in fact dominated by less serious 2nd harmonic at the 1.0% level. The 8 ohm specification was almost perfectly met, so the system will be easy to drive to the full voltage/sensitivity rating of the amplifier. Averaging showed just how well this speaker worked within the room. +/-2.5 dB limits sufficing from 60Hz to 15kHz. The rolloff beyond 15 kHz was a little steep, the bass falling below 50Hz and the midrange being slightly humped, but the room system response never-

the less beat many models at much higher prices. Our power rating was for a minimum of 10W/channel rising to 100W peak maximum, the latter allowing high sound levels of up to 104dBA in the listening room from a stereo pair. Reasonable extension was shown at low frequencies with the -6dB point at 50Hz.

Sound quality

This speaker scored very well on all the listening tests, performing with a consistency that we have come to expect only from much costlier models. It would be all to easy to ignore its faults in the light of this astonishing performance, but obviously it is not perfect. Some coloration and a tendency to brightness was demonstrated, while the treble also showed an uneven tendency on occasion, with some of the characteristic Audax 15kHz 'fizz'.

Conversely it provided a fine stereo presentation with above average depth, good spatial effects and ambience plus a transparency and detail which conveyed a high proportion of the musical information contained in a variety of programme.

More coloration was noted on the live comparisons, but the system's detail and tonal accuracy won the day and high scores were recorded. Up to a 150W peak of bass guitar was happily tolerated, the system demonstrating a fair fundamental bass power, a neutral and even character, plus an ability to play loud.

Summary

This compact speaker possessed a great many attributes, notably good sensitivity, wide dynamic range and power handling plus moderate distortion and an essentially neutral frequency balance with satisfactory bass extension. It also demonstrated fine stereo, good clarity and detail, so it deserves to be fed good quality material - a second-rate turntable with a 'fizzy' cartridge will destroy it. The Coda is not only a classic Best Buy but will. I believe, set the standard for budget compacts for years to come. If used on stands without the grilles and angled inwards by about 20° to cross in front of the listener, the results compare with many models costing up to £300.00 a pair. As such, it provides embarrassing competition for some of KEF's own more expensive models.

Update

A Coda III will shortly be on sale for £89 with improved terminals, new styling and improved tweeter.

GENERAL DATA

Size (h x w x d)		47 x 28 x 22cm
Weight		7 kg
Decommonded emplify	or nower per channel	

(ref 2.83V, ie: 1 watt in 8 ohms) at 1m	. 88.5dB/W
Approximate maximum sound level (pair at 2m)	104dBA
mpedance characteristic (ease of drive)	. very good
Forward response uniformity excellen	t (grille off)
Typical price per pair inc VAT£80 when review	ed, now £89



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without arille).



Harmonic distortions: solid 3rd 96dB, dotted 2 nd 96dB, dashed 3rd 90dB, chain-dashed 2 nd 90dB,



EF Caprice

KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP. Tel (0622) 672261



KEF seem to be caught in the current marketing trap, whereby all small loudspeakers must be labelled 'bookshelf'. By restricting depth to 22cm, such a system may be located on even a shallow bookcase flush fitted to the wall, but in subjective terms such a location unfortunately sacrifices much of the stereo quality, freedom from coloration, and accuracy of tonal balance. In common with many other accurate speakers the Caprice in fact sounds best when properly located on open stands clear of the room walls.

While it is a Coda lookalike in general specification, size and lineup, there are several important variation, not the least of which is the 2:1 price difference! The Caprice uses a decoupled frame bextrene-cone 200mm bass/mid unit with a generous magnet assembly, which has higher cone mass and a lowered system resonance than the Coda (from 73 to 69Hz). A Coda, for example. more complex 12-element crossover divides the frequency range, though this includes three

resistors and two capacitors for 3rd order low frequency tuning. The 25mm soft dome tweeter is KEF's own refined driver, as also used in the R105.4 and R103.2; in fact, if you change the box shape and add the electronic protection the Caprice could turn into a R103.2 vet it costs £100.00 less.

The same prejudicial grille fitted to the Coda is also used for the Caprice, and similar criticisms are appropriate. Decent foam grilles would have done both these models a service, and probably would offer a further reduction in price, since they are now less expensive than cut chipboard with a paint finish plus hand-applied woven cloth.

Lab performance

Measured at 1m, the Caprice illustrated an extremely uniform response up to 6kHz, above which a very mild lift in the treble was present; in the lower range, +/-2dB limits sufficed for 55 Hz to 6 kHz, while the upper lift amounted to 1.5dB. With an average 87dB/W sensitivity the low frequency response was quite extended. showing a -6dB rolloff point of 45Hz. Close to the 8 ohm standard with a minimum impedance no lower than 5.6 ohms, the Caprice was rated a 'good' amplifier load.

At 2m with 1/3-octave averaging, the output proved to be very consistent particularly on axis. Note should however be taken of the small dip at 3kHz at 15° above, which suggests that the speaker should be at or slightly above ear level. As with the Coda, off-axis lateral plane listening is perfectly possible, with 20° almost perfect. The speaker met close overall limits under these conditions, in practice measuring +/-2dB.

The distortion results were favourable, with some 3rd harmonic reaching 0.8% midband, 96dB but not increasing beyond 1.0% until below 70Hz. Second harmonic was higher at around 1-2.0%. At 90dB. which is still a fairly high sound level, most distortion has vanished below the 0.3% baseline. At 100W, compression was negligible with 5th harmonic at 0.3%, 3rd at 1.0% and 2nd 5.0%, all more than satisfactory at both 500Hz and 5kHz.

In the listening room the response indicates a fine balance, showing a gentle rolloff at high frequencies and good power delivery down to 50Hz with little emphasis. Minor uneveness was also present throughout the upper midrange. 500Hz to 3kHz, and this speaker's output did not sound quite as well integrated or coherent as the

Sound quality

As with the Coda the Caprice scored consistently high in all the listening sessions, and in some respects it was more subtle in its approach, with a smoother more restrained effect plus worthwhile extra bass. Conversely some of the excitement and 'alive' quality of the Coda was suppressed, harking back to the 103.2. Interestingly, the Caprice was felt to be rather better balanced than the 103.2, and has scored significantly higher in these tests.

Compared with live sounds this model was felt to be slightly 'rich' in the midband, with a trace of 'glassiness' in the treble and mildly sucked out in the middle. Slight 'Bextrene type' 'nasality' was present, although this was not serious, and while the bass showed fair extension, it only scored average, demonstrating some 'softness' and 'lumpiness'. Power handling was however good.

On the stereo sessions slight 'tubbiness' and a suspicion of 'eday' treble was reported, but the tonal character was liked, showing an airy, transparent and detailed picture. Good enough stereo was demonstrated with grilles on, but the focus significantly improved and the speaker scored over the Coda in this area and in its ability to produce a convincing degree of detail after they had been removed.

Summarv

A year ago the 103.2 just merited a Best Buy rating. The Caprice is in fact a 103.2 without the protection circuitry and genuine veneer finish, but with a more lively tonal balance which in our opinion makes it rather better. This is a clean. neutral and compact speaker of good dynamic range, sensibly wide response, high quality construction, and cost effective engineering, so it obviously qualifies for Best Buy rating.

GENERAL DATA

Size (h x w x d) 47 x 28 x 22 cm
Veight
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)(15)-100W
Recommended placement open stand
requency response within ± 3dB (2m)
ow frequency rolloff (-6dB) at 1m
oltage sensitivity
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
pproximate maximum sound level (pair at 2m)
npedance characteristic (ease of drive) very good
orward response uniformity

Typical price per pair inc VAT£150



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response with grille).





Impedance (mod Z).

R103.2 KEF KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6OP Tel (0622) 672261





The original R103 was one of the most technically advanced speakers of its time, and still stands comparison with current references. However it was costly and difficult to manufacture, and a new version is now available which is also a two-way compact sealed box system (19 litres). This uses an entirely new high power 200mm bextrene driver for bass/midrange, which possesses a revised profile and trochoidal steel frame designed for balanced anti-vibration mounting to reduce cabinet panel resonance. The tweeter is also a new design from KEF, comprising a 25 mm fabric dome unit

As with the 101 and 105 a third-order alignment is used at low frequencies, this providing both bass improvement over simple sealed box loading, as well as subsonic overload protection (a series capacitor element). KEF's full electronic overload protection unit (S.Stop) is also incorporated in the complex 14-element crossover, and in common

3

with all the *Reference* series speakers, the 103.2 is subject to extensive computer aided tolerancing and matching.

Lab results

Pair matching was indeed very good, and generally within ± 0.6 dB up to 18kHz. An average sensitivity of 86.5dB was recorded, which is some 4dB greater than for the original 103. In terms of the size and sensitivity the 48Hz -6dB low frequency point was quite low, and the sensitivity is in any case assisted by the good amplifier loading offered by the 8 ohms nominal impedance. Fairly high phase angles were recorded – typically 40° with up to 60° at about 2.8kHz (12 ohms modulus) and 40° at 3.5kHz (7 ohms modulus).

At 1m with sinewave excitation the response was unusually smooth and well balanced, meeting ± 2 dB limits from 58Hz to 18kHz. At a fairly high 96dB sound level, distortion was guite low, with third harmonic well controlled except at 1kHz where a mild rise to 1% was recorded; second harmonic was higher than average at low frequencies, measuring 2%, at 100Hz, though this is pretty innocuous subjectively. Fed 100W tone burst pulses just 0.3dB of compression was noted at 500 Hz, with no appreciable increase in distortion apparent, and at 5kHz the results were perfect. This, together with the high bass power handling capacity, means that the *R103.2* is judged capable of accepting up to 200W of programme, generating substantial 103dBA sound levels in a typical room.

The very uniform trend exhibited by the 103.2 was confirmed at a 2m measuring distance using ¹/₃octave analysis. The dispersion characteristics were very good and a general trend to moderate 'richness' or downtilt in the frequency balance was apparent, more so in fact than for the 105.2, and the grille was found to be partially responsible.

Sound quality

Scoring average on the live sound comparisons, the system was judged to have a mildly 'thickened' character, exhibiting some 'boxiness', and alternatively described as insufficient openness in the presence range. The bass was however fine with surprising depth and evenness, and it withstood 80W average (200W peak) of electric bass guitar.

On the stereo sessions the panel found the speaker easier to accept and awarded considerably higher marks. It was judged a little 'bland' vet very smooth, with aggressive colorations at a minimum.

Piano and full orchestra were very well reproduced, and stereo imaging was to a good standard; the speaker tended to 'grow on' the panel slightly during the proceedings, which is an encouraging sign.

Top: Frequency response, 1m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB Middle: Impedance (modulus) Bottom: Frequency response, 2m 1/3-octave averaged (solid, axial: thick dashed. 30° horizontal: thin dashed. 45° horizontal: dotted 15° vertical).

Summary

20

Hz

50

100

200

500

1k

2k

5k

10k

20k

The R103.2 was a strong performer, taking into account its above average sound quality and good stereo, plus its smooth slightly rich perspective and reasonable sensitivity. It also offered excellent power handling, moderate distortion, and surprising bass for its size. If the very good finish and engineering are taken into consideration as well as the comprehensive electronic protection, this is clearly the recipe for firm recommendation at a typical £260 a pair.

Recommended amplifier power per channel

(for 96dBA per pair at 2 metres minimum)



KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6QP, Tel (0622) 672261



EF R105.4

Well established in Mark 2 form, the R105 continues to set an enviable standard for sound quality. The rather confusingly named R105.4 with its advanced 110mm Bextrene-coned midcrossover/equalisers which provide a remarksighting light to aid accurate positioning of the adjustable heads.

Although smaller than the Mk 2, the R105.4 is

in parallel, rather than the costly 305mm unit of the 105.2. Radiating area is much the same, and the reduced band-width has endowed the '4 with even higher power handling capacity, though at a cost of some 13Hz of bass extension. A new 25mm soft dome tweeter is used, allowing a small increase in sensitivity.

Lab performance

We disagree slightly with KEF concerning the shape and level of the low frequency response. With nearfield correction relative to our 85.5dB reference sensitivity, we charted a hump of some 2.5dB, accentuated by a rolloff below 100Hz. KEF's own computed data from their reference system at the factory shows that the hump barely exists, at just 1 dB above their reference taken at a 2m measuring distance. Our low frequency overlay for the Choice 2m characteristic response showed less lift, but 100Hz was still fractionally over 2dB above the 1kHz point. While these may seem small discrepancies, in fact the described variations in low frequency tilt and balance were audible, and the listening panel proved sensitive to such factors.

With the bass grille removed (it adds a reflecting edge below the mid unit), the speaker produced a remarkably smooth response, +/-1.5dB from 150Hz to beyond 20kHz, which is better than a number of precision microphones! The bass slope has already been noted, while the -6dB point was moderately extended to 46 Hz and with a slow decay thereafter to 35Hz, -10dB.

At 2m the characteristic responses were exemplary. A significant and subjectively important aspect of the tonal balance was however revealed by a gentle upwards trend from 200Hz, the converse of the aentle down-tilt in the 105.2 represents an effort to bring 105 technology to a previously measured (especially with grilles on). lower price category, and is not intended to A slight energy depression was present from replace the R105.2. However much of the latter's 600 Hz to 1.5 kHz: that this is a deliberate comelaborate foolproof protection systems have been pensation is clearly evident from the averaged retained, together with the unique head assembly room response, which is correctly balanced in this region, in contrast to the 105.2. In fact range unit, and the sophisticated high-slope comparing the room responses for these two models tells us a great deal about their subtle able degree of driver integration. The 200W peak sound quality differences. The '2 has the smoother. power indicator is also included, and this is also a deeper bass, but betrays a falling output with frequency only relieved by the mid prominence. while the reduced extension of the '4 leaves the

upper bass more prominent, but gives a more still substantial, measuring just under a meter consistent and better balanced response up to high. The major difference between the Mk2 and 4kHz. Above this the anticipated smooth die 4 concerns the bass enclosure, which has been away occurs. Averaging 10 ohms, the 104.4 was reduced to 40 litres for this new model, and uses an excellent amplifier load and will be easy to drive two less expensive 200mm bass units operating to the potential of its rated 85.5dB/W sensitivity,

with up to 500W generating 107dBA maximum levels, and 20W representing a sensible minimum.

At 96dB third harmonic distortion was held to around 1% down to 55Hz, while 2nd harmonic was higher reaching 3.0% around 600 Hz. At the reduced 90dB level 2nd and 3rd order effects were still evident in the 0.3 to 1.5% range, and this performance could be better in view of the price level. The 100W pulsed inputs were accepted without protest, showing negligible compression and similar harmonic levels at both test freguencies, with 5.0% 2nd and 1.0% 3rd harmonic. both of which are satisfactory figures.

Sound quality

The 105.4 had no difficulty in matching the high scores attained by the '2 on all the listening tests. and while broadly similar, the comments reflected the measured differences. The '4 sounded 'livelier' and more 'open' with enhanced 'see-through transparency' and some extra detail, so that it appeared even less coloured. The bass register of the '4 was powerful and well extended, but undeniably slightly rich, even 'lumpy' in the upper regions. But in contrast to many other systems it could 'play tunes' well in the bass, and thus scored high in this area.

The comparisons with live sounds were in the '4s favour, though a trace of 'boxiness' and 'nasality' remained, with a mildly 'plummy' and 'chesty' quality in the upper bass. Stereo imaging was exceptionally good, with a seemingly effortless recreation of space, ambience, and depth (when present in the programme). Where the '2 impressed by its 'scale', and relaxed, more distant perspective, the '4 provided greater excitement and 'immediacy', without any sacrifice of the depth impression.

Summarv

The 105 concept clearly has much mileage in it yet, and I suspect that given a choice, most listeners would prefer the 105.4 to the 105.2. The latter has a slightly smoother and more extended bass plus a sweeter treble, but the former possessed a quality of 'liveliness' which sets it apart from the ordinary. It also offers one of the largest power handling capacities for this size of enclosure. and with a welcome cost saving over the '2 the 105.4 is enthusiastically recommended.

GENERAL DATA

Size (h x w x d)
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)
Recommended placementon floor, clear of walls
Frequency response within \pm 3dB (2m) 55Hz to > 20kHz
Low frequency rolloff (-6dB) at 1 m
Voltage sensitivity
(ref 2.83V, ie: 1 watt in 8 ohms) at 1 m
Approximate maximum sound level (pair at 2m)107dBA
Impedance characteristic (ease of drive) excellent
Forward response uniformity excellent
Typical price per pair inc VAT £650



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room



Reference sinewave response (1 m on axis, 2.83 V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response with grille).







KEF B105 2 KEF Electronics Ltd., Tovil, Maidstone, Kent ME15 6OP Tel (0622) 672261



Tested for the last issue in pre-production form, the Mark 2 R105 has been completely reassessed this time round, complete with its full grille assembly. This substantial floor-standing three-way system has a bass enclosure which alone measures 70 'head' assembly to contain the mid and high frequency drivers: this is adjustable for tilt and lateral angle to aim the optimum axis at the listener without re-orienting the entire speaker. The overall configuration reduces phase and time delay distortion, and accurate driver integration is provided by a complex 24dB/octave crossover (acoustic). All vital components are computer matched to achieve a very close correspondence between the two 'halves' of a numbered stereo pair.

The 305 mm trochoidal cast chassis bextrene coned bass unit is aligned to a third order response at low frequencies, and is located on anti-vibration

ω

mounts to reduce cabinet coloration. The 400Hz to 3kHz range is handled by a special 100mm bextrene coned unit, and the treble by a 38mm polyester dome tweeter. Instead of the fuses used in the original 105, comprehensive electronic protection is now incorporated to cover bass excursion, absolute voltage, and dynamic thermal tracking for each driver. Peak power indicators and test facilities are also provided.

Lab results

As claimed, the pair matching was extremely good, and the terminal sensitivity was a little below average at 85dB/W. However, the low frequency range was well extended, with a -6dB point at 33Hz (without taking into account the floorstanding position that would normally be encountered).

The swept distortion results at 96dB were good. particularly at low frequencies, but there was a rise to 1% third and 1.5% second harmonic around 1kHz, which was somewhat worse than average. Fed 100W toneburst pulses, a 0.4dB compression was noted at 500 Hz though with a negligible increase in distortion, while at 5kHz no compression or distortion was detected.

The sinewave response at 1m on axis was charted with and without the grille in position, and suggests that in the former case a detectable absorption of upper mid and treble energy occurs. placing a slightly rich balance on the otherwise remarkably uniform and extended response (+2dB)limits suffice from 50Hz to 20kHz). At 2m with ¹/₃-octave averaging (grille on), the marginally attenuated presence and treble range was still apparent, but a notably even and well ordered array of off-axis responses was achieved, confirming the very good driver output integration. By normal standards the speaker is undoubtedly litres and uses a separate low diffraction moulded unusually flat in response. The high impedance characteristic presents an easy amplifier load, which helps to offset the low sensitivity; phase angles were held to 40° up to 15kHz, and typically measured 20°.

> Analysed in the listening room using our new averaging test working in ¹/₃-octave bands, the 105.2 showed a fairly smooth and well-extended low frequency range, +/-3dB 40Hz to 500Hz, but also gave a hint of 'forwardness' in the 600 Hz to 1.2kHz octave. The 2kHz presence region was marginally depressed by comparison, and on the whole the treble range rolled off too early despite a smooth extension to the highest frequencies.

KEF B105

(fully re-assessed)

Sound quality

The 105 2 did well on live sound comparisons, with the bass range very even and deen sustaining 150W average or 350W peak of electric bass guitar. Coloration was low, with a trace of 'nasal'. 'hollow' and 'boxy' effects, and overall the panel felt that the speaker was somewhat 'duller' than life

On the stereo tests the imaging was probably the best auditioned, exhibiting exceptional lateral stability and precision, and with a remarkable realisation of depth and ambience. Overall the sound quality on commercial programme was considered very good, with criticisms confined to a moderate tendency to a 'warm' and 'rich' character. and with a bass that could have benefited from sounding 'drier', in our room at least.

Summary

20

Hz

50

100

Aside from minor quibbles concerning frequency balance, the R105.2 was an exceptionally well engineered design. It offered an easy load, a wide bandwidth, low levels of coloration, moderate distortion, as well as good power handling. Stereo reproduction was remarkable and full electronic protection was provided. While it may not satisfy those seeking a lively (and possibly exaggerated) sound more suited to loud rock programme, as it stands the 105 is surely one of the most consistently accurate speakers in current production. It should however be noted that the sound is more sensitive to room acoustics than many due to its wide midband dispersion, so where possible a home audition is recommended.

Completely reauditioned for this issue, the '2 retained its very high ranking and thus continues to merit recommendation, although on balance we prefer the cheaper 105.4.

200

500

Size (11, w, D)
Weight
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum) 25-300 W
Recommended placement
Frequency response within ±3dB (2m)
Low frequency rolloff (-6dB) at 1m
Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) at 1m 85dB
Approximate maximum sound level (pair at 2m)103dBA
Distortion (96dB at 1m)
Distortion (100W peak)
Impedance characteristic (ease of drive) very good
Forward response uniformity very good
Typical price per pair inc. VAT £860 when reviewed, now £899

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Averaged forward characteristic response in room at listening position.

Top: Frequency response. Im sinewaye, plus 2nd (solid) and 3rd (dashed) harmonic distortion @ 96dB Middle: Impedance (modulus)

Bottom: Frequency response, 2m 1/3-octave averaged (solid. axial: thick dashed 30° horizontal thin dashed 45° horizontal: dotted 15° vertical).



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Lentek Audio Ltd., Edison Road Ind. Est, St. Ives, Huntingdon, Cambs. Tel (0480) 62225



Lentek S5

Known for their conscientious attention to detail and finish, as well as no-compromise attitude to design. Lentek have come up with their interpretation of the classic stand-mounted two-way reflex system. A low coloration design, the S5 is larger than usual at close on 50 litres internal volution. The thinwall double-veneered chipboard call et is heavily damped by internal bituminous cla 'ding plus a top quality acoustic foam lining. The generous port is 75mm in diameter backed by a 180 mm long duct. Despite its volume the S5 is comparatively narrow, but when seen side on the depth is considerable. It is superbly finished on all surfaces with a fine American walnut veneer, and a matching solid wood stand is also available.

Two proven drive units are used, the bass/mid is a 200mm Bextrene large magnet long throw design from KEF, offering good sensitivity and ideal characteristics for a large reflexed system. As in the S4, the established Audax 25mm soft

dome tweeter is used, in this case a high sensitivity version to give scope for crossover equalisation.

Considerable care has evidently been taken over the crossover, which comprises 13 elements. of which four are damping/ attentuating resistors. Lentek claim good power handling for the S5, as well as low distortion which in class and bandwidth broadly supercedes the larger and earlier Monitor X.

Lab performance

At 1 m the S5 showed an even balance, which is a characteristic hallmark of an accurate design. However Lentek's +/-2.5dB limits were judged a trifle too narrow, and we needed +/-3.5 dB to contain the peaks and troughs between 2.5kHz and 6.0kHz; this apart, the system met +/-2.0dB. 60Hz to 20kHz.

The sensitivity was above average at 88dB/W. with a useful bass extension to 44Hz, -6dB, rolling off slowly to -10dB at 34Hz. With 1/3octave analysis at a more representative listening distance (2m), the system retained that mild 'lumpiness' in the presence range, and the S5 must be used with the tweeter near to ear level. as the 15° above response shows a 7dB loss at the 3kHz crossover frequency. Overall the lateral off-axis trends were very good.

Somewhat compromising the sensitivity, the impedance rated as an average amplifier load, with a dip to 4.5 ohms, 4kHz, and continued low impedance to 8kHz. Lentek in fact claim a 8 ohm value with a 6.4 minimum, but we cannot endorse this.

Distortion levels were low reflecting the very good power handling, which was exemplified by the bass guitar tests which reached 250W programme. High sound levels of up to 107 dBA were possible from a pair, though satisfying results could be obtained using as little as 15W/channel. At 96dB 3rd harmonic was excellent at well below 0.3% down to 150 Hz; 2 nd harmonic varied from 0.3 to 1.5%, and was also very good. reducing at lower levels. The 500Hz 100W pulse gave a little trouble with 0.3dB compression and 8% 2nd harmonic, but 3rd still held to 0.55%. At 5kHz compression was negligible with 0.8% 2nd. though here 3rd harmonic distortion had increased to a 3.0% level and 5th appeared at 0.8%. Though capable of 250W the last few dB of the dynamic range will in fact show some distortion in the mid and treble.

The room response was not as good as the axial curves might suggest. This is believed to be related in the midband at least to the speaker's narrow width and unusual depth. Two prominences

appeared in the region of 500Hz and 5kHz. though the bass was almost ideally balanced and extended. As with other systems showing deviations in their room-averaged responses, a point of interest was whether any correlation could be made with the listening test results.

Sound quality

Some conflict was apparent in listening test results, for while the live session results were above average they were not outstanding, but the scores on the stereo programme sessions were significantly better.

On the solo live sounds criticism was made of an 'altered' tonal balance in the midrange, with some 'hardness' and attendant 'boxiness'. The treble range could be harsh in the lower registers while extreme high frequencies were deficient. The bass showed good extension with strong reproduction of low bass fundamentals, but with slight 'softness' and overhang.

On the stereo sessions the speaker was found to image well with good depth reproduction and a high level of lateral precision. String tone was a trifle 'wiry', and voice slightly 'thin' tonally, with some hardness on piano. Extreme treble was deficient, although this was not judged too serious. Most listeners liked the speaker nonetheless, and felt that it was comparatively neutral, clear and 'powerful'.

Summary

This fairly expensive, substantial and well-finished speaker has a performance commensurate with its price, and meets Choice's required standards for recommendation. It offers moderate distortion. good sensitivity, an extended low frequency response, and fine stereo imaging. The choice of amplifier needs some consideration, and the minor idiosyncracies described above indicate that a thorough audition would be worthwhile before purchase.

GENERAL DATA

Size (h x w x d)	66 x 26.5 x 41cm
Weight	21.5kg
Recommended amplifier power per channel	el
(for 96dBA per pair at 2 metres minimum	n)
Recommended placement	open stand
Frequency response within \pm 3dB (2m)	64Hz to 20kHz
Low frequency rolloff (-6dB) at 1m	44Hz
Voltage sensitivity	
(ref 2.83V, ie: 1 watt in 8 ohms) at 1 m	88dB/W
Approximate maximum sound level (pair at	2 m) 107 dBA
Impedance characteristic (ease of drive)	average
Forward response uniformity	very good
Typical price per pair inc VAT	£380



Forward characteristic response (1/3-octave @ 2m. dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



at listening position.



input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille)



Impedance (mod Z).

Monitor Audio MA66

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



During the last twelve months, the successful *MA6 II* has been superceded by a new *MA66* model. This owes a lot to its predecessor, and retains the same mid and treble units, namely a 25mm grille-protected Audax soft-dome tweeter, and an exclusive 200mm unit from Dales which uses a lightweight flared pulp cone, and a nitrile surround damped by applied visco-elastic coating. The internal volume remains unaltered at 33 litres.

Obvious differences concern the driver panel, where the original ducted port has been replaced by a very long throw 200mm ABR (auxiliary bass radiator), fitted with a dense and inert bextrene cone. The bass driver resonance occurs at 63Hz and the ABR is tuned to 33Hz. Internally the cabinet damping has been upgraded to incorporate bituminous panel cladding, with the internal absorption including both a thick polyurethane foam lining plus a polyester volume filling. The grille frame is guite open, and

is effectively rebated on its inside edge to reduce diffraction effects in the treble.

Nominally placed at 3.5kHz, the crossover employs 8 elements including two damping attenuator resistors, and the components are made to a high power rating. Externally the system was finely finished in a real light oak veneer of unusual quality. Electrical connection is via the usual 4mm socket/screw terminals, recessed to avoid damage.

Lab performance

The reference sensitivity was just about average at 86dB/W, with useful bass extension to 42Hz, -6dB. Although the low frequency range was generally well balanced, it was elevated by some 2dB referred to the rated sensitivity.

At 2m the V_3 -octave characteristic made the basic trends more obvious. The overall forward off-axis response was very well controlled, though with a slight mid prominence around 1.2kHz and a shelf elevation in the treble. A shallow depression was present in the 300 to 700Hz region, while at lower frequencies a definite tendency to bass'richness' was present. Despite these comments, a wide 50Hz to 20kHz range could be encompassed within +/-3dB limits.

With a 100W maximum power input suggested by the tests, this speaker was capable of a moderately loud 101dBA for a pair in a typical room, with 20W as the recommended minimum. 100W pulsed inputs were effectively dealt with, the speaker showing little compression, and at both 500Hz and 5kHz test frequencies a 2nd harmonic level of around 2-5%, and a 3rd harmonic level of 0.5-0.8% were obtained. Steady state measurement gave good results, with negligible 3rd harmonic until frequencies below 100Hz were reached, and even here results were not unacceptable. The response curve shows small regions of second harmonic generally less than 1.0%, and of little significance. Comfortably meeting the 8 ohms specification, the '66 possessed a minimum impedance of 6.7 ohms and rated as an easy amplifier load.

The room response perhaps gives a better idea of what the panel actually heard. The bass prominence below 100Hz is unmistakeable, notwithstanding the dominant room mode at 60Hz. Above 100Hz the trend met +/-2.5dB limits to 8kHz, and demonstrated a rather fortunate interaction with the room when standmounted clear of walls as intended. The treble range rolled off smoothly in the preferred manner.

Sound quality

The bass was considered cleaner and deeper than the MA6, showing fairly good fundamentals plus an ability to play quite loud. The panel noted some criticisms as regards balance and distortion on the live sound comparisons, but they never theless awarded surprisingly high marks. On speech some 'chestiness' was noted, while the treble sounded a little 'exposed' and 'sibilant', with mild 'boxy' and 'nasal' effects also present.

On the recorded programme the 66 still did very well, and the midrange was particularly liked. A mild uneveness in balance was recognised, together with a touch of excess bass, but the overall effect was well above average. Some loss of clarity and stereo depth were apparent, and with a 'tighter' bass plus 'sweeter' treble this model could have rated very highly.

Summary

Though mild criticisms are in order, so that the intending purchaser must take the final decision whether to buy or not, the sonic performance versus price equation comfortably qualifies the *MA66* for Best Buy status. At the price the quality of external finish is exceptional, and the speaker is quite substantial in physical size and acoustic bandwidth, demonstrating low levels of coloration and proving easy to drive. As with other speakers of this bandwidth and sensitivity, stand mounting well clear of the rear and side walls is essential to obtain the best and most natural balance, as well as the best stereo effect.

GENERAL DATA

ze (h x w x d)	
ecommended amplifier power per channel	
(for 96dBA per pair at 2 metres minimum)	
ecommended placement stand, clear of walls	
requency response within ± 3dB (2m) 50Hz to 20kHz	
ow frequency rolloff (-6dB) at 1m	
oltage sensitivity	
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m	
pproximate maximum sound level (pair at 2m) 101dBA	
npedance characteristic (ease of drive) very good	
prward response uniformity very good	
voical price per pair Price estimated at time of review as £180.	
now £212 including VAT	



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert, small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without arille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, 0 shows stop point at 96dB).



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Mordaunt-Short Pageant 3

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



After a long run the *Pageant* has now been updated to *Mark III* form – a wise move in view of the speaker's reputation, but a confusing one, since the *III* is more of a redesign than a revamp, and is entirely different from its predecessor. The latter was a two-way system, but now three drivers are used in a larger more expensive box which looks quite different. This time Mordaunt Short are using the 'soft furnished' look, the slim form of the *III* covered on all sides by a sleeve of textured material, with the end caps teak veneered, rather in the manner of the KEF *Concord/Celeste* series. In many rooms they do appear less obtrusive than conventional systems.

The internal volume of 25 litres is reflex-tuned to 26Hz by a twin port system, each of which is 43mm in diameter and 150mm deep, and the driver resonance occurs at 68Hz. Built of 15mm chipboard, the designer has abandoned damping in favour of extensive internal bracing to reinforce the enclosure, and a polyester fibre filling provides internal absorption.

A vertical-in-line system, the bass is handled by Mordaunt Short's DS208 200mm driver, derived from the Pageant series 2, and comprising a rigid pulp cone unit of good performance. A modified Audax 100mm unit covers the midrange, and the treble is allocated to another Audax unit, this time a ferrofluid 12mm cone/dome. All three are integrated by a fine quality 12-element crossover operating at 750Hz and 4000Hz.

Lab performance

Good pair matching was shown, with a fine 1 m axial frequency response giving a typical $\pm/-2.5$ dB 48Hz-20kHz. The rated sensitivity was about average at 86dB/W, and bass extension was good for the size at 41Hz, -6dB.

The forward characteristic response showed excellent consistency and integration, plus a promisingly uniform frequency balance under $\frac{1}{3}$ -octave averaging, namely $\frac{+}{-2.0 \text{ kHz}}$. Best on axis, the speaker will be available with matching pillar stands to maintain the correct listening height.

Rated at up to 100W programme, the 500Hz pulsed power input was just beginning to overload the system with 1.2% 2nd and 1.8% 3rd harmonic. At 5kHz 3rd harmonic was much improved to 0.7%, with 2nd at 2.5% (a moderate value). The steady state distortion graphs reflected a more complex picture: at 96dB, 3rd harmonic was satisfactory at an average of 0.4– 0.8%, while 2nd measured double this and showed a distortion peak in the treble unit at 15– 16kHz, reaching 8.0%. Low frequency distortion was quite good, but interestingly over most of the range the distortion did not improve greatly at reduced power. It should be noted that the *III* did meet spec. except above 14kHz.

With a 100W maximum input, high sound levels of 105dBA can be achieved from a pair, with 20W suggested as a sensible minimum.

Assessed by room averaging, with the exception of a mild and partly room-induced excess at 60Hz, the result looked extremely promising, with a near perfect mid balance and a well controlled smooth rolloff towards the highest frequencies. Decent output was still present down to 40Hz. Specified at 8 ohms, the *III* just failed the test by dipping to 5.8 ohms, 150Hz, although this is comparatively harmless, and the amplifier rating is still good.

Sound quality

This speaker performed better on the recorded

than the live tests. On the latter some colorations were noted: a 'tube' effect in the mid, plus a degree of 'edginess' and 'sibilance' in the treble, not apparent from the response graph. The bass register proved powerful with fair depth extension, but some 'nasality' and blurring of definition were also noted, and the overall score was average in this respect.

The marks improved significantly on the stereo sessions, sufficient to bring the *III* into the recommended class. Stereo presentation was well liked, with fine lateral stability and precision plus promising depth, while clarity was good in the midrange, though not quite as good as we would have liked at the frequency extremes. The treble again gave rise to some reservations regarding smoothness particularly on transient sounds, despite the smooth measured response. Overall the frequency balance was pretty well neutral, with the sound fairly open and transparent.

Summary

A highly competant three way design, the *Pageant III* shows improved bass extension, reduced coloration, a smooth lab and room integrated response, good quality construction, and an interesting furnished appearance. Conversely the treble was not favoured by some panelists, while in general distortion levels were higher than average. On balance the good ratings for the stereo sessions plus the overall promising performance justifies inclusion in the recommend category.

GENERAL DATA

Size (h x w x d)
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)
Recommended placement clear of walls on stand
Frequency response within ± 3dB (2m)
Low frequency rolloff (-6dB) at 1m41Hz
Voltage sensitivity
(ref 2.83V, ie: 1 watt in 8 ohms) at 1 m
Approximate maximum sound level (pair at 2m)105dBA
Impedance characteristic (ease of drive)
Forward response uniformity excellent
Typical price per pair inc VAT£290



2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral)



Averaged forward characteristic response in room at listening position



Reference sinewave response (1 m on axis, 2.83 V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, 0 shows stop point at 96dB).



ProAc Studio 3

ProAc. 30 Lodge Avenue, Elstree, Middlesex Tel 01-207 1150



Paul Tyler, the founder of Celef Audio, also designs and manufactures speakers for the upmarket Proac company. The *Studio 3* is their most expensive model to date, and costs around £1,200 a pair.

Externally the speaker does not seem particularly elaborate, vertically aligned 250mm bass unit, 75mm midrange and 19mm tweeter making up the driver complement. The thinwall chipboard carcase has bituminous panel damping and a fairly modest 51 litre internal volume, reflex loaded by a large 75mm diameter 50mm deep tunnel port. However, details are important here, and hold the key to the engineering quality of the '3. Front and back panels are in costly 19mm multiply, while the high quality 11-element crossover uses close tolerance components of high power handling capacity. All three drive units are unusual. The 19mm soft fabric dome tweeter is a ferro-fluid

130

cooled version of the Scan D2008. The remaining two units are British and are virtually hand-made by ATC. The midrange unit is a large soft dome with a massive magnet and great power handling, and the bass unit has a 75 mm coil and an equally large magnet on a die-cast frame, the diaphragm in this case being a highly rigid shallow pulp cone with heavy damping. These very costly units account for much of the system price.

Lab results

Pair matching was good and the sensitivity was just average at 86 dB/W, though the very good power handling capability enables high sound levels of up to 109dBA for a pair, using amplifiers delivering up to 500W per channel. For the overall size the low frequencies were quite extended, with the -6dB point at 42Hz. As with the Celef 'HE the grille was found to exert a significant influence. and the responses through the presence band were marginally smoother with it removed. The axial response was nonetheless well balanced with the grille in position, particularly above 200Hz, although some LF unevenness was also present below 200Hz (±2dB peak to trough). The excellent and balanced behaviour of the drivers and crossover was confirmed by the fine set of off-axis responses. With such good integration the potential for a fine stereo performance is self-evident.

At 96dB distortions were low, particularly the critical third harmonic which averaged 0.5%. At 100W peak (some 106dB at 1 m) these low levels were maintained at 500Hz, although at 5kHz an 0.5 dB compression was noted together with a mild 2% second harmonic content. Possessing a 6.4 ohm minimum impedance, the amplifier loading was an easy 8 ohms nominal, with the phase angles held to less than 20° above 100 Hz.

Sound quality

Scoring highly on the live sound comparisons, the Proac showed a light, airy character sympathetic to the test sounds. The usual 'boxy' 'woodeness' of most conventional designs was absent, and percussion sounds were notably clean but without excessive treble emphasis. The electric bass guitar was also well handled, providing good evenness, depth and great power. The full 500W was tolerated on peaks with an extraordinary 140W average power input.

This model did equally well on the stereo programme sessions. The bass was judged slightly lumpy but was nonetheless favoured for its power and depth. Imaging was very good, and proved stable with a pleasing perspective and well developed depth, while the whole sound was 'atmosnheric' and not concentrated on the enclosures. An zontal: dotted 15° vertical). 'airy' if slightly 'thin' effect was produced but without any hardness and with very little 'fizz', while coloration was very low by conventional standards. Clarity and detail rendition were also both very good.

Summary

A compact, high quality speaker with extended bass and exceptional power handling, the Proac 3offers a smooth and wide frequency response -20 together with low levels of coloration and very good sound quality. The price is undoubtedly very high, but the performance is exceptional, and justifies recommendation.

Size (H, W, D)
Weight
Recommended amplifier power per channel (for 96dBA per pair at 2 metres minimum)
Recommended placement stands
Frequency response within ±3dB (2m)
Low frequency rolloff (-6dB) at 1m
Voltage sensitivity (ref 2.83 V, ie: 1 watt in 8 ohms) at 1m86dB
Approximate maximum sound level (pair at 2m)
Distortion (96dB at 1m)excellent
Distortion (100 W peak)
Impedance characteristic (ease of drive)
Forward response uniformity very good
Typical price per pair inc VAT£1265

50

20

Hz

100





The Acoustical Manufacturing Co. Ltd., Huntingdon PE18 7DB. Tel (0480) 52561



This new design has been long awaited, and we even hoped it might be ready in time for inclusion in the last issue. The original *Electrostatic* was reviewed some years back by a different author in *Choice*, and certain of the problem areas which emerged, namely directivity, bandwidth sensitivity, power handling and amplifier loading have all found partial solutions in the new model, albeit at a high price of around £1000.00 a pair.

A single large-area damped plastic film diaphragm has been electrostatically energised to operate as a phased array of eight concentric elements, and the emerging wavefront is an approximate simulation of the radiation from a theoretical point source 30cm behind the centre of the panel. A high voltage delay line feeding the multiple elements incorporates compensation for the clamped boundary of the diaphragm, and also equalisation for the axial frequency response. The size and apportionment of frequency range and delay to the elements allows control of directivity, which is adjusted to give a smooth and uniform decay at increasing off-axis angles. But it should still be borne in mind that the directivity of the 63 is poor by comparison with the best moving-coil designs, and that the speaker remains rather critical of listening angle.

The latter characteristic presented a problem on tests, since in the modest confines of my listening room only two of the six Quad panelists could be in the optimum zone, and when used as suggested on the floor at our typical 3–3.5m listening distance, the main axial treble response was directed nearer to their chests than their ears. Accordingly, the speakers were elevated by

about 20cm on open stands and marginally tilted backwards. As with the Acoustat, further auditioning was also conducted with solo listeners to augment the panel subjective data.

The Quad 63 is a bipolar design which generates regions of acoustic power fore and aft, but is suppressed in the sideways directions. In consequence a rather different drive of room reverberation results compared with small box speakers which are considerably more omnidirectional. Thus even if the Quad did provide an identical axial frequency response to a low coloration moving-coil model, it would not sound the same due to the significantly different room reverberation tonal balance.

Lab performance

The sensitivity reading was not comparable with a normal speaker due to the doublet directivity, and furthermore, the 1 m reference response was theoretically too close, risking proximity and integration errors. Approximation or not, the reading was below average at 84dB/W, the reference response meeting +/-2dB limits between 50 Hz and 9kHz, outside of which some irregularities were charted which could not be wholly blamed on proximity, as a 2m and 3m check verified.

Averaged in ¹/₃-octave bands at 2m, the speaker demonstrated a superbly even mid and low range response, with some mild 'lumpiness' above 5kHz. The response sensitivity to axis was shown by the special dotted curve, just 7.5° off axis vertically, which reveals more than a 5dB loss above 12kHz. The output decayed much more than average off-axis, but the decay pattern was exceptional in terms of consistency and evenness (see Acoustat.) In practice the bass rolloff point was indeterminate, depending on the listening room boundaries and in particular the distance to the rear wall (with zero bass when placed against the latter). In open air or in large rooms 34Hz -6dB is possible, but at a modest acoustic level.

While not as kind a load as Quad suggest, the speaker should not cause most amplifiers too much trouble, but when the speaker is heavily overloaded it protects by a short-circuit 'crowbar' which may damage some amplifiers and dips to 3.5 ohms were recorded at 50Hz and 10kHz. Above 60Hz, even at a full 96dB, the distortion performance was superlative, though the curve does not illustrate the 63's inability to accept inputs over 30W or so below this frequency without diaphragm rattling. Above 100Hz the distortion was 10–100times better than usual but due to the speaker's protection circuit compression occurred at a 100W peak input;

however at 50W, just 3dB less, the pulse reproduction was simply too perfect to register measurements.

Due to the unusual directivity the room response is probably of marginal value, and certainly cannot be directly compared with the results for normal box systems. It is however included just for the record, but did not correlate well with the subjective data. The midrange at least is notably smooth, but the 60Hz prominence is more exaggerated than usual.

Sound quality

At risk of appearing to makes excuses for the 63. the subjective data did partly reflect its directionality, and side positioned listeners were not well served. Prolonged solo sounds suggested that to some extent the sound was something of an acquired taste, and that if its particular qualities appealed, these could assume such overriding importance than no other model would suffice On first hearing however it can sound somewhat 'dead' and 'clothy' due in part to the loss of reverberant energy in the upper frequencies when compared to a conventional speaker. A trace of a 'whistly' quality in the extreme treble was audible to a few keen-eared listeners, while the sweetness and integration of the mid/treble band at first lends a dim impression until experience shows that the necessary treble detail still exists but in an unusually natural form.

Listeners accustomed to a dynamic and punchy bass of good power handling, particularly on rock -oriented programme, found the 63 disappointing since it could not play very loud, and the bass power though a little more extended than a 3/5A, was little greater. Without the 'liveness' and 'excitement' of some of the better box systems, it at first appears to lack detail and transparency. But prolonged listening showed that this was due to the misleading frequency balance, and that on axis superb image depth as well as detail were apparent. Respectable scores were nevertheless achieved throughout the sessions.

Summary

A speaker which must be auditioned at some length with neutral programme drive*, the 63 is probably the finest electrostatic in current production. It has frustrating limitations, and yet possesses a midrange and treble which are notably lacking in 'boxiness', 'nasality' and 'hangover' colorations. Utterly revealing of programme distortion, mike technique (or lack of it), as well as tonal balance in ancillary equipment, it sounds at its best driven to sensible levels on classical orchestral programme, but it will nonetheless make a good attempt at rock if treated with caution.

GENERAL DATA



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



Reference sine wave response (1 m on axis, 2.83 V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, o shows stop point at 96dB).



Rogers LS3/5A

Swisstone Electronics Ltd., 310 Commonside East, Mitcham, Surrey Tel 01-640 2172



Three companies are currently licensed to produce the BBC-specified LS3/5a design, namely Audiomaster, RAM and Rogers (together with the latter's associated company Chartwell). Current production samples from Rogers form the subject of this review, but the other manufacturers' versions should prove very similar. The closeness of the specification and the regular checks made by BBC engineers should ensure that this is amongst the most consistent loudspeakers commercially available.

The 3/5a is a miniature sealed box system of some 5.5 litres volume. An elaborate and costly crossover is employed to equalise and balance the drivers to a strict licence specification, and transformer matching is incorporated for fine control of tweeter sensitivity differences. Two vertically aligned KEF drivers are used, namely a large magnet 110mm bextrene cone bass/mid, and a 19mm grille-protected dome tweeter. A felt tweeter surround is fitted to reduce diffraction anomalies, and the high quality cabinet is made from fully seam battened plywood with bituminous panel damping.

Lab results

In the crossover region a mild 1-2dB mismatch between left and right reference traces was noted, but elsewhere an excellent correspondence existed. A low 82.5dB sensitivity was measured with the -6dB point at 59Hz. The system resonance was placed at 75Hz, and the speaker was easy to drive, the modulus of impedance being typically 12 ohms and never falling below 8. Understandably the test level for third harmonic distortion was set at the lower 90dB level, and under these conditions an excellent result from 70Hz upwards was recorded.

At 1 metre the reference curve showed a very uniform midband, 200Hz-3kHz, with an equally uniform HF range, although this was mildly lifted by 1-1.5dB relative to the mid; upper bass was marginally exposed as a +3dB hump.

At 2 metres the characteristic responses were seen to be remarkably well integrated. All curves, 30° lateral and 10° vertical, conformed with that on axis to within 2-3dB throughout the frequency range.

Although smooth, the response was however characterised by a 3dB hump at 150Hz, with a related area of dip at 400Hz.

Sound quality

The table showed that the sound quality was above average on an overall basis, which is not only a good result for the price, but is also remarkable considering the speaker's diminutive size. No allowance was made for the latter during the listening sessions.

Rated well above average on the live sound comparisons, colorations were only of slight degree, and included 'tubby', 'edgy', 'bright', 'chesty', 'thin' and 'mid-recessed' effects. In general, however, its rendition of the live sounds was very good.

While imaging was very good, the subjective frequency balance would appear to have affected the speaker's stereo programme performance. The panel described slight to moderate 'hollow', 'edgy', 'fizz', 'sibilant' and 'metallic' effects, with a thinned mid-balance, and a light, 'plummy' bass.

Little bass depth was perceived, although detail and clarity were both of a high order.

A further pair assessed in the last tests have allayed our fears with a better overall balance and fewer criticisms from listeners.

Summarv

The intrinsic quality of this design has well enabled it to maintain its competitive market position, and its reputation as a miniature of monitor quality is undoubtedly justified. Sounding more natural on high stands clear of walls or corners, quite good results can also be obtained in open shelf location. Bearing in mind the limited bass power handling and loudness, the 3/5a may nevertheless be recommended on the basis of its high sound quality for the price.

Size 30(12) H	18 5(7 5) W	16(6.5) D cm(inches)
Weight			5 5(11 5) kg(lbs)
Recommended amplifier power p	ber cha	nnel (tor	
96dBA per pair at 2 metres mini	mum)		30 to 50W
Recommended placement			high stand (or shelf)
Frequency response within ±3d	90Hz to 20kHz		
Low frequency rolloff (-6dB) a	59Hz		
Voltage sensitivity (ref 2 83V. ie	l wa	t in 8 ohms)	82 5dB at 1m
Approximate maximum sound le	vel (pa	air at 2 metres) 93dBA
Third harmonic distortion (90d	Batl	metre)	very good
Impedance characteristic (ease	of driv	e)	very good
Forward response uniformity			very good
Typical price per pair		£200 whe	n reviewed, now £229

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Update

Rogers LS3/5A

Only Rogers, Spendor and Goodmans are currently licensed to produce the LS3/5A design.

(partly re-assessed)

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





below: averaged frequency response at 2m (solid

curve on axis, dotted curve 10° vertical, dashed

Swisstone Electronics Ltd. 310 Commonside East, Mitcham, Surrey Tel 01-640 2172



Rogers Studio 1

Now in its second year, the Studio has undergone a few minor changes which make it worth another look. None of the alterations obsolete the original, and comprise slight modifications to the crossover, a revision of the detail construction of the main bass-mid driver, and a flaring of the reflex port exit. The cabinet tuning has also been shifted to a slightly lower frequency to account for the running-in of the bass driver resonance. Historically this design has evolved from the Rogers Export Monitor, a highly competent if unexceptional speaker, itself a relative of the original BBC LS3/6 which Rogers manufactured for some years.

Representing a classic two-way wide range system, the main driver is Rogers own die-cast frame 200mm unit using a light bextrene cone. It is related in general design to the original BBC unit, but large increases in the mechanical damage limit and the thermal power handling have been made, plus a reduction in distortion.

The treble unit comprises the renowned Celestion HE1300, augmented over the final audible half octave by a version of the KEF T27 (which has a well extended response to 30Hz)

A very high quality complex crossover integrates the drivers, and electrical connection is via a professional XLR connector which may not be too convenient for domestic use. The welldamped cabinet is finely veneered with the carcase made of Medite resin composite board. The 43 litre enclosure is tuned to approximately 40Hz by a large diameter flared ducted port of high volume velocity. (The flaring served to reduce the odd chuffing noise caused by the 'wind' at the port exit.) It is perhaps almost unnecessary to note that the drivers are mounted vertically in line to give maximum lateral stereo image symmetry.

Lab performance

Updated by new response measurements for the reference curve, sensitivity, the room characteristic and distortion, the remainder of the data is carried over from the previous issue. The sensitivity shows a 2dB reduction in the latest samples, and is now a little below average at 84dB/W. As a result, the bass register has lifted a little in relative terms to make the system more bass heavy than before, the -6dB point extended to a fairly low 42Hz and the overall ¹/₃-octave response from 46Hz-20kHz at +/-3.0dB

Incidentally both the Spendor and the Rogers show a characteristic irregularity between 14kHz and 17kHz. This limited effect is due to the awkward transition between the steeply falling rolloff of the HF1300 and the entry of the supertweeter. In practice it can be heard, but is only a minor factor.

Comparing the new 96dB distortion curves with the previous ones, there has been no significant change at low frequencies, for example, 1.0% of 2nd harmonic at 200 Hz is now 1.2%, but below this region 3rd harmonic has been noticeably improved. At 90dB (not plotted) the distortion was particularly good in the mid and treble bands. A wide dynamic range is illustrated by the competent handling of the 100W pulsed inputs. these showing only slight compression and negligible additional distortion.

The forward response at 2m showed fine integration and off-axis control, and the 300W estimated power handling allowed high sound levels of up to 104dBA for a pair. The system has become slightly 'richer' in balance over the year, as the reprinted ¹/₃-octave 2m response shows when its overall trend is compared with the new reference sinewave response.

Assessed by multiple room response averaging. the Studio shows a reasonably good characteristic from 100 Hz to 10kHz albeit with some emphasis between 600 Hz and 800 Hz. The treble fell quickly above 12kHz before recovering a little. While good output was present to 40 Hz, the 60-80 Hz region of the bass was rather prominent. suggesting some bass excess in the room. Sound quality

Fully re-auditioned, the Studio sounded a little 'richer' and 'sweeter' than before, with an improved tonal balance in the mid register. Howeven the bass was on the full side, and the system. would be improved by a 'drver' 'sharper' balance here

Surveying the overall results, the Studio has comfortably equalled the exceptional ratings achieved last time, so there can be no doubt concerning its overall sound quality. The bass can be driven to high levels, and though a little 'oppressive', had great power and was free from distortion. When compared with live sounds it appeared very smooth and relaxed, with mild 'chestiness' and slight 'boxiness' on speech. A bit on the 'dim' side, the occasional 'chirp' or 'fizz' could be heard in the extreme treble, though the main treble was considered very good

On commercial programme it was felt to be subtle clear, transparent and well-focused. with a fine stereo image depth. Slight 'heaviness' was noted in the bass but was not considered too damaging, and in fact there was more praise than criticism - a rare event in listening tests! Summary

Despite or perhaps because of the minor changes. the Studio has kept the promise shown by the original samples. It is an exceptional performer by Choice standards, and if the bass balance is deemed acceptable, then there is little else to criticise. It offers a wide and smooth response, a high power capacity and dynamic range, plus a level of coloration and neutrality in the genuine monitor class. It was very well finished and engineered, and continues to be confidently recommended, the overall performance meriting Best Buy status.

50

20

Hz

GENERAL DATA

Size (h x w x d)
Weight
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)
Recommended placement open stands
Frequency response within ± 3dB (2m) 46Hz to 20kHz*
Low frequency rolloff (-6dB) at 1m
Voltage sensitivity
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
Approximate maximum sound level (pair at 2m) 104dBA
Impedance characteristic (ease of drive)
Forward response uniformityvery good
Typical price per pair inc VAT £340 when reviewed now £380.

*depends on precise mike axis



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1m on axis 2.83V input shows sensitivity) (dashing corrects for chamber LF. dotting shows response without arille).



Harmonic distortions: solid 3rd 96dB. dotted 2nd 96 dB. dashed 3rd 90 dB. chain-dashed 2nd 90 dB. ○ shows stop point at 96dB).




Rotel Hi-Fi Ltd., 2-4 Erica Road, Stacey Bushes, Milton Keynes, Bucks. Tel (0908) 317707



Rotel RL915

It is probably to the advantage of both Rotel and Mordaunt-Short to explain the origin of this UK designed speaker. It is in fact a custom version of the M-S Pageant 2, possessing a similar internal volume, crossover and drivers but with a new enclosure shape plus certain detail improvements to the overall recipe, which has resulted in what is essentially a new model.

Moderately priced, the well finished vinyl walnut exterior is complemented by a smoked glass top, neatly inset and fitted by the purchaser after unpacking. A plain 12 mm thick detachable grille is used and has no rebate. The internal volume is 28 litres with the main system resonance at 56 Hz, and the system is reflex-tuned by a small ducted port 37 mm in diameter, with the box/vent resonance occuring at 25Hz.

Comprising an integral part of the rear connector panel (which offers DIN and spring terminals). the crossover comprises an 8-element high power design, and includes two resistors.

Bass/midrange is allotted to the established Mordaunt-Short 200mm unit, a rigid damped pulp cone driver possessing a useful sensitivity. The vertical line up is completed by a 25mm softdome tweeter.

When last reviewed the Pageant 2 showed considerable merit but was marred by a degree of prominence in the lower mid which made the sound tonally unbalanced and emphasised a 'boxy' coloration. It is therefore interesting to see whether the new Rotel version has overcome this weakness, bringing the design up to date.

Lab performance

Checked by the 1 m reference curve, pair matching was fine to within +/-0.75 dB, and the axial responses also gave a promisingly smooth result. Sensitivity is fractionally above average at 87dB/W, which in conjunction with the good power handling will provide high maximum sound levels of up to 104dBA for a stereo pair. The low frequency response was guite well extended to 43Hz - 6dB, and the overall range met +/ -2.5dB limits from 55Hz to 16kHz.

At 2m the forward characteristic was better defined, with the system showing a slight upwards trend with frequency. As may be seen from the off-axis curves, the speaker was very well integrated, showing fine lateral uniformity and only a slight dip at 5kHz, 15° above axis. In 1/3octave tests and despite broadband trends, the system met +/-1.5dB. 65Hz-9kHz, which is no mean achievement.

Inspection of the distortion graphs shows that our selection of 5kHz and 500Hz as the high power pulse test frequencies was particularly fortunate for this design. At 500 Hz, compression was slight at 0.3dB, with 2.0% 2nd and 0.4% 3rd harmonic distortions, while at 5kHz compression was negligible with 0.24% 2nd and 0.5% 3rd harmonic. At the 90dB test level, the swept distortion results were good, with less than 1.0% 3rd; above 40Hz 2nd was slightly higher but still under control. At 96dB 2nd harmonic increased, particularly at 300Hz and 2kHz, reaching 2-3.0%.

Classed as an 8 ohm system, and thus a very good amplifier load, the minimum impedance was precisely 6.4 ohms at 140Hz, and exactly to spec. Reactive effects were low, with a mean impedance of 12 ohms above 500 Hz.

Assessed by room averaging the Rotel was most impressive. Including the room modes, the overall tolerance was +/-2.5dB from 40Hz to 10kHz, with the response commendably balanced. The only minor criticism might be directed at the steep fall above the 16kHz third octave band.

Sound quality

The RL915 scored above average results on all the listening tests, and looking back to the data for its progenitor, this would appear to represent an improvement over the Pageant. Capable of high power handling, the bass register showed minor port chuffing and distortion at a 50W peak input, but went on to accept over 100W before more serious overload. A reasonable bass extension was demonstrated, with a trace of 'lumpiness' when driven hard, and the lower register was relatively diminished due to port blocking resulting from airflow turbulence - an effect common to all small ports driven to high sound levels.

Compared to live sounds, a fair measure of the 'sharpness' and clarity of the original was demonstrated. Negative effects included a degree of midrange 'thinness' and 'harshness', a trace of 'tizz' in the high treble, and a degree of general 'boxiness', with one panelist noting aptly that speech reproduction sounded a little bit 'speakerish'

On recorded stereo programme the 915 made a good effort. Detail was evident throughout the tonally well-balanced range, and the image quality showed good stability as well as precision in the lateral plane. Residual coloration appeared to mask the full impression of stereo depth, and the sound stage was thus flattened in perspective terms, while mid coloration was noted as mild 'graininess' and 'boxiness'.

Summarv

Well made and finished and possessing a quite natural neutral balance and a wide response, the RL915 has done well enough to be included in the Recommended category at its price of a little under £200.00 a pair. Producing the best results on an open stand clear of the walls, Rotel have chosen this model wisely.

GENERAL DATA

Size (h x w x d)
Weight
Recommended amplifier power per channel
(for 96dBA per pair at 2 metres minimum)(15)-150W
Recommended placement stand, clear of walls
Frequency response within ± 3dB (2m)
Low frequency rolloff (-6dB) at 1m43Hz
Voltage sensitivity

57 × 30 × 26 5cm

(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
Approximate maximum sound levei (pair at 2 m)
mpedance characteristic (ease of drive) very good
Forward response uniformityexcellen
Typical price per pair inc VAT£200



Forward characteristic response (1/3-octave @ 2m. dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



at listening position.



Reference sinewave response (1 m on axis 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB,



Sony SSG1 II

Sony (UK) Ltd., Staines House, 158-162 High Street, Staines, Middlesex Tel Staines 61600



In line with the current policy among Japanese hi-fi manufacturers to seek closer ties with their European markets, this new system from Sonv is built in West Germany, using special versions of SEAS drive units made in Norway. Finely finished in the Sony tradition the 37 litre enclosure is well veneered in a dark rosewood or equivalent material.

namely a reflex loaded 250mm bass (carbon fibre reinforced pulp cone), a doped 80mm pulp cone midrange and a 25mm soft plastic dome tweeter. The crossover points, basically 12dB/octave, are placed at 800Hz and 4kHz, and while time-delay-compensate properties are not claimed, the bass unit is in fact brought forward from the front panel on a cast ring mount.

Lab results

A very good pair match was illustrated to within

0.5dB over the whole frequency range. Claimed at 91dB/W, our estimate for sensitivity was nearer 89dB/W, which is still well above average, while the -6dB bass rolloff was well damped at 50Hz, being typical for the size and sensitivity. (It is in any case amenable to bass lift).

Rated as excellent on third harmonic distortion, values were very low in the bass and quite remarkable in the treble where they measured well under 0.1%.

Scoring average on amplifier loading, largely due to a dip to 5.5 ohms at 100Hz, the remaining range was near to 8 ohms and was notably free of reactive components, helping to mitigate the impedance dip. Power handling was exceptional with the clear and even sound on electric bass guitar sustained up to 200W peak program. While a touch 'hard' on rock program, a very high 105dBA was produced at 250W, with the peak level per channel causing the G1 little embarrassment.

Using sine wave drive on axis at 1m, the G1 did not look so promising, with some minor diffraction problems between 5 and 10kHz. increased irregularity from 1.5 to 5.0kHz, and a trough in the 200Hz region.

When averaged in ¹₃-octave band (much as the human ear perceives the frequency response), the result was much tidier, in practice meeting $\pm -2dB$ limits from 63Hz to 14kHz. A mild plateau was evident around 250Hz, while the vertical off-axis responses were a little untidy above 4kHz, the best response being that obtained on axis. Clearly the speaker should be axially aligned to face the listener in the vertical plane. On the lateral axis the results were fine and appeared less critical.

Sound quality

A vertical array of drivers is employed. The GI performed very well on all listening test sequences. Rated as 'good' on the live tests, it demonstrated a relatively neutral if slightly hard and forward sound with a trace of hollowness, but its fine bass performance and 'open' clarity were strongly in its favour.

> Ranked as 'very good' on stereo programme, the imaging was commended with satisfactory stability and a fair depth impression. Possessing above average clarity, nonetheless it did not escape certain criticisms of coloration, these

mainly concerned with mild 'hard', 'wiry', 'nasal', 'boxy' and 'brash' effects whose subjective importance will tend to vary with each listener.

Summarv

This good looking and well engineered system offered a fine all round subjective performance with firm bass amenable to lift if desired. A very high maximum sound level was attained with high sensitivity, excellently low distortion and an 'average' amplifier rating. Recommendation is clearly in order, but as the GI was on occasion a touch aggressive, personal audition would be worthwhile.

Note:

The Mk II version which was fully retested for the last edition offers minor modifications to improve the high power durability, but was otherwise very similar to the Mk I. It did well on the pulsed power test with a minimal increase in distortion, but performance was better with the grille off, the latter responsible in part for the 3kHz response irregularity.

Size
Weight
Recommended amplifier power per channel (for
96dBA per pair at 2 metres minimum)
Recommended placement stand or open shelf
Frequency response within ±3dB (2m)
Low frequency rolloff (-6dB) at (1m)
Voltage sensitivity (ref 2.83V. ie: 1 watt in 8 ohms) 89dB/W at 1m
Approximate maximum sound level (pair at 2 metres)
Third harmonic distortion (96dB at 1 metre)excellent
64Hz-0.8%, 100Hz-0.35%, 500Hz-0.4%,
3.6kHz=0.08%, typically 0.1% in the treble

Impedance characteristic (ease of drive). Forward response uniformity. Typical price per pair inc VAT

100

200



Sonv SSG1

(revised and reprinted)



¹₃-octave averaged frequency response, 2m solid axial; dotted 10° above and below; dashed 30° horizontal

2k

5k

10k

Hz

20k

500

Spendor Audio Systems Ltd., Unit 12 Station Road Ind. Est., Hailsham, Sussex BN27 2ER. Tel (0323) 843474



Spendor SA2

A hard target to achieve, Spendor set out to complement the long lived BC1 with a less expensive and more compact model, possessing higher sensitivity and greater power handling. Following extensive redevelopment the 200mm driver used as a midrange on the BC3 and bass/mid on the BC2 was deemed suitable for the SA2. The bextrene-cone unit was only finalised after interminable experiments to determine optimum flare, thickness termination and damping. In the SA2 it is married to the popular 25 mm soft dome Audax tweeter which is also used in the miniature SA1.

A true compact, the SA2 is some 50cm high with an internal volume of 28 litres, reflex-tuned by a large port possessing a high acoustic power capacity. This is 75mm in diameter and has a slant cut internal duct to reduce higher order transmission modes in the tube. With a cabinet/ driver resonance of 70Hz, the enclosure itself is tuned to 48Hz to generate a maximally flat response. A costly design to produce, the cabinet is a thinwall type made from the finest multi-ply, heavily damped by bituminous cladding and finely veneered. A sensible acoustic foam grille ensures minimum obstruction of the sound field emerging from the drivers. Built of close-toleranced components, the crossover uses low distortion radiometal-cored inductors and polyester capacitors, and the treble sensitivity is adjusted on production to a precise match by a tapped auto-transformer which is also part of the high frequency section. In total 8 elements are used, with electrical connection via the usual 4mm screw terminal sockets at the rear.

Lab performance

Comfortably meeting +/-2.5dB limits from 55Hz to 16kHz, the SA2 showed an even and well balanced response at 1m. Sensitivity was higher than for the BC1 at 86.5dB/W, which is about average for the group, and the bass response was moderately extended to 50Hz, -6dB. Pair matching was very good.

At 2m the response balance was exceptional, with ± -1.5 dB a fair representation of range from 65Hz to 17kHz. Fine integration was demonstrated and the 30° response was still very good; only at 45° did the uniformity begin to break up, and this result holds out the promise of good stereo imaging.

Showing little compression on the 100W pulsed inputs, the distortion was moderate at around 5% of 2nd harmonic at both frequencies, while 3rd measured 0.7% at 500Hz and 2.0% at 5kHz. On steady state it remained at very low levels down to 50Hz even at 96dB, and the majority of distortion products charted are harmless second order ones. Low frequency distortion was particularly good for the size.

By complying with an 8 ohm spec the SA2 was rated as a very good amp load, with a minimum impedance of 6.5 ohms 4kHz and an average value of 10.

Providing significant bass power down to 40Hz, the room averaged response suggests that the 60Hz region was rather prominent. The mid range possessed a gentle curvature with a 600Hz prominence, followed by a well-controlled gentle rolloff to the highest frequencies. This trend does not appear to correlate well with the anechoic response until the 45° off-axis curve is taken into consideration, whereupon some relationship between the anechoic and room responses can be recognised. With a 300W peak power handling the SA2 proved capable of delivering high sound levels, while 20W per channel was judged sufficient for satisfactory results in moderate domestic use.

Sound quality

The SA2 succeeded handsomely in its objective of beating the BC1 on bass power handling, surviving over 500W peak of direct injection electric bass guitar. Good fundamental power was present, and although some 'nasality' or harmonic emphasis was noted, with a touch of overhang, it scored above average on bass coloration.

Both live and commercial recorded sessions were competently dealt with, and a fine performance was delivered for the price. In character and balance it was felt to be 'lifelike', but some coloration was apparent, notably a low/mid 'boxiness', some muddling of detail in the upper bass, plus a slightly 'dulled' effect and some 'nasality' on voice.

Stereo image quality was well above average, with well-focused central detail, wide precise lateral presentation, and good depth. It possessed a generally smooth character and revealed promising detail, but did not attain the level of transparency available from a *BC1* for example, and some clouding was noticed in the lower midrange.

Summary

The SA2 scores and performance justify Best Buy ranking. It possesses many attributes, notably a neutral, relaxed sound, fine stereo, excellent power handling and above average bass, plus excellent constructional quality and finish, as well as a reasonable sensitivity at a realistic price and in a highly compact form. It deserves serious consideration especially if a tidy enclosure of small dimensions is required.

GENERAL DATA

(ref 2.83V, ie: 1 watt in 8 ohms) at 1m
Approximate maximum sound level (pair at 2m)106dBA
mpedance characteristic (ease of drive) very good
Forward response uniformityvery good
ypical price per pair inc VAT£297



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long dash 45° lateral).



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response without grille).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, o shows stop point at 96dB).



Spendor Audio Systems Ltd., Unit 12 Station Road Ind. Est., Hailsham, Sussex BN27 2ER. Tel (0323) 843474



Spendor BC

As is our custom in each succeeding issue, we have taken another look at a speaker which has established itself as a long term reference by virtue of its consistent ability to fight through to a front rank position in more blind listening tests than I care to remember. This year's sample is of some interest due to two small design changes, but neither of these, it must be said at the outset, affect the sound very greatly. One concerns the reflex port which has had its acoustic power capacity increased by substituting a foam lined duct of larger diameter for the original foam lined aperture; the other is the application of a little damping to the pleated surround of the supertweeter.

First produced in the late 1960s and widely used since as a compact medium power professional monitor, this reflexed system has 44 litres of internal voume and uses two main drivers. The 200 mm bextrene-cone bass/midrange of Spendor design and manufacture covers the

40Hz to 3kHz range, while above 3kHz the specially selected Celestion *HF1300* comes in. The final half octave is augmented by a 19mm plastic dome unit. The professional quality crossover has auto-transformer provision to match the driver sensitivities on production test.

Another Spendor special is the unusually low coloration enclosure, a costly birch multi-ply carcase heavily damped with bituminous pads and lined with absorptive acoustic foam. Both front and rear panels are screwed into place, and far from representing a weakness these joins are in fact part of the complex boundary conditions affecting internal resonance damping of the enclosure panels.

Lab performance

Partly re-measured for this issue, a new axial response was produced together with distortion, sensitivity and room averaged data.

Still showing the characteristic mild bass response 'hump', the revised tuning appears to have provided more bass extension, with the –6dB point now appearing at 39Hz. Sensitivity was much the same at 83.5dB/W, below average for the group, and in conjunction with the comparatively modest peak power capacity, the maximum possible sound level from a pair is limited to around 98dBA, with 30W a sensible minimum rating.

As before, excellent pair matching was shown, with the axial response demonstrating a fine overall balance. There are the usual mild anomalies at 4kHz and 14kHz, which nonetheless do not seem to prejudice the subjective results unduly.

Possessing a minimum impedance of 6 ohms, the *BC1* rates as a good amplifier load, and was easy to drive.

Comparing the new and old 96dB distortion data, above 150 Hz the satisfactory performance was unchanged, though the 4.4% 2nd at 200 Hz is still more than I like. However, below 150 Hz and down to 60 Hz, 3rd harmonic has been reduced by several orders of magnitude, and 2nd has also benefited. On balance the low frequency distortion has been reduced to between a half and a third of that found previously. As before the system happily tolerated the 100 W pulsed input with little compression and no increase in distortion.

The forward characteristic responses were generally very good, though some misbehaviour was evident around the 3.4kHz crossover region. The balance is as before, and the bass region is still prominent, but with a uniform trend elsewhere. Assessed by room averaging the result was very promising, fitting +/-3dB limits above 80 Hz and up to 16 kHz, and with a fine mid/treble transition. The bass extension is clear enough and the 30 Hz band is well maintained, tending to disguise the effect of the 60 Hz prominence in an overall gently rising bass trend.

Sound quality

Extensively reauditioned, the *BC1* demonstrates with little difficulty that its continuing high reputation is wholly justified. Scoring very well on the live sound comparisons despite its 'richer' than average tonal balance (the brighter speakers as a rule have the advantage here) the *BC1* was felt to be a consistently smooth all-rounder. The usual criticisms in this area, although some 'deadening' and 'nasality' was noted in the mid, while speech was a little 'chesty' (*a la* BBC). The bass was somewhat deeper and clearer than before, and the overload limit was little changed at around 100–150W.

Firmly placed up with the leaders on stereo programme, the *BC1* showed excellent tonal balance transparency and depth in the midrange, without the usual emphasis or exaggerations. Good bass extension was apparent, though frankly the bass was of a mildly'leaden' quality as well as somewhat excessive, particularly at high volume levels. This speaker proved more faithful to intrinsic programme balance and tonal differences than almost any other model we tried – the hallmark of a true monitor.

Summary

The high subjective ranking and general attainment merits Best Buy classification, particularly in terms of the still unrivalled mid and treble performance for the price. However it is not without its faults, and the prospective purchaser should bear in mind that by recent standards the *BC1* leaves something to be desired in terms of bass neutrality and damping, as well as in overall power handling and sensitivity.

100

50

Hz

GENERAL DATA



Reference sinewave response (1 m on axis, 2.83V input shows sensitivity)







200

Spendor SA3

Spendor Audio Systems Ltd., Unit 12 Station Road Industrial Estate, Hailsham, Sussex BN27 2ER, Tel (0323) 843474



First seen in prototype form early last year, the SA3 was designed in response to a requirement for a high sound level alternative to the BC1 for use in broadcast monitoring in West Germany, and is still a rarity in UK shops. Spendor possessed the necessary technology to produce a wide frequency range 305mm bextrene cone driver capable of the required acoustic power, and this design was further developed for use in the SA3, working up to 2kHz. The range above is covered by a high power 34mm soft dome tweeter, a recently refined model from Audax.

The large 120 litre enclosure is intended for stand mounting and is fitted with a minimal diffraction foam grille. The system is reflex loaded by a large 80mm diameter short duct port. This review essentially covers the active prototype version which employs a 100W bass and 50W

electronics built in to a removable trav at the rear of the speaker. A passive version of very similar performance is also available at around £890 a pair. Possessing a nominal 88-89dB/W sensitivity, it can be updated to active drive at a later date.

Lab results

A low -6dB point of 33Hz was charted showing the bass extension expected of such a large loudspeaker. The power headroom settings showed that a high maximum level of 110dBA should be available from a pair under normal conditions (and working on an estimated 200W programme handling capacity for the passive version, this should be capable of 108dBA but without the sizeable subjective overload headroom of the active model).

The distortion at 96dB 1 m was judged excellent. with admirably low levels of third harmonic. While not strictly applicable, the pulsed distortion test was tried at two sound levels, namely 108dB and 98dB. At the former no distortion was detected. although a significant 0.6dB compression was measured at 5 kHz and a negligible 0.1 dB compression at 500Hz. Reducing the s.p. l. to 98dB gave a minimal 5kHz compression of 0.1dB.

On axis at 1m the response on the sinewave met close ± 2.5 dB limits from 35Hz to 16kHz. A touch of depression in the presence band, 1.5-2.6kHz, was apparent and was consistent in the 2m ¹/₃octave characteristic, but a remarkable feature was the very good integration exhibited by this model despite the use of a 305mm bass unit, the diffraction slot in front of the latter believed to be partially responsible for this performance. However the upper treble did fall off a little earlier than usual at 30° of axis, due to the tweeter's larger than usual radiating diameter.

Sound quality

Rated as very good throughout the listening tests the prototype SA3 confirmed its pedigree. A trace of mid 'richness' - almost 'plummy' effect - was noted, but the general accuracy and balance versus live sounds was highly rated. In our room the 60-80Hz range seemed a little heavy, but the bass was well differentiated and extended, as well as powerful and free of spurious noises.

Stereo imaging was very good, with high lateral precision and good depth ranging. Experience showed us that imaging continued to improve with treble amplifier with an electronic crossover, the distance, and we regard 3.5 metres as about the

closest a listener should sit. The treble was exceptionally sweet, clear and transparent, while the midrange set high standards in terms of coloration and accuracy of balance.

Summary

Joining that select group of accurate high performance systems, this fine and powerful loudspeaker intended for professional duties will. I am sure, find great favour on the domestic market as well. While in objective terms it does not quite possess the same midrange subtlety as the BCI, the system offers greater power handling, extended bass superb dynamics, and a top-class treble Voiced and balanced in the conscientious Spendor tradition, it is virtually handcrafted throughout and is highly recommended

Production models in both active and passive configurations were auditioned just before press date, and these more than confirmed the exceptional promise indicated by the pre-production samples which we had fully assessed.

torve Stand Recommended placement stand Frequency response within ±3dB (2m) 33Hz-20kHz Low frequency rolloff (-6dB) at 1 m 33Hz Voltage sensitivity (ref 2.83V, <i>ie</i> 1 watt in 8 ohms) at 1 m 33Hz Approximate maximum sound level (pair at 2m) 110dBA Distortion (96dB at 1 m) excellent Distortion (100W peak) very good Impedance characteristic (case of drive) active Forward response uniformity very good Typical price per pair see update	Size (H, W, D)
Recommended placement Statu Frequency response within ±3dB (2m) 33Hz-20kHz Low frequency rolloff (-6dB) at 1m 33Hz-20kHz Voltage sensitivity (ref 2.83V, <i>ie</i> 1 watt in 8 ohms) at 1m 88/89dB/W passive* Approximate maximum sound level (pair at 2m) 110dBA Distortion (96dB at 1m) excellent Distortion (100W peak) very good Impedance characteristic (ease of drive) active Forward response uniformity very good Typical price per pair see update	(for 900BA per pair at 2 metres minimum)active
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Low frequency rolloff (-6dB) at 1 m	Frequency response within ±3dB (2m)
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Approximate maximum sound level (pair at 2m)	88/89dB/W passive*
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Distortion (100 W peak)very good Impedance characteristic (ease of drive)active Forward response uniformityvery good Typical price per pairsee update	Distortion (96dB at 1 m) excellent
Impedance characteristic (ease of drive)	Distortion (100W peak) very good
Forward response uniformity	Impedance characteristic (ease of drive)active
Typical price per pairsee update	Forward response uniformity very good
	Typical price per pairsee update

Update

Prices were anticipated at the time of review as £1656 (active) and £890 (passive — not tested. Prices were confirmed as £1725 (active) and £966 (passive) both inclusive of VAT.

Spendor SA3 (revised and reprinted)

Top: Frequency response, 1 m sinewave, plus 2nd (solid) and 3rd (dashed) harmonic distortion (a 96dB Bottom: Frequency response, 2m¹3-octave averaged (solid. axial; thick dashed, 30 horizontal; thin dashed, 45 horizontal; dotted, 15 vertical).





Wharfedale TSR108.2

Wharfedale Loudspeakers Ltd, Highfield Road, Idle, Bradford BD10 8SF Tel (0274) 611131



Previously reviewed, the 'Mk 1' 108 showed promise but possessed significant flaws which barred it from recommendation. It has since been extensively revised, and now has an improved frequency response in the midband, and a revised mounting for the treble unit (which puts it on the front panel rather than down an absorbent pit as was previously the case). Bass extension has been increased, while the sensitivity is reduced by 2.5dB.

This is a 30 litre enclosure reflex-loaded by a substantial 80mm diameter/130mm deep ducted port; the duct resonance occurs at 47 Hz, and the main driver resonance at 68 Hz. The 6-element crossover includes one resistor plus a variable treble control on the front panel. With the latter set to the nominal 'O' or flat position, the treble was considered to be excessive (this was found with all the Wharfedales we tested); in our view a '10-11 o'clock' position gave the best results.

Built on a substantial rectangular casting, the

200mm bass/mid unit was fitted with a Wharfedale mineral filled (talc) polypropylene cone and a generous magnet. The chipboard enclosure panels were finely veneered in real walnut, and damped internally by bituminous cladding. A top grade acoustic foam provides volume absorption. However the grille was less desirable, placing significant side panels near the tweeter and worsening the diffraction properties of the enclosure. Not shown on the printed graph, the grille's removal improved the smoothness of the treble between 6kHz and 14kHz on the sinewave reference, and also gave better image focus in the upper frequencies. Fortunately the speaker looks quite presentable without the grille in nosition

Lab performance

Charted at 1 m on axis (with grille), the family of curves illustrate the settings of the treble output control from '7' to '3 o'clock', with '12' at an indicated flat. Above 150Hz this speaker was pretty smooth and well balanced, and better still with the grille removed. The reduced sensitivity resulted in more bass excess than before, namely a 4dB lift at 100Hz. The low frequency cutoff is lowered to -6dB, 40Hz, which is a good extension for the volume.

At 2m the characteristic response showed an axial curve integration that was marginally less favourable, although the general uniformity was laterally good. The vertical axis was less promising, with 15° above showing a peak/trough effect of moderate severity between 2kHz and 6kHz.

The room average response was rather prominent in the bass, which is caused by coincidence of speaker excess and room mode maximum. Good output was still present at 40Hz, while above 500Hz the forward trend was quite favourable. Still it might be difficult to escape subjectively from the general excess of bass.

A minor fault was shown on the distortion graphs at 230Hz, whereby the manufacturer had inadequately tightened the bass unit screws resulting in a resonance; on re-adjustment this particular feature subsided. The chart was dominated by fairly innocuous 2nd harmonic distortion at the 1–2% level, with 3rd harmonic rather less at 0.3–0.6%. At 50Hz 2nd and 3rd were equal at 5.0%, which is a reasonable value. Little change occurred in distortion on the 100W pulsed test, but some compression was noted at 500Hz. With an impedance characteristic comfortably meeting the 8 ohm standard, and with mild reactive effects, the 108 was judged a very good amplifier load.

Sound quality

Capable of sustaining up to 150W peak programme on electric bass guitar and with a good result on the 100W pulsed test, a 150W maximum power rating was suggested, with 20W as a sensible minimum. Fairly high sound levels of 103dBA were possible from a pair.

Despite a fully recognised and acknowledged bass prominence, the listening panel thought so highly of the rest of the frequency range that consistently high marks were awarded. It scored well on the live sound comparisons, appearing comparatively neutral and notably transparent, with a convincing manner. Slight sibilance and 'boxiness' were also noted, with a 'chesty' effect on speech.

On the stereo programme the bass extension was appreciated despite the upper bass richness, and aside from a rather'slow' bass character, this model seemed to be comparatively free of vices. Stereo image quality was well above average with good precision (especially with the grille off) as well as promising depth. Although mild'plummy' and 'boxy' effects were noted, these were not serious.

Summary

Though the new *TSR108* has a lower sensitivity and the bass is less even and well defined, it offers a near monitor class standard of mid and treble quality at an attractive price, and must be one of Wharfedale's best yet in terms of its overall sound quality. Easy to drive, well finished in natural veneer, and capable of decent sound levels, the *108* moves into the Best Buy class in its latest *Mk II* version.

GENERAL DATA

Size (h x w x d)	
Veight14kg	
Recommended amplifier power per channel	
(for 96dBA per pair at 2 metres minimum)(20)-150W	
Recommended placementopen stand clear of walls	
requency response within ± 3dB (2m)130Hz to 18kHz	
ow frequency rolloff (-6dB) at 1m	
oltage sensitivity	
(ref 2.83V, ie: 1 watt in 8 ohms) at 1m	
opproximate maximum sound level (pair at 2m)	

Approximate maximum sound level (pair at 2m) 103dBA
Impedance characteristic (ease of drive)very good
Forward response uniformity very good (grille off)
Typical price per pair inc VAT£240 when reviewed, now £270



Forward characteristic response (1/3-octave @ 2m, dotted 15° vert., small dash 30° lateral, long sh 45° lateral



Averaged forward characteristic response in room at listening position.



Reference sinewave response (1 m on axis 2.83V input shows sensitivity) (dashing corrects for chamber LF, dotting shows response variations of treble control).



Harmonic distortions: solid 3rd 96dB, dotted 2nd 96dB, dashed 3rd 90dB, chain-dashed 2nd 90dB, o shows stop point at 96dB).



Yamaha NS1000M

Hi-Fi Markets Cousteau House Greycaine Road Watford Herts WD2 4SB Tel (0923) 27737

A relatively compact loudspeaker that can be used on stands or on a substantial open shelf, it is very sturdily constructed. While tests were conducted with the controls set 'level', we subsequently came to the conclusion that the '10 o'clock' position for the mid control gives the most pleasing balance, and that the listener should be on the mid axis, as an above axis position imparts a response suckout in the presence region.

Technical details

A sealed box design, a 300mm bass driver operates up to 500Hz crossing over to a 85mm bervllium-dome mid unit with a hollow pole piece and an absorbent chamber. At 6kHz another beryllium driver takes over — a 30mm together with a 'thin' balance. unit with a phase correcting assembly.

Lab results

Pair matching was excellent at 0.5dB up to 12kHz, and within 1dB beyond. A high (particularly for a sealed box design) 90dB sensitivity was recorded, with the -6dB LF point at an early 50Hz, despite the system resonance being placed at 40Hz. (This proves that the low frequency end is overdamped, and permits bass lift to be applied.)

A minimum impedance of 4.8 ohms was recorded at 120Hz, the typical value being 6. and with low reactive effects the system gained an 'average' loading classification. Above 200Hz the distortion on the third harmonic readings was below threshold. It rose gently at the lower frequencies to a still fine 0.6% at 100Hz 1 2% at 50Hz and a maximum of 3% at 30Hz

The 1 metre sine wave response was very even from 60Hz to 16kHz, but showed a mild mid prominence (this controlled by the 10 o'clock mid setting), with the early but slow low frequency rolloff clearly visible.

Out at 2 metres the 10° above response showed why the mid unit should be at ear level, or at least angled towards it. A mild hump at 300Hz was visible on axis, together with a slightly prominent 500Hz to 12kHz range. The HF was uniform to 16kHz, rolling off slowly beyond, but on the 30° lateral axis. the uniformity was fine, showing excellent integration in this plane.

Sound quality

The NS1000M matched its previous high quality ranking, even if it has not achieved quite the same level of commendation. Overall a 'very good ' sound quality was denoted, going a long way towards justifying the high price.

It performed best on the live sound comparisons, reaching a high 107dBA, and accepting a 500W peak input without audible breakup. It showed excellent power handling on electric bass guitar, with up to 75 watts average tolerated without distortion, and while the bass character was lacking some warmth on the 'E' string, an even and powerful output was obtained. The mild colorations noted were 'dull', 'hard', 'tizz', and 'middy',

Scoring 'above average' on the stereo sessions, this Yamaha exhibited fine imaging and excellent rendition of musical detail. Some panelists were sensitive to a mid prominent hardness and brittleness which is a known feature of the NS1000M and cannot be wholly alleviated by adjusting the mid control. Colorations were more readily perceived under these conditions and included mild 'cup'. 'nasal' 'hard' and 'presence dull' effects, with slight 'tube' and 'fizz' comments also apparent. One panelist felt that it might prove fatiguing. Summary

The NS1000M is clearly a fine if expensive loudspeaker. It gains a recommendation despite its price, but with some reservations concerning its potential hardness and fatiguing properties not severe, but sufficient to excite comment by one or two panelists. It can offer high volumes. with very clean if overdamped bass, and is both beautifully engineered and constructed.

Recommended placement high or tilted stand

Low frequency rolloff (-6dB) at (1m) 50Hz

Voltage sensitivity (ref 2.83V, ie: 1 watt in 8 ohms) 90dB at 1m

Approximate maximum sound level (pair at 2 metres) 107dBA* Third harmonic distortion (96dB at 1 metre) excellent

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

Yamaha NS1000M

(revised and reprinted)





ARE HI-FI SPECIFICATIONS JUST ANOTHER FORM OF DISTORTION?

You may be puzzled as to why Hi-Fi with apparently superb specifications often doesn't sound quite right. Well, the human ear is not a piece of electronic apparatus. It is sensitive to subtleties and colours that are unappreciated by a machine. As our reviews have shown, A&R equipment transcends specifications. Take the time to <u>listen</u> to A&R. You'll find it well worthwhile. Return the coupon to receive copies of our reviews, data sheets and dealer lists.





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TUNERS: FACTS FOR BUYING AND SETTING UP

It has been quite a time since Hi-Fi Choice looked at tuners and so rather than reprint out-of-date material it has been decided to pull together a list of recommended separate tuners with brief comments on measurements and listening tests from the tuners tested as a part of Hi-Fi Choice Receivers (Tuners & Amplifiers) Issue No. 19 and from Systems - Racks and Minis issue No. 27. With the turnover of Japanese electronics now coming with a grim9 month regularity you will not find many Oriental products among this list of 'stayers'. Though to help the prospective customer to draw up a shortlist containing enough products from this guide it has been decided to mention briefly those tuners that did well but are now known to have been replaced. The benefit here is hopefully that the manufacturers will not have seriously downgraded their products and that last year's model may have undergone only simple cosmetic changes to become this year's, and also that any buyer wishing to pick up a bargain may yet find last year's model at a tempting discount. Where we have been unable to make firm recommendations I would state that auditioning is essential, preferably on the aerial intstalled in your home rather than on any shop rig. If auditioning cannot be arranged then do not buy, or realise that your purchase will be a gamble.

Radio broadcasts

To transmit music through the air an audio signal is made through the air an audio signal is made to ride piggyback on a radio wave. There are two ways in which the signal can be encoded on a radio wave itself is changed (modulated) according to the frequency of the audio signal this is known as *frequency modulation* or *FM*. The other system is *amplitude modulation* or *AM* where the radio wave varies its strength in time to the audio frequencies.

Take the FM transmission first. The

FM transmitter operates about a nominal carrier frequency upon which the audio signal rides The frequency or pitch of the audio signal is represented by the rate of change in frequency of the carrier, which also carries audio amplitude imformation, represented as the amount of frequency variation. The benefit here is that the audio signal is not affected by changes in the radio signal strength and comes free of background noise limitations and interference inherent in AM broadcasting where the amplitude, intensity or strength of the radio signal is used to encode the audio signal. FM broadcasting is thus capable of handling high quality signals of wide frequency range and wide dynamic range.

FM broadcasting also offers the potential to transmit stereo information by broadcasting the sum of the left and right channel signals, and broadcasting the different signal of the left and right channels encoded on a 38kHz subcarrier. This gives good mono compatibility but enables a stereo decoder to do a bit of adding and subtracting to come up with separate left and right channel signals for stereo.

(For those who need to know a bit more, the stereo information is broadcast as an amplitude modulation of the FM radio wave with the 38kHz subcarrier suppressed to give more room for the sum signal. Instead a pilot tone of 19kHz is transmitted which enables the tuner to reconstruct the subcarrier (19 x 2) to get at the difference signal.)

FM broadcasting has its problems though, as those readers who live in Wales or Scotland will know; its high frequency waves don't travel far (about 60 miles) and don't go round hills too well requiring a chain of main transmitters and repeater stations to give UK-wide coverage of FM stereo.

AM broadcasting in the UK is split between two wavebands, the Medium waveband and the Long waveband. Medium wave travels well but is prone to atmospheric and local electrical interference, the quality of signal that can be encoded is very limited too. Long wave travels better and is a less populated waveband. Long wave transmission is used mainly in the UK and Europe and after recent internationally-agreed wavelength changes (to minimise afterhours interference) it has become essential to have a Long wave receiver if one is to listen to Radio 4 UK from the BBC.

Aerials

Clearly each waveband has its own shape and style of antenna or aerial. Medium and Long wave reception can be achieved by using a ferrite rod with tuning coils attached to it- this is the bar aerial fitted to the back of tuners. This should be free to swivel about to help get the best signal and minimise interference.

FM aerials have in my experience been the cause of more problems with hi-fi than almost all the other hi-fi worries put together. You can't buy a 'best' aerial because too much signal is often worse than too little. You need an aerial that is suited to the specific reception conditions local to the tuner. However well meaning the advice from a shop in Glastonbury, it is of little help to the guy installing an aerial in Bradford. Local help and local knowledge of the compass bearing of transmitters and of multipath conditions is essential. (*Mul-tipath* is where the FM signal reaches your aerial after being bounced off different large objects both near and far-hills, blocks of flats, even aircraft can reflect the signal.)

The balanced 3000hm sockets on the tuner are for the connection of a wire dipole aerial. These aerials are frequently unsuitable for hiss-free stereo reception. The 750hm unbalanced sockets or terminals on the tuner are for the connection of coaxial aerial lead (like TV aerial wire) and a real aerial. You can buy 'baluns' transformers to connect 750hm unbalance feeds to 3000hm balanced inputs and vice versa if necessary. The aerial should be mounted high and should be aligned onto the compass bearing of the strongest transmitter, signal strength should be checked as should any multipath signals coming down the lead. Professional installation and alignment of an FM roof aerial commonly costs only £30.

Many people have never heard FM stereo as it should be. Remember that a stereo transmission needs ten times more signal to have the same background hiss as a mono signal. A good aerial properly installed is the only way to provide this; TV aerials, coat hangers, 'rabbit ears' and dipoles wires are not really suitable. A tuner is only as good as its aerial.

Features

A tuning knob with flywheel and a long illuminated tuning scale with pointer are the most common features. Some tuners however have an LED or similar digital display. This can be one of two things, a digital readout of the tuned frequency, or the reading from a true digitally synthesised tuner front-end. Don't pay for the latter if you are getting the former. Though these digital scales are impressive many are more convenient for the manufacturer than they are for the user (and family) unless they remember radio stations as they would telephone numbers rather than 'up the left of the scale'. Preset tuning is convenient once the initial tuning is secured through some manufacturers spoil the simplicity of preset with over-sophisticated wave band switching or auto scanning.

Some aids are normally provided for accurate tuning, almost always a centre-tune meter or LED display showing when the station is tuned bang on. A signal strength meter is less often found but this gives an idea of how strong a station is and whether it will be able to be received in noisefree stereo. Many of these meters are just so many wasted LEDs as manufacturers choose inappropriate sensitivities.

There are other features which help with tuning. Most tuners and receivers are now adays fitted with an AFC (Automatic Frequency Control) which holds a station once selected. If you are trying to receive a weak station very close to a strong one you may have to disable the AFC as it will normally lock onto the strongest signal in the vicinity of your tuning. The FM mute feature cuts out interstation noise by suppressing the tuner's front end output if it is not receiving a strong enough signal. This should cut out noise between stations if correctly aligned but again may have to be switched out to receive weak stations on or near its threshold strength.

Some tuners, often the more expensive models, offer variable selectivity with 'wide' and 'normal' positions which can help keep away interference problems from adjacent channels but is thus of more interest to the DX-ing enthusiast (DX is the jargon term for long distance radio reception). One common facility is called the *FM hi-blend* which enables the irritation value of noisy stereo to be reduced without losing stereo separation by progressively blending the stereo high frequencies, where all the hiss is, together into a quiet mono signal.

An output level control is a useful feature if you want to be able to switch from radio to disc to tape or cassette without having to change the volume control setting.

Performance

Sensitivity shows how well the tuner will pick up weak stations above a certain background noise. It is a measure of the aerial strength required to suppress the background noise a certain way below the signal. Figures are quoted for both mono at 30dB signal noise and for mono and stereo at 50dB signal to noise. The lower the figure the better the tuner.

Limiting. When different stations are received at different signal strengths, to avoid the user having to adjust his volume control to cope, the tuner carries this out with a limiting circuit which keeps the tuner's output constant for signals which are stronger that the limiting threshold. The lower the threshold the easier it is to listen to weak stations.

RFIM or **Radio Frequency Intermodulation** is caused when two adjacent stations interact to produce harmonics which crop up around the tuning scale. The RFIM test checks how well the tuner can reject these unwanted intermod signals, the higher figure the better. Good tuners show better than 75dB.

Capture ratio shows how well at uner would deal with two stations on the same frequency but at different strengths. Its figure is one for the smallest difference between the two stations that will result in the weaker being rejected 30dB below the stronger. The lower the figure the better the tuner will be in areas where two transmitters operate on the same wave-length, for instance in the fringe area overlaps between two transmitters.

Selectivity tells how well the tuner can cope with two stations close in frequency and is specifically quoted for the adjacent channel (200kHz away) and the alternative channel (400kHz away). The signal strength in these channels required to breakthrough onto the desired station is measured. The bigger the figure the better, with 10dB being good on the the adjacent channel and 60dB good on the alternative channel.

AM rejection measures the tuner's immunity to interference from electrical or other radio-borne noise. The bigger the number the better the rejection.

Image rejection and **IF rejection** are both measures of the tuner's front end performance; the bigger the figures the better

All these measures relate to the **radio frequency** part of the tuner; the **audio** section is of equal importance and can be assessed with three simple measurements.

Crosstalk. This is the breakthrough

of one channel of stereo information onto the other and should be familiar from amp and cartridge measurements. The lower the figure for crosstalk the better the stereo separation and the better the imagery of the received broadcast.

Pilot-tone suppression. The stereo decoder will produce at its output a signal which contains all the wanted audio signal, some high frequency rubbish and the 19kHz pilot-tone used to activate the decoder. A steep filter is introduced above 15kHz to chop off this rubbish and pilot-tone which could otherwise upset preamps or tape recorders. Pilot-tone suppression measures how good the tuner is at removing this frequency and gives a figure for how far down the pilot-tone has been reduced, the more minus dBs the better.

Frequency response. The filter mentioned above must act very steeply to get rid of the 19kHz pilottone and yet leave the top end of the audio spectrum intact. Tuners don't give us the 20 to 20kHz bandwidth expected of amplifiers and cartridges but should produce a clean response up to 15kHz without wrinkles.

Getting the best from your Tuner

Aerials have already been covered to some extent but is is important to bring home the point that an aerial must be suitable for local reception conditions. There are two things that increase with increasing complexity of aerial design, the first is gain (more signal) the other is increased directionality. If you want good stereo from the BBC FM stations and from your local BBC and independent radio stations then you will in all probability need only a simple roof or loft mounted dipole (an aerial with a couple of elements).

If you want to go in for longer distance reception of local radio stations in the next big city or even foreign FM stations then more gain will be required and a more complex aerial installed (more elements). But more elements means more directivity which may mean compromising the reception of one station to be able to beam in on another. The solution here for the real enthusiast is to install an aerial rotator which offers perfect aerial alignment from the armchair with a motor-driven aerial controlled by a compass setting on a remote control.

Once you've got a good aerial installed don't spoil the job by using cheap lossy cable for down lead. The best it will do is weaken your signal which cost you money to get in the first place but it may just as well act as a rain trap and channel water down from the roof into your tuner. Aerial ampilifiers may be used to boost the signal over very long runs but professional advice and installation is recommended in these circumstances to avoid disappointment after expense.

Finally if you are plagued by interference check first that it is not just a badly aligned or connected aerial and then bring in the BBC/IBA, better still the Post Office Interference people.



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TUNERS: SUMMARY REVIEWS

Full reports appear on the **A&R T21**, the new medium wave compatible **NAD 4020A**, the **Meridian 104** and the **Sugden T48/II** in the chapter on *Receivers*. These models cover a price range from £98 to £259. Of the tuner models originally reviewed in Issue 19 the majority have now been discontinued. The saddest loss is perhaps the UK's own **Rogers T100** digital tuner which along with the rest of the Rogers range of electronics is now suspended.

However, as part of the Systems: Racks and Minis edition, Hi-Fi Choice has tested over 30 tuners in the context of one-brand systems; the findings are of great help in this context enabling a good number of new recommendations to be made. In Issue 27 it was found, that with a few exceptions, the tuners in the rack systems tested performed well.

The biggest recent development has been the growth of the digitally synthesised, tuner, but these do seem to use their technology to an inconvenient extreme and sometimes the simple 'analogue' tuner with scale and pointer offers far easier tuning. This however must be weighed against the lack of station presets on analogue models. In one case it was found that the digital synthesiser circuitry was adversely affecting the noise performance of the completed tuner

Centre tune LEDs or meters and signal strength indicators seemed generally to be very poorly designed. Many signal strength meters offered little or no help in determining the signal stength required for minimum noise performance on stereo FM and more often than not would light across their full scale with the smallest of aerial signals.

The level at which the interstation mute threshold was set seemed also to be badly chosen in some models. There was a small group of tuners that were not capable of being fed with 75ohm unbalanced feeder and which would require a baluns transformer to enable a good aerial to be used with their 300ohm balanced socketry. Reliance on inadequate 300ohm ribbon dipole aerials is not recommended.

The first tuner to gain recommendation was the **Aurex ST-T10L** (£109). This simple conventional three-band tuner proved free and easy to tune through the signal strength meter was entirely inadequate. On test it was found that stereo separation was tune-sensitive and that the tune window was very narrow indicating that low distortion tuning may not be achieved in use. The sound was considered slightly 'dry' and to lack bass 'presence' but medium wave reception was considered excellent.

The next recommendation is taken from a *Best Buy* system — the Dual System 2. The simple analogue three-band **Dual CT-1150** (£95) slim line tuner proved a good-all rounder on the test bench with low distortion across the tune window; the switched AFC offering consistently good distortion results in use though some convenience may be sacrificed. The signal strength meter for once gave a true indication at full scale reading that minimum noise conditions had been reached. The overall sound was slightly 'hard' and 'forward' though the tuner was not found fatiguing.

The slimline **Fisher FM-550** (£119) is a true digitally synthesised tuner with auto scanning and six presets each capable of storing one FM and one AM station each. There is no Long Wave reception on this model. The signal strength meter was well aligned and proved useful in establishing that signals were strong enough for minimum noise performance to be achieved. On test the tuner proved good in every respect with a classical flat frequency response.

The **Hitachi FT-3500L** (£79) is a basic analogue tuner with wide scale and flywheel loaded tuning knob. There is no signal strength meter but the scale pointer doubles for centre tune and maximum strength indication. A very good frequency response was charted though the tuner sounded less precise and lacking the weight of the chosen reference tuner. A good performance at this price level nevertheless.

As tuners seem to turn around less quickly than other electronic components, the JVC T-X2L(£150) may still be found in the market. This is a fully synthesised design with both automatic and manual scanning though the auto scan was found to be too sensitive. One FM and one AM station can be stored on each of seven presets with the aid of a memory button. The signal strength meter was of little use being little more than a row of lights which lit up whatever the strength of the incoming signal. On test the tuner measured well in all respects but showed a falling treble response

The **Marantz ST-310L** (\pounds 69) is a basic three band tuner with wide scale having a centre tune indictor

built into the end of the tuning pointer. Using this, tuning was easy though the signal strength meter gave little help. On test the tuner measured well for such an inexpensive model showing high sensitivity and exceptional selectivity; the tuner did however need a healthy aerial signal to achieve minimum noise. Sound was 'full' and not guite as confident as the reference but all-round this was considered an excellent pertinctively styled Marantz ST-450L (£109) can also be recommended; it is not a fully synthesised model but has a digital readout of the received frequency. On test the tuner gave above average results but sounded, at times, slightly 'dry' and 'edgy'

A second strongly recommended budget tuner proved to be the **Pioneer TX-520L** (£70) which should still be available. This was a classic example of how 'value engineering' can work, as the excellent fascia had received the better part of the production budget, the back and bottom panels being hardboard! Test bench measurement showed the Pioneerto be exceptional low noise figure and wide stereo separation.

The Teac T-9 (£135) is a true digital synthesiser tuner, though the scanning facility was not too easy to operate as two buttons have to be held down for both scan-up and scandown. Five FM and five AM presets could be accessed using the keypad and memory button. There was no Long Wave reception possible on the T-9 though as if in compensation there was a cassette deck line-up tone oscillator to enable recording levels to be set before broadcasting begins. The tuner's output was usefully adjustable with one of fascia controls.

The **Tensai TT 3245** (£80) tuner offered exceptional performance on test with low distortion, wide stereo separation and a text-book frequency response trace. The tuner has connection for 300ohm balanced aerial inputs only which means that the consumer will be tempted to use the supplied rabbit-ear dipole rather than get a baluns to match a 75ohm aerial of better performance — this is a shame considering the exceptional results this tuner could provide.

Other tuners which did well but are now discontinued include the poorly aligned **Optonica 5200** and the well thought of **Hitachi FT-4500L**. The no-frills **Rotel RT-400L** offered consistently well above average results.



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AMPLIFIERS	HITACHI FT 3500 £69.95	SA515L £199.95 SA212L (25) £149.95	TCFX20C £79.95	SL 6/K £149.9	5 E50 £199.95	IS 770 £399.95 IS 990 £569.95	QLM34 £10.45	R
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CASSETTE DECKS

Cassette tape recorders built around the Philips patented and licensed Compact Cassette came onto the market in the mid sixties. These machines offered only low fidelity sound and at the time few people saw the impact this medium was to make in the years following

Looking at the cassette itself it is important to realise that it cointains parts of the transport mechanism and the pressure pad that on a reel-toreel tape deck are part of that machine's costly mechanics. Looking into the tape opening of a cassette you can see the three cutouts, reading from left to right, for the erase head, record/replay head and for the capstan and pinchwheel drive. Behind the tape in the centre slot is the sprung pressure pad and magnetic shield. The spine of the cassette has small plastic lugs which can be broken out to prevent the tape being erased as these are sensed by a probe once the cassette is inserted into the player. Alongside these lugs are additional cutouts to enable another sensor, fitted to some decks only, to check on the type of tape contained within the cassette and then to switch the bias and EQ from normal to chrome or metal as required.

The magnetic tape itself carries four tracks some 0.6mm wide as two pairs of stereo twin tracks separated by guard bands. The tape moves over the heads at a much lower speed than with a reel-to-reel machine (4.8cm per sec as opposed to 19 or 38cm per sec). In addition to the problems of slow tape speed the cassette medium has to cope with a tape only half the width of reel-to-reel tape.

Tape recorder basics

Magnetic tape recording is unique as a medium for the domestic storage and replay of music in that it offers the potential to recording and re-use. Radio and disc obviously do not have this flexibility. The magnetic tape is a plastics base covered with a magnetic layer of fine particles of metallic oxide or more recently pure metal or metal alloy particles. Recording consists of passing this tape across a record head which alters the orientation of the magnetic particles in the tape and encodes an audio signal in that new structure. This signal can be retrieved by passing the tape again over a replay head where the magnetic code generates a small electrical signal for amplification and replay.

These record and replay heads consist of coils wound on iron or other magnetic formers having a minute gap over which the tape passes. When an electrical signal is fed into the coil it generates a magnetic field across the head gap which changes according to the electrical signal being applied. If the tape is passed across the gap in close contact with the head this changing magnetic field is permanently stored in the changed magnetic properties of the particles in the tape.

To erase the tape for re-use the tape is passed over an erase head before it reaches the record head. This erase head carries a strong signal oscillating at very high frequencies which effectively randomises the stored magnetic code on the tape. Some of this high frequency erase signal is fed to the record head and is mixed with the audio signal to enable the tape to make a recording of low distortion. This is known as the bias current which is required to be set for different tape formulations. The bias current also partly erases the high frequency signals and so considerable electronic boost must be applied by the deck's amplifier on both record and replay to compensate for this loss. This is known as equalisation or EQ. Both bias and the EQ are covered in some more depth in the chapter dealing with Cassette Tapes.

Cassette problems and solutions

The two big compromises brought about by the compact size of the cassette are reduced tape width and slower running speed, this means that there are fewer magnetic tape particles passing the record heads and this accounts for the medium's relatively bad high frequency performance, high hiss level and severely limited dynamic range. These were the limitations that kept the Compact Cassette and the machines built to use it merely toys in hi-fi terms until the advent of noise reduction.

Dr Ray Dolby found a way to overcome these problems by designing noise reduction circuitry which could be incorporated cheaply into every cassette deck. The Dolby system is a so-called differential system operating only when the signal is low. During queit music passages it senses the level and pushes up the signal as it is recorded onto the tape. During loud passages where noise would effectively by masked, the system drops out. During replay the Dolby 'decode' circuitry does the inverse and deemphasises those low signals to restore the dynamic range but also to push down the hiss level of the tape. The Dolby B system is only designed to operate in the high frequencies where hiss is a problem and Dolby encoded tapes played back without Dolby will sound trebly.

Simultaneously with the introduction of Dolby circuitry there came rapid improvements in transport mechanics and in tape formulations

themselves which brings us up to date. Improved noise reduction systems are beginning to be offered: *Dolby C* is effectively a Dolby B encoding of an already Dolbied tape offering good extra performance without sacrificing compatibility with old tapes and without too much extra cost. *Dolby HX* seems to have been left behind in the noise reduction race by Dolby C but it is a headroom expansion (HX) system which is in effect a noise reduction system operating with Dolby B emphasis.

JVC have their own NARS and Super ANRS systems with ANRS now offering fair compatibility with Dolby B while Super NARS, which operates by reducing high frequency tran-sients on record and expanding them on replay, works on some programmes and not with others. dbx noise reduction systems offer startling noise reduction but noise pumping behind the signal seems still to be problematic to some listeners. Toshiba's adres system was technically more advanced than the original dbx units but suffered from similar problems. The High-Com system originally put in a very poor show-ing and Dobly C seems to be sweeping this noise reduction system away as it is all others. Tandberg have their own Dyneq system to overcome high frequency compression problems; their work seems to parallel Dolby's

own on the HX system, again both being put into the shade by Dolby C on cost grounds.

Cassette deck features

In using the word tape *deck* we are in this *Guide* referring to a machine primarily designed to interface with a domestic hi-fi system and be connected to an amp or receiver. A tape deck does not include its own power amplifiers and speakers but most have a headphone socket suitable for monitoring purposes. All the decks reviewed are stereophonic, recording two channels of information down one edge of the cassette tape which is then turned over to offer the remaining tape for recording in the other direction.

The tape is transported from one hub to the other inside the cassette by being pinched between a rotating capstan and rubber pinchwheel in the tape deck. Some machines find space in the tape opening to insert another capstan and can isolate a short length of tape from the vagaries of the cassette's mechanics. These dual capstan decks should offer better speed stability measurements.

Only the least expensive cassette decks use 'piano key' actuators on the transport modes (play, record, fast forward, rewind and pause), most machines now have electromechanical switches or solenoid control from touch sensitive micro switches often remote from the transport itself.

While the majority of decks are twohead machines with a head for erasure and one for record/replay some of the more expensive models split the record and replay facilities by providing two separate or one twinned heads. The big advantage is that a three-head machine allows you to monitor the recording a fraction of a second afteritis made, making it easy to get everything right first off. Threehead machines also allow instant offtape comparisons with the source being recorded which can be a great help when setting a machine up for bias and azimuth or checking for compatibility with different tape types. Combined heads for record/ replay have to compromise on gap size and this compromise is wiped out with separate record and replay gaps which can be individually optimised to provide better performance.

The problems in adding a third head to the cassette medium were many fold. Finding somewhere to put it was the first problem as the number of apertures in the cassette housing were limited. A third head created additional friction and required transports to be beefed up and their tolerances improved. Misalignment and magnetic interference are other problems that must be solved for a third head to be incorporated successfully.

Tape heads themselves are produced in a variety of different materials often carrying exotic names such as Permalloy, Sendust, Glass Crystal Ferrite. Do not presume that because a tape head is made of a specialist material it is going automatically to perform better, our reviews tell you more about life expectancy, overload, etc.

You of course need to know how much signal you are putting down onto the tape. Various types of meters can be provided; the older type is the VU meter with a needle running over a scale. These meters are intended to show the average level during any passage of music but they cannot react fast enough to respond to transient sounds accurately and constantly under-read on such programme. To overcome this peak meters or indicators can be added.

LED, liquid crystal and fluorescent displays are now commonly used, though in many cases even these meters are adjusted inappropriately and may not have a wide enough range even though they act fast enough. Meters should really show the peak level of the incoming signal but some manufacturers find it easier to put the meters after the Dolby circuitrywhenacompressed/equalised signal is read. This can cause you to record at the wrong level and not utilise the tape to the full. The safest idea is to experiment with metering various programmes at various levels to check out the particular operation of the meters on your machine. Our reviews comment on the range, speed and adjustment of fitted indicators where it is necessary

Some machines offer facilities that

can help improve the sound quality such as user-adjustable heads which can ensure that the machine is properly aligned to any other tape recorder's azimuth. If you want to use a wide variety of tape brands then a machine with variable bias will be essential. Some machines have automated bias setting which can offer reasonably accurate results after a few seconds.

Electrical interface with your hi-fi system is the last cassette deck hurdle to overcome. First you need to know the amplifier or receiver's input sensitivity and impedance at the tape in/line in or record sockets and the tape output level and impedance. Sensitivities are normally quoted as a minimum while outputs tend to be quoted as a maximum. To match the cassette deck best it should have a slightly higher output than the tape's sensitivity while the cassette deck's input should have a lower figure for sensitivity than the amplifier's tape output. Impedance matching is a shocking tangle and some simple guidance is offered in the chapter Amplifiers and Receivers under the heading Tape Input/Output. Most cassette decks have both DIN standard and phono sockets for connecting up equipment; as these often work to different standards it is advisable to stick with one type exclusively.

Getting the best from a cassette deck

There are three important areas to get right if you want the best performance your particular tape deck can offer. First of all the machine should beaccuratelyelectronicallyadjusted so there are no errors of equalisation or any Dolby tracking errors. This alignment should be done by the manufacturer and referred to a particular type and brand of type though all too often this alignment needs to be redone.Alignment accuracy depends on the quality control applied; hopefully our reviews have picked up the instances where this alignment is inconsistent. To check this for yourself ask to use the cassette deck you intend to buy in the shop and make a quick A/B test making a recording from disc say and then playing back the cassette and disc together, switching between them and listen-

ing for gross dissimilarities. You should be prepared to pay for alignment service though many shops which do not offer discount will offer alignment as part of their aftersales service — but don't expect alignment and discount.

The second area is that each machine should be aligned for use with one brand of tape or with a small family of similarly performing tapes. If you choose a machine for a particular feature and wish to use it with your library of tapes which happen to be made on an unsuitable tape then you should have the machine realigned to work best with the majority of your Check in the instruction tapes. manual as to which tape the manufacturer uses for alignment and stick with it. Alignment differences are often bigger than differences between different makes of cassette deck.

Finally maintenance is very much in your own hands. Regular cleaning to keep the heads and tape path free from fluff and oxide particles shed from the tape is essential. Cleaning should be done every 20 hours. Cotton wool buds moistened with isopropyl alcohol is the cheapest way but for decks that have difficult-toaccess heads then a tape cleaner should be used though often the erase head gets missed.

Additionally one should be prepared to remove the residual magnetism that will build up in the record/ replay heads with a device known as a de-gausser. These head de-magnetisers can be either hand-held models or come in the form of a cassette. Follow the manufacturers instructions for use to the letter and regularly de-magnetise the heads of your machine. This is of benefit every couple of months.

REEL-TO-REEL DECKS

The market for budget reel-to-reel tape decks that existed some ten years ago has been completely wiped out by the boom in cassette machines. The reel-to-reel machines on the market today are almost always advanced specification highquality recorders appealing to the pro and semi-pro musician (and of course the committed amateur) and to those seeking real high-fidelity replay and recording from the tape medium. If you want longer than 45 minutes replay, editing facilities and are not worried by the bulk of a reelto-reel tape deck then the medium is for you. Cassette, while convenient and of good quality, cannot yet match reel-to-reel in these terms.

Reel-to-reel best buys

The following models were all recipients of Best Buy status in Angus McKenzie's roundup of the reel-toreel tape deck market as published in *Hi-Fi Choice* No 29. The **Philips N4522** (£850) was considered to offer the finest value being described as a semi-professional recorder at a domestic price and it received top recommendation for its outstanding electronic design and amazing facilities. The **Philips N4250** (£785) received a strong recommendation for its splendid electronics, ergonomics and features.

The high and low speed **Revox B77** (£750 approx) were recommended for their reliability and ergonomics; they offer the important facility of switchable mainsfrequency for the user who travels the world with his machine. Other models offering various speed combinations, professional balanced socketry and one including an amplifier and monitor speakers are available. Slide sync and track synchronization can be achieved on some models.

The quarter track **Tandberg TD20A** (£550) gave an overall outstanding performance with no drop outs and a very wide dynamic range potential. The high speed version was also well liked but for the replay clipping margin, though Tandberg promised to improve on this. Both machines can be considered as a first successful entry for Tandbesrg into the semi-pro reel-to-reel market.

Thankfully, the reaction from the critics wasn't as flat as the response from their equipment.

Nothing less than we expected really, still it's very satisfying to receive such accolades from professional commentators in recognition of the phenomenal performance of our new Series 3000 units.

Integrated or used as separates, they represent the last word in no-compromise Hi-Fi for the serious enthusiast or professional studio.

But don't take our word for it, study the following quotes, read what independent experts have to say about these incredible units, then judge for yourself.

All the following extracts appeared during September and October in these popular magazines -Hi-Fi For Pleasure, Gramophone, Hi-Fi Choice Amplifiers, Hi-Fi News And Record Review...



THE SERIES 3000

A welcome addition to the ranks of the highest quality equipment and strongly recommended.

Well, what can I say about the performance of Tandberg Series 3000 separates except that the

results on some counts were to a scale not previously encountered in my laband by now I have evaluated a good few hi-fi items!



THE 3001 PROGRAMMABLE FM TUNER

Complete absence of background

noise and beat notes, high sensitivity and selectivity make the 3001 my tuner of the year.

Internally the tuner is one of the finest designs I have ever encountered.

I must admit that my instruments were being hard pushed to measure such low noise levels. Selectivity ratios, too, were astonishing and very difficult to measure accurately.

Undoubtedly a standard-setting tuner for the real enthusiast and professional and one which would not be out of place for broadcast monitoring by the transmitting authorities.

THE 3002+3003

The 3003 (with its 3002 companion) must represent an unbeatable purchase for the audiophile who values integrity of construction and engineering excellence.

This combination of pre-and power amplifier

is most attractive with a standard of finish the equal of anything around and a design that has distinct touches of Scandinavian flair.



THE 3002 CONTROL AMPLIFIER

... I found it difficult to confirm

with confidence a few of the manufacturer's figures since the control amplifier

performance reached the limits of my measurement apparatus.

To all intents and purposes the 3002 generates no significant harmonic distortion at its normal

operating level, the products being below the noise floor.

Distortion at all inputs was below the test noise floor...



THE 3003 POWER AMPLIFIER I was unable to detect with

certainty any transient intermodulation

distortion.

I can confirm the makers claim that the amplifier frequency response is virtually flat from 5 to 100.000HZ

...a combination of design construction and performance which can only be applauded.



And finally, a couple of comments from us.

Yes, we realise these are merely snippets excellent though they are - so if you'd like to examine the complete laboratory reports for yourself, write to us at the address opposite. We'll be delighted to send you a free booklet containing the full and unabridged test results and reviews.

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A combination record/playback head is fitted to this new Aiwa deck, which thus allows source/tape monitoring. Dolby B and C are werevery good indeed. fitted, together with very fast automatic tape alignment. Four push buttons are provided to select ferric, pseudochrome, ferrichrome and metal tape types – no IEC numbers are shown for these settings.

Aiwa AD-3800

Additional buttons select a very comprehensive series of tape counter and memory functions, including elapsed time, and auto rewindand play. An automatic head demagnetising facility is operated by another push button, as is the automatic tape-calibrate facility. Two parallel operating horizontal slide faders are provided for record level setting, whilst replay gain is adjusted by a similar but shorter ganged fader. This latter control also affects headphone volume, ample volume for all normal types being available from the standard 14" stereo jack provided.

Metering is with an LED bargraph display with good discrimination and multi-coloured. These meters are capable of reading transients very accurately indeed and were much liked. Deck functions operated very smoothly indeed. The controls offer the ability to switch from play-into-wind and back (with cueing if required), the pause control stopping and restarting the tape, and a record mute is fitted. Cassette insertion was simple, and tape tension is automatically taken up after inser-

tion. A superb display panel indicates the selected functions and general ergonomics

Pairs of phono sockets for line in/out, along with the mono $\frac{1}{4}$ " jacks for microphone input are found on the back panel, together with an MPX filter switch and a remote control socket.

The mic inputs were fairly quiet and had just adequate gain. The line inputs were very sensitive and had no clipping problem, but input noise was slightly high for a Dolby C deck. Output level was moderately high, from a reasonable impedance.

Replay azimuth was only marginally in error, but the accuracy of head and guide heights, and head penetration was not guite adequate. Some 50Hz hum was just noted with a few harmonics (not good), but hiss was reasonable. Replay amp distortion measured well, and the clipping margin was adequate. Source monitoring showed slight overall distortion, but this was kept below 1%.

Since the machine could align any reasonable tape type, TDK D ferric was used, which gave adequate MOLs and high frequency saturations. Overall noise was reasonable. with noise reduction good. The frequency response pen charts show just a gentle HF rise, which was actually liked very much subjectively, the overall sound quality being thought excellent for a budget tape type, although high levels were of course poor.

Dolby C allowed the recording levels to be reduced, the quality then being very highly praised throughout. Modulation noise was minimal, the chart being amazingly good.

TDK SA pseudochrome gave adequate MOLs and saturation, with overall noise measuring well throughout. Pen charts showed a slight lift at extremely high frequencies throughout, but there was a presenceband valley, especially on the right channel, with Dolby C. The subjective response was again much liked, though the overall quality was criticised because of general mid-frequ- 0 ency distortion becoming apparent rather rapidly above only modest peak levels, the quality at lower levels however being well liked. Modulation noise again was minimal. The Dolby C circuits however, were poorer than average, producing a 'paper-and-comb' sound on French horn.

TDK MA metal tape produced very good lowfrequency MOLs, and saturation results were reasonable. Overall noise was good throughout, and responses excellent without Dolby. and good with it - though note the presence dip. Distortion was audibly quite low, the sound quality at best being excellent throughout. Some record-current saturation was noted at high frequencies.

Wow and flutter measured incredibly well. but the actual speed was a little fast. Quality of spooling was average, and tape tensions well optimised.

We all liked this deck very much, and the sound quality was excellent throughout. provided high levels were avoided on ferric and pseudochrome tapes. Dolby C helped greatly with dynamic range potential, though not 10d8 giving the best dynamic distortion performance. Very reasonably priced for the facilities, T this deck must be placed in the best buy class as it offers so much.

GENERAL DATA
Replay azimuth deviation from average
Line input sensitivity
Worst audible replay num component – 690B (150Hz)
Replay noise terric CCIR/ARM weighted (NR out) 58.20B
weighted (NR out)62.0dB
Peopley amp aligning ref DI
Max replay level for DL
Wow and flutter average (neak weighted DIN) 0.04%
Speed average +0.8%
Meters under-read
Overall 10kHz sat ferric L/B ref DL
Overall Dolby C 10kHz sat ferric L/R ref DL 5.5/ - 4.5dB
Overall distortion ferric L/R for 5% dist
@ 315 Hz ref DL+ 4.6/+ 5.2dB
Overall 10kHz sat chrome position L/R ref DL 5.5/ - 5.5dB
Overall Dolby C 10kHz sat chrome position L/R
ref DL – 2.5/ – 2dB
Overall dist chrome position L/R for 5% dist
@ 315Hz ref DL+ 5.0/+ 4.6dB
Overall 10kHz sat metal L/R ref DL
Overall Dolby C 10kHz sat metal L/R ref DL + 2/ + 3dB
Overall distortion metal L/H for 5% dist
@ SISHZ TEL DL
NP improvement Delby P/C
Overall poise chrome NB out (CCIB/ABM) ref DI53 0dB
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Overall noise metal NB out (CCIB/ABM) ref DI51 6dB
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Modulation noise chrome broad/close ref 3kHz tone - 43/ - 38dB Line input noise floor ref 160mV/DL (CCIR/ARM) 78.0dB Spooling time (C90) Im 58s Dynamic range ferric/chrome/metal 74/277.5/80.5dB Noise reduction system
Modulation noise chrome broad/close ref 3kHz tone43/-38dB Line input noise floor ref 160mV/DL (CCIR/ARM)78.0dB Spooling time (C90). Im 58s Dynamic range ferric/chrome/metal. 74/177.5/80.5dB Noise reduction system. Dolby B/C Tapes used. TDK D/TDK SA/TDK MA Typical retail price. £270 OVERALL FREQUENCY RESPONSES - 20dB, ref Dolby level Comparison of the table of the table of the table of tabl
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TDK SA TDK MA, Dolby C in

Akai CS-F14 Akai (UK) Ltd. Unit 12. Haslemere Heathrow Estate. Silver Juhilee Way Hounslow, Middlesex, Tel 01-897 6388



Despite its modest price, this deck includes both Dolby B and C noise reduction. Unusually, the rotary record level control is ganged, and is complemented by a centre-indented balance control - an arrangement which we rather liked. Phono line in/out sockets are on the rear. and while the pre-production sample reviewed omitted a five-pole DIN socket, one is threatened on the production models! A trio of threeposition lever switches select noise reduction (off, Dolby B, Dolby C), tape types (ferric, pseudochrome and metal, no IEC numbers marked) and finally mains timer-start in play or record modes.

Metering is with a fluorescent bargraph display, accurately reading even fairly short transients, and with adequate discrimination - this being strong commendation for a budget deck.

Cassette insertion was simple, but painful on one occasion because of sharp corners on the door. Deck functions allowed transfer straight from play into wind and back (causing the tape to jerk a bit though), and dropping into record, whilst the pause stops but does not restart. Behind the cassette door is revealed a user - adjustable head-azimuth pre-set, useful for optimising pre-recorded cassettes. The mechanical tape counter jammed on one occasion during our tests.

Microphone inputs (1/4" plastic mono jacks) had inadequate sensitivity, but were adequate

on hiss levels. The line inputs had average sensitivity, and noise measured well, whilst no clipping problem was encountered. Output levels (not adjustable) were average and the output impedance was reasonably low. On the Akai's headphone output, low impedance headphones were too loud, whilst high impedance ones were too quiet - circuit design was rather unsatisfactory here. Replay azimuth had been very accurately set, whilst head and guide heights were adequate. Replay hum and hiss levels measured well, whilst replay amp distortion and clipping measurements were verv good.

Maxell UD ferric gave pen charts showing a slight high frequency boost, and bass 'woodles' (uneven response), with very low frequencies rather down. Sound quality was quite smooth, slightly bright, but liked. Lowfrequency MOLs and high-frequency saturation results guite acceptable, and sound quality was very good indeed up to reasonable peak levels. Overall noise measured very well. with very good Dolby improvements. Replay equalisation was slightly incorrect, there being not enough high frequencies. Modulation noise was slightly better than average. The Dolby C circuits (which make use of the Hitachi chip) had appreciably better than average dynamic distortion characteristics.

TDK SA pseudochrome gave rather a poor low-frequency MOL on the left channel, with high-frequency saturation results not too hot. Pen charts confirmed our subjective comment that the right track was a little down at high frequence (due to being over-biased), whilst the left was reasonable (bass 'woodles' again). Overall noise throughout measured well with mod noise reasonable. Sound quality was quite good but only up to moderate peak levels, but high levels audibly distorted (Dolby C allows lower levels for recording).

TDK MA metal gave a poor MOL at 315Hz on the left channel, but HE saturations were excellent (left track under-biased). Responses were reasonably good, but showed presence droops, although subjectively the response sounded quite smooth. Quality was much liked up to moderate peak levels, but distortion was clearly evident above these. Overall noise measurements were very good throughout. Slight record current saturation was noted at high frequencies. Overall, Dolby calibration was found to be generally erring positively. SA on the right channel being plus 1.2dB.

Wow and flutter measured very well and none was noticed on the listening test programme - which is excellent for a budget deck. Speed was marginally fast, whilst spooling time was a little slow, tensions being steady and well optimised.

Considering the price of this deck, the overall sound quality was remarkably good. Since the industry of Dolby C permits a fairly good dynamic range to be achieved without having to record at a high level, the deck is very obviously a best buy and can be strongly recommended. It is difficult to understand how Akai have made the price so low, considering the excellent metering, good wow and flutter and the provision of Dolby C noise reduction. (Note: the review sample was a pre-production model. We understand that the decks imported to the UK do not have such good meter performance. but this is not serious enough for the 'Best Buy' rating to be withdrawn.)

GENERAL DATA

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Replay azimuth deviation from	n average6°
Line input sensitivity	
Worst audible replay hum con	nponent – 69dB (100Hz)
Replay noise ferric CCIR/ARM	weighted (NR out) 59.4dB
Replay noise chrome position	CCIB/ABM
weighted (NR out)	– 62.8dB
Replay amp clipping ref DI	+ 16.0dB
Max replay level for DI	545mV
Wow and flutter average (neal	(weighted DIN) 0.08%
Speed average	+0.5%
Meters under-read	
Overall 10kHz sat ferric L/R re	f DL
Overall Dolby C 10kHz sat ferr	ic I /B ref DI 4.5/ - 5.5dB
Overall distortion ferric L/R for	or 5% dist
@ 315 Hz ref DL	+ 4.6/+ 6.0dB
Overall 10kHz sat chrome pos	ition L/R ref DL – 7/ – 7.5dB
Overall Dolby C 10kHz sat ch	rome position L/R
ref DL	– 4.5/ – 6dB
Overall dist chrome position	L/R for 5% dist
@ 315Hz ref DL	+ 3.2/ + 4.6dB
Overall 10kHz sat metal L/R re	f DL+ 0/ – 0.5dB
Overall Dolby C 10kHz sat met	al L/R ref DL + 3.5/ + 3dB
Overall distortion metal L/R f	or 5% dist
@ 315Hz ref DL	+ 4.4/ + 5.4dB
Overall noise ferric NR out (CC	CIR/ARM) ref DL – 52.8dB
NR improvement Dolby B/C	
Overall noise chrome NR out (CCIR/ARM) ref DL – 54.0dB
NR improvement Dolby B/C	
Overall noise metal NR out (C	CIR/ARM) ref DL – 52.0dB
NR improvement Dolby B/C	10.2/19.2dB
Modulation noise ferric broad	/close ref 3kHz tone – 38/ – 33dB
Modulation noise chrome bro	ad/close ref
3kHz tone	
Line input noise floor ref 160m	1V/DL (CCIR/ARM) – 79.6dB
Spooling time (C90)	
Dynamic range ferric/chrome/	metal
Noise reduction system	Dolby B/C
Tanas usad	Maxall LID/TDK SA/TDK MA

OVERALL FREQUENCY RESPONSES

Typical retail price.....£100



Bang & Olufsen Beocord 9000

Bang & Olufsen (UK) Ltd, Eastbrook Road, Gloucester GL4 7DE



This latest deck from the Bang & Olufsen stable is guite the most remarkable that I have vet seen, being almost completely microprocessor-controlled throughout. A combination record and replay head is fitted, but no off tape monitoring is provided. Dolby B and C noise reduction systems are complemented by B & O's patented HX Professional system (developed from Dolby HX) which works very well. DIN interconnections on the back and front allow for normal DIN inputs and outputs and alternative high-level DIN, the choice of either a DIN socket of a stereo jack being available for mic input. A stereo jack with its own level fader provides ample volume for all normal headphones. The 'amplifier' DIN, although five-pin-compatible, has additional pins for remote operation/control with other B & O equipment.

The deck is most unusually styled, with the main pushbutton controls on the front right, in the form of a calculator-type keyboard. In addition to all normal deck functions, these allow tape playing time calibration for the counter (elapsed or time-to-go can be displayed), 'go to' (selects any desired timing point for access), and almost any other function that you might imagine, including cycling and a vast memory facility.

Tape calibration and setting-up is automatic and fast, and the built-in metering can indicate the tape MOL, normal levels, bias, sensitivity and equalisation. The programme meters did not have good discrimination, whilst the 0dB point always indicated the tape's 2% distortion level at mid frequencies, but were heavily equalised. There is no room to detail further the amazing possibilities offered by the microprocessor control system.

The microphone inputs were very sensitive and quiet, whilst the DIN inputs were also very quiet, and various input switching options allowed great versatility of input level/ impedance matching, the record levels being separate faders for left and right channels. Output levels are adjustable, and if these are set too high, clipping might result, but set to 500mV the replay clipping margin was really excellent, distortion in the electronics being generally low.

Replay azimuth was very accurately set and in any case. B & O supply an azimuth tape. Head heights were also accurately set.

The latest BASF Ferro Super LH I ferric gave excellent low frequency MOLs, but high frequency saturation was good rather than outstanding — although Dolby C improved it to excellent. Overall noise measurements were average without Dolby, and showed very good Dolby improvement. Frequency responses were very good throughout, with only minor deviations (some cheap tapes also gave amazing charts). Modulation noise was guite reasonable, and sound quality throughout superb, provided one watched the meters carefully.

BASF Superchrome CRS II gave excellent MOLs and a good high frequency saturation particularly with Dolby C, but 3.15kHz MOL was poor due to the tape's characteristic. As expected, this tape produced an amazingly low overall noise, with good Dolby improvement, and thus high recording levels are totally unnecessary. Responses showed a slight presence valley with extremely high frequencies marginally up, although the sound quality seemed very open, smooth and generally excellent modulation noise being just average.

TDK MA metal gave fairly good MOLs, but was very good at high frequency, and outstanding with Dolby C. Overall noise measurements were all good, and responses excellent with just a slight rise at extremely high frequencies. Sound quality was superb throughout, very open and clean. The Dolby C circuits gave an average dynamic distortion performance. Replay amp noise measurements were all good, but mysteriously the right channel was even quieter than the left on two different samples.

Wow and flutter measured very well indeed, none being heard on the programme, whilst speed was as accurate as we could check! Spooling time was slightly faster than average and no tension problems were noted.

The original sample delivered to me for review had given an even better performance throughout, but a problem developed in the record feed circuitry, and at very short notice a B & O dealer helped out with the second sample used for many of the measurements (thanks to Rex Radio). Their sample had been well used, and yet gave the good overall main measurements and charts shown here, which in a way is a useful test. The early sample fault caused all MOLs and saturation results to degrade by over 3dB throughout, but we could not find the cause.

It is a pity that the UK model totally excludes phono sockets, whereas the US one has these. But the US version is of course only for 110V mains, so you can't win. I am full of praise for this deck, and whilst basic instructions are actually written under the hinged lid of the cassette compartment you will need to study the manual for some time with much concentration to gain the full benefits of operation. Despite its very high price, I can recommend this model as one of the best buys. It employs some extremely advanced microprocessor technology, and is superb to use once you understand its workings. Very much a 'B & O person's machine', and a model which will further enhance the Danish company's prestige.

GENERAL DATA

Replay noise ferric CCIR/ARM weighted (NR out).... – 60.0dB Replay noise chrome position CCIR/ARM Wow and flutter average (peak weighted DIN).....0.07% Speed average......0% Overall distortion ferric L/R for 5% dist @ 315 Hz ref DL.....+7.4/+7.6dB Overall 10kHz sat chrome position L/R ref DL.....-6/-5.5dB Overall Dolby C 10kHz sat chrome position L/R Overall dist chrome position L/R for 5% dist Overall 10kHz sat metal L/R ref DL. Overall Dolby C 10kHz sat metal L/R ref DL + 2.5/ + 2.5dB Overall distortion metal L/R for 5% dist+6.8/+6.0dB @ 315Hz ref DL..... Overall noise ferric NR out (CCIR/ARM) ref DL. - 50.0dB NR improvement Dolby B/C..... 10/19.0dB Overall noise chrome NR out (CCIR/ARM) ref DL - 57.0dB NR improvement Dolby B/C.....9.2/17.2dB Overall noise metal NR out (CCIR/ARM) ref DL - 51.8dB Modulation noise chrome broad/close ref 3kHz tone..... - 35/ - 32dB Line Input noise floor ref 160mV/DL (CCIR/ARM)......

Typical retail price.....£675

OVERALL FREQUENCY RESPONSES







C844 Dual Havden Laboratories Ltd. Churchfield Road, Chalfont St Peter, Bucks SL9 9EW Tel Gerrards Cross 88447



This top-of-the-range deck from Dual has both Dolby B and C noise reductions systems. offers two tape speeds and incorporates a combination head which allows off-tape monitoring. Phono line inputs and outputs on the rear panel are complemented by a five-pole DIN socket to normal DIN specification, with an additional DIN socket giving an off-tape monitoring signal. Separate friction-locked rotary record level controls are provided for line/DIN and mic inputs, thus allowing mixing if required.

A series of push buttons select tape or source monitoring, 9.5 or 4.8 cm/sec tape speed, repeat function, auto-space (assisting music search), fade edit (switching on, and level up and down, allowing re-recording over an existing one with fade), counter set. memory and reset (digital counter). Rotary switches select tape type (medium/high bias ferric, chrome/pseudochrome, ferrichrome and metal). Dolby off/B/C, and remote mains timer play/record.

The deck itself is open at the front, a cover coming over the heads to protect them when the mains is off. Cassette loading is both simple and rather cunning. Metering is provided with two VU meters which under read badly, but are complemented by four mono LED peak indicators. These peak LEDs are fast, but indicate the equalised head signal.

The first review sample was so badly aligned

that we requested a second one, properly set up — the original sample had grotesque Dolby errors of up to 4dB!

Deck functions allow you to move straight from play into wind and back, pause stopped but did not restart. It is also possible to go from play into rewind, starting programme search, but with much clanking, all operations being fairly slow and noisy. To enable source monitoring, record and pause also have to be selected, which is annoying.

The microphone inputs (1/4" mono jacks) were rather insensitive, and slightly noisy, whilst the DIN input was a little noisy too, and a little insensitive. (The effective input impedance was too low, thus attenuating the DIN source level too much). The line inputs were fairly sensitive, but slightly hissier than average for a Dolby C deck, no clipping problem being noted though. Output levels were average and not adjustable, headphones being driven from a 1/4" stereo jack. All headphone types were on the loud side using this output. Replay azimuth was very accurately set, head and guide heights being fairly accurate. Very slight hum was noted on the right channel on replay, but hiss levels were low. Replay amp distortion was reasonable at all normal levels, but increased over quite a range up to the clipping point, which was at a very high level.

Maxell UDXL / ferric produced excellent

MOLS but poor saturation results although Dolby C improved the latter to acceptability. Overall noise was slightly high, but both Dolby B and C gave good improvements. Modulation noise was minimal and frequency responses without Dolby very good, although Dolby C caused a slight high frequency loss on the left. and a marked one on the right. Subjective quality was very good indeed throughout the test programme. XL IS showing a slight high frequency lift, whilst UDXL I did produce a predictable HF loss.

Maxell XL IIS pseudochrome dave acceptable MOLs and high frequency saturation, the saturation results improving to good with Dolby C. Overall noise measurements were all quite satisfactory, modulation noise being low. Frequency responses measured well throughout. Although the slight very low frequency loss was mildly criticised subjectively, quality throughout was thought excellent and well above average up to moderate peak levels. higher ones probably being restricted by the MOL capability of the tape.

Fuii Metal gave good MOLs and very good high frequency saturation levels, overall noise measurements being average throughout. Responses were smooth but a little up at high frequencies. Tape-to-head stability was criticised, on the metal tape, but was acceptable on the other types. The chrome II position Dolby calibration was clearly optimised between chrome II and pseudochrome cassettes, which might be useful. The Dolby C circuits gave no dynamic distortion problems on speech, but French horn showed up some distortion here the circuits being considered slightly better than average.

Wow and flutter measured reasonably well at normal speed, and superbly well at double speed (performance at 9.5 cm/sec being very good throughout). Speed was marginally slow and spooling times very slow, with back tension slightly high, but otherwise tensions were satisfactory.

I liked this machine very much, and it offers some excellent facilities and sound quality for its price, but whilst I am delighted to give a European machine a best buy, I must advise extreme caution in purchase, and you should check your sample for Dolby record calibration accuracy.

GENERAL DATA Replay azimuth deviation from average..... Worst audible replay hum component. - 64dB (150Hz) Replay noise ferric CCIR/ARM weighted (NR out).... – 58.8dB Beplay noise chrome position CCIB/ABM weighted (NR out)..... Wow and flutter average (peak weighted DIN).....0.1% Speed average.....-0.5% 7dB on 64ms 25dB on 8ms Meters under-read Overall distortion ferric L/R for 5% dist @ 315 Hz ref DL. + 7 6/ + 7 6dB Overall 10kHz sat chrome position L/R ref DL... -6.5/-6.5dB Overall Dolby C 10kHz sat chrome position L/R - 4.5/ - 5dB ref DL.... Overall dist chrome position L/B for 5% dist Overall distortion metal L/R for 5% dist NR improvement Dolby B/C.....9.8/17.2dB Overall noise metal NR out (CCIR/ARM) ref DL. – 51.6dB Modulation noise chrome broad/close ref ... - 42/ - 38dB 3kHz tone Line input noise floor ref 160mV/DL (CCIR/ARM)..... – 76.8dB Noise reduction system......Dolby B/C Tapes used......Maxell UDXL1/Maxell UDXL IIS/Fuji Metal £280 when reviewed, now £290 Typical retail price OVERALL FREQUENCY RESPONSES - 20dB, ref Dolby level +++++ 100 Maxell UDXL I. Dolby C in 100 200 500 Maxell UDXL IIS, Dolby C in

> 500 1k

Fuji Metal, Dolby C in

Hitachi Sales (UK) Ltd. Hitachi House, Station Road, Hayes, Middlesex UB3 4DR Tel 01-848 8787



This front loading deck incorporates both Dolby B and Dolby C noise reduction making use of Hitachi's combined new B/C micro chip. Having just basic functions, the *D*-*E*44 is fairly compact. But as well as the usual pairs of phono sockets for line input and output, the rear panel also carries a ganged output level fitted.

Hitachi DE-44

The 1/4" stereo headphone jack delivers a fixed level, about the right volume for low impedance headphone models, but high impedance ones will be too quiet.

for record level, along with switching for line/mic inputs. Pushbuttons select cassette tape types 1, 2 and 4 (well labelled), Dolby on/off, Dolby B or C, and tape counter reset. A three-position switch selects remote play/record start.

Deck functions all worked well, being solonoid operated, and permit transfer from but not out. The pause control can be used for stopping but not for restarting a function, and a record mute button is provided. Whilst the machine is extremely well laid out and presented, it is obviously made to a price - for board-mounted, and thus rather floppy.

Metering is by extremely fast acting LED bargraph indicators, but these offer only 12 indeed up to a fairly high recorded level, above

indicated levels unfortunately. The microphone inputs (1/4" mono jacks) did not have sufficient gain, and input noise was only fair, and in using Dolby C slight transient distortion was noted in the crosstalk. The line inputs were fairly sensitive and no clipping problem was noted, although the input circuitry was slightly preset, and a DIN remote control socket is noisier than usual, thus limiting the Dolby C noise improvement.

Replay azimuth was extremely accurate, but the replay tape guide was set a little high. Head penetration into the tape was perhaps slightly insufficient, being at the extreme of its A large friction-locked rotary control is fitted tolerance. Replay noise without Dolby measured very well, but Dolby C improvement was not quite sufficient. Replay distortion and clipping margins were excellent, showing the new Hitachi chip to be very good here. Output level for Dolby level was average and from a fairly low source impedance. A non-switchable MPX filter is built in incidentially.

Hitachi ER ferric tape gave good MOLs at play into wind and back, dropping into record low frequencies and acceptable high frequency saturations for the tape type. Overall, the pen charts showed a very smooth HF response throughout, but low frequency variations (including bass 'woodles') were slightly more noticeable than usual, but not example the phonos and replay presets are really severe. Overall noise was good without Dolby, the noise reduction improvement also being good. Subjective quality was very good

which distortion set in rather rapidly. But this is not a problem with Dolby C, since you needn't record at a very high level for good dynamic range. Modulation noise was low, but stability was only fairly good.

Hitachi EX (pseudochrome) penned extremely good charts without Dolby, and only a slight presence droop was noted with Dolby C, which is a good result. Low frequency MOLs measured badly, but high frequency saturation results were good. Some head saturation was noted on the lab charts, and the reproduced quality of loud levels was severely criticised. Overall noise was very good without noise reduction, but the input noise clearly affected the maximum improvement with Dolby C. which was only averaging 17dB. Modulation noise however was low. Dolby C action in general showed far less transient problems than usual, so Dolby have clearly fixed some of the early troubles.

Maxell MX metal gave acceptable MOLs and good saturations for a two head deck. The pen charts showed a slight drop at high frequencies which was a little emphasised with noise reduction. But this was not disturbing subjectively, a slight presence droop receiving only very mild comment. Overall noise was average. with 18dB improvement given by Dolby C.

Wow and flutter measured well, and was not a problem subjectively. Speed was just over 1% fast, whilst spooling was slightly faster than average. Play tensions were slightly jerky. This machine can give some very good overall quality if the recording levels are watched carefully particularly on ferric and metal, but could not find out why pseudochrome required a low level. This is not too serious though with Dolby C. The meters were very fast and this helps matters.

The machine was liked ergonomically and considering that the Dolby C circuits worked well, this model seems a reasonably good buy, but Hitachi really must look into their record electronics/record head saturation problems. A recommendable Dolby C budget model.

GENERAL DATA Replay azimuth deviation from average1°
Line input sensitivity
Worst audible replay hum component – 63dB (50Hz)
Replay noise ferric CCIR/ARM weighted (NR out) 59.6dB
Replay noise chrome position CCIR/ARM
weighted (NR out)
Replay amp clipping ref DL+ 16.5dB
Max replay level for DL
Wow and flutter average (peak weighted DIN)
Speed average+ 1.2%
Meters under-read0dB on 8ms
Overall 10kHz sat ferric L/R ref DL
Overall Dolby C 10kHz sat ferric L/R ref DL – 4/ – 3dB
Overall distortion ferric L/R for 5% dist
@ 315 Hz ref DL+ 6.4/ + 5.6dB
Overall 10kHz sat chrome position L/R ref DL – 5/ – 5.5dB
Overall Dolby C 10kHz sat chrome position L/R
ret DL
Overall dist chrome position L/R for 5% dist
@ 315HZ ref DL
Overall TOKHZ sat metal L/H ret DL
Overall distortion metal L/R for 50/ dist
© 215Hz rof DI
@ 315HZ TET DL
NP improvement Delby P/C 10 2/19 6dP
Overall poise chrome NR out (CCIP/APM) ref DI54 8dR
NR improvement Dolby R/C 98/17.0dR
Overall noise metal NB out (CCIB/ABM) ref DI
NR improvement Dolby R/C 10.0/18.2dB
Modulation noise ferric broad/close ref 3kHz tone
Modulation noise chrome broad/close ref

3kHz tone..... Line input noise floor ref 160mV/DL (CCIR/ARM).... - 74.8dB Spooling time (C90) 1m 41s Dynamic range ferric/chrome/metal......76.5/75/77dB Noise reduction system..... Dolby B/C Tapes used.....Hitachi ER/Hitachi EX/Maxell MX Typical retail price ... £135 when reviewed, now £125

OVERALL FREQUENCY RESPONSES



Hitachi Sales (UK) Ltd. Hitachi House, Station Road, Haves, Middlesex UB3 4DR Tel 01-848 8787



A three head front loader, this deck has fairly simple functions but as it turned out was well liked ergonomically. The usual pairs of phono sockets are fitted to the rear panel for line input and output, together with a DIN socket for connecting a remote control unit. Output from the 1/4" stereo headphone jack is adjustable (along with replay gain) and at maximum was easily sufficient for low impedance headphone models but only just adequate into high impedance ones.

Hitachi DE-66

The deck functions worked well, and allowed transfer from play into wind and back, dropping into record but not out, the pause control stopping but not restarting the tape. Pushbuttons are provided for tape types 1 to 4 (well labelled with IEC numbers). Dolby on/off. Dolby B or C, MPX filter on/off, monitoring source/tape, and counter reset. Switches select memory rewind (stop or play) and timer set (record of play). A line/mic input selector switch is also fitted, and a record/mute button is provided. The counter indicates both elapsed time and numbers, which can be reset separately. The record level control is a large friction-locked rotary type.

Metering is by LED bargraph displays, which read transients very accurately, with good discrimination and were very well liked. Microphone inputs (1/4 " mono jacks) were quite sensitive and very quiet, and gave excellent quality. The left jack only can be used to feed

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both channels if required. Line inputs had average sensitivity, no clipping problems and low input noise.

Replay azimuth was very accurate, and head/guide heights well set. Replay noise levels were very good without noise reduction, but Dolby C did not auite give enough improvement in hiss reductions here. Replay hum was not really noticeable, and amplifier distortion and clipping measurements were good, and output level being just under 0.5V for Dolby level from guite a low impedance, which may be useful.

Hitachi SR (ferric) gave very good low frequency MOLs whilst 3.15kHz and 10kHz maximum outputs were average. The responses were again slightly down at high frequencies and some bass 'woodles' were noted, particularly with Dolby C — although subjectively the sound was much liked throughout with several 'excellents' noted in the listening test programme. Overall noise was average, and Dolby C achieved 18dB noise reduction. Modulation noise was very low. The Dolby C circuits, dynamically, worked better than average.

Hitachi SX pseudochrome had rather poor MOLs, and high frequency saturation was just average, showing record head saturation. Distortion was criticised subjectively, but in practice Dolby C allows lower record levels. which would be clean. Overall responses

measured well apart from some bass 'woodles' and very low frequency cut. Overall noise measured very well but only 17dB noise reduction was given by Dolby C. Modulation noise was again very low, which is commendable.

Maxell MX metal penned reasonable charts without noise reduction but presumably bias breakthrough into the record Dolbys caused the noticeable high frequency loss, particularly with C. Low frequency MOLs were only fairly good and high frequency saturation was poor for metal, and replay equalisation was not sufficient here, causing the overall response anomalies. Overall noise was frankly too good for metal, proving the previous ascertion regarding replay equalisation and again just 17dB noise reduction was given by Dolby C. Modulation noise was again very low. A/B sensitivities were well matched throughout.

Wow and flutter measured very well, and none was heard in the test programme. Speed was only marginally fast, but slowed down slightly at the end of a cassette. Spooling was slightly faster than average.

Tensions were a little on the low side, with forward tensions slightly erratic, the tension held at just 1g when in pause. If the replay equalisation had been closer to standard, high frequency saturations would have been better throughout, and would have allowed slightly better overall performances, hiss not being a problem anyway because of the Dolby C circuit.

To conclude, then, the DE66 is a very reasonably priced three-head deck, with some good ergonomics, and one which I rather liked. despite minor criticisms. The performance on metal tape should have been better, but even so a recommendation.

GENERAL DATA

Replay azimuth deviation from average
Line input sensitivity
Worst audible replay hum component – 70dB (150Hz)
Replay noise ferric CCIR/ARM weighted (NR out) 62.6dB
Beplay noise chrome position CCIB/ABM
weighted (NB out) - 65 0dB
Replay amp clipping ref DI + 15.0dB
Max replay level for Di 485mV
Wow and flutter average (neak weighted DIN) 0.09%
Speed average -0.7%
Meters under-read – 0dB on 8ms
Overall 10kHz sat ferric L/Bref DI _ 65/_65dB
Overall Dolby C 10kHz sat ferric L/B ref DI
Overall distortion ferric L/B for 5% dist
$@ 315 \text{ Hz ref DI}$ $\pm 7 \text{ A}/\pm 6.8 \text{ dB}$
Overall 10kHz sat chrome position L/B ref Dl $= 5.5/-5.5$ dB
Overall Dolby C 10kHz sat chrome position L/R
ref DI $-2/-2dB$
Overall dist chrome position L/B for 5% dist
\bigcirc 315Hz ref DI +34/+4 4dB
Overall 10kHz sat metal L/B ref DI - 3.5/-3.5dB
Overall Dolby C 10kHz sat metal L/R ref DI
Overall distortion metal L/B for 5% dist
@ 315Hz ref DI + 5 4/5 4dB
Overall noise ferric NB out (CCIB/ABM) ref DI - 50.8dB
NB improvement Dolby B/C 10 8/18 0dB
Overall noise chrome NB out (CCIB/ABM) ref DI - 54 2dB
NR improvement Dolby B/C 10 4/17 2dB
Overall noise metal NB out (CCIB/ABM) ref DI _ 53 4dB
NB improvement Dolby B/C 10 6/17 4dB
Modulation noise ferric broad/close ref 3kHz tone – 38/ – 35dB
Modulation noise chrome broad/close ref
3kHz tone $-37/-36$ dB
Line input noise floor ref 160mV/DL (CCIR/ARM) $= 81.6$ dB
Spooling time (C90)
Dynamic range ferric/chrome/metal 77 5/77/76dB
Noise reduction system
Tanes used Hitachi SR/Hitachi SY/Mayell MX
Typical retail price £210 when reviewed now £195
Typicariotai proc

OVERALL FREQUENCY RESPONSES



Hitachi D-2200M

Hitachi Sales (UK) Ltd, Hitachi House, Station Road, Haves, Middlesex UB3 4DR Tel 01-848 8787



Hitachi have had considerable success with their Automatic Tape Response System ('ATRS') in previous models, and this time they again have a winner. A three head (combination head) deck, the D2200M includes Dolby B and C noise reduction, and has just line in/out phonos and a remote control socket on the rear panel, with all operating controls on the front. Metering employs a fluorescent bargraph display which indicates peaks very accurately with good discrimination, and up to included, which is excellent.

A friction-locked rotary record level control is complemented by a ganged replay gain control, which affects headphones level. The 1/4 " stereo jack provides ample volume for all normal headphone types. Two counters provide indications of tape position (with reset), and of elapsed time. Pushbuttons select Dolby on/off, B/C, MPX on on/off, tape/source monitoring line/mic input, tape types 1 to 4 (well labelled), 'ATRS' tuning and fixed pre-set calibration. A three-position switch selects remote timer play/record. Auto memory rewind switching is also useful.

Tape deck functions are slightly slow in action but smooth (the controls are of the finger-touch type), and allow direct transfer from play into wind and back, and dropping into record. The pause stops tape movement

simple and the ergonomics liked. Lights indicate each main function as it is selected.

The microphone inputs (1/4" mono jacks) have insufficient gain, and are slightly noisy, although otherwise satisfactory. The line inputs have average sensitivity, no clipping problems, and a low input noise level. Output levels were just a little lower than usual, but the source impedance was also low, which is dood.

Replay azimuth was in error (which will be +8dB. High frequency peak lights are also noticeable on pre-recorded cassettes). Head/guide heights were reasonably accurate though. Replay amplifier noise measured very well, but marginal hum was noted at 150Hz with replay gain well up. Replay amp distortion and clipping performances were excellent.

'ATRS' calibration was used for setting all tape types in the tests. Hitachi SR ferric gave phenomenal low frequency MOLs and high frequency saturations, and whilst overall noise was a little hissier than usual, noise reductions achieved were good. Responses without Dolby were excellent, although with Dolby C, the right channel was slightly up at high frequencies, and some bass 'woodles' were noted throughout. Modulation noise measured extremely well, and sound quality was rated superb virtually throughout, the Dolby C circuits also being better than usual.

Hitachi SX pseudochrome gave good MOLs but does not restart it. Cassette insertion was and saturation results, but was clearly not up to the fantastic ferric performance. Overall noise measured well with very good noise reduction on *B*, and fair with *C*. Responses were very good, but again showing bass 'woodles', and the right track slightly up at high frequencies. Modulation noise was good. Subjective quality was excellent, but the tape could not stand the highest levels as well as the ferric could. Stereo positioning was excellent throughout.

Maxell MX metal gave good low frequency MOLs, and phenomenal high frequency saturations! Pen charts were very good throughout, but showed the same bass 'woodles' again. Overall sound quality was rated superb throughout, and clearly better than metal on most decks. Whilst low frequency performance was bettered by the astonishing ferric, the high frequency end was fantastic - very open and clean. Overall noise was average, with reasonable Dolby improvement.

The wow and flutter performance was again phenomenal, one of the finest ever. Actual speed was only marginally fast, and spooling was reasonably fast. Tensions were wellcontrolled, being retained in the stop mode.

We all liked this machine very much indeed since it not only worked extremely well, but produced some phenomenally good sound quality. Its price is very reasonable indeed for its performance, and it is very strongly recommended as a best buy.

GENERAL DATA
Replay azimuth deviation from average
Line input sensitivity
Worst audible replay hum component – 65dB (150Hz)
Replay noise ferric CCIR/ARM weighted (NR out) 61.2dB
Beplay noise chrome position CCIB/ABM
weighted (NR out) -64 2dB
Replay amp clipping ref DI
Max replay level for DI 475mV
Wow and flutter average (pack weighted DIN)
Speed overage
Motors upder read
Overall TUKHZ satterric L/H ret DL – 1.5/ – 0.5dB
Overall Dolby C 10kHz sat ferric L/H ref DL+ 2/ + 3.5dB
Overall distortion terric L/R for 5% dist
@ 315 Hz ref DL + 8.6/ + 8.2dB
Overall 10kHz sat chrome position L/H ref DL – 3/ – 2dB
Overall Dolby C 10kHz sat chrome position L/R
ref DL+1/+2dB
Overall dist chrome position L/R for 5% dist
@ 315Hz ref DL+ 6.6/ + 5.8dB
Overall 10kHz sat metal L/R ref DL+2/+3dB
Overall Dolby C 10kHz sat metal L/R ref DL+6.5/+7dB
Overall distortion metal L/R for 5% dist
@ 315Hz ref DL+ 7.6/7.4dB
Overall noise ferric NR out (CCIR/ARM) ref DL – 48.4dB
NR improvement Dolby B/C10.8/18.0dB
Overall noise chrome NR out (CCIR/ARM) ref DL – 52.4dB
NR improvement Dolby B/C10.8/17.4dB
Overall noise metal NR out (CCIR/ARM) ref DL 50.6dB
NR improvement Dolby B/C10.8/17.8dB
Modulation noise ferric broad/close ref 3kHz tone – 41/ – 37dB
Modulation noise chrome broad/close ref
3kHz tone
Line input noise floor ref 160mV/DL (CCIR/ARM) 81.2dB
Spooling time (C90) 1m 33s
Dynamic range ferric/chrome/metal
Noise reduction system Dolby B/C
Tapes used Hitachi SR/Hitachi SX/Maxell MX
Typical retail price £330 when reviewed now £319
OVERALL FREQUENCY RESPONSES
– 20aB, ret Dolby level



JVC (UK) Ltd. 6-8 Priestlev Way, Eldonwall Trading Estate, Staples Corner, London NW2 7AF. Tel 01-450 2621



monitoring, and includes JVC's 'BEST' system for automatic setting-up on different tapes. The record and play heads are of the combination type, built into a single housing. The DD9 is fitted with Dolby B and C noise reduction systems, and has line in/out phono sockets in the rear, and MPX switch also being mains, and a remote control socket.

VC DD-9

tons for 'down' and 'up', which operate the etc. motor-controlled internal potentiometers. The bargraph type meters, with 18 increments, can be set to indicate normal VU or peak reading measurements. These meters can read transients very accurately, which is excellent, but insufficient range above Dolby level is provided for. Peak readings are held for two seconds. The counter reads either time rewind and play, cycling and so on.

Tape functions are solenoid operated, and work very smoothly, (but with a loud clunk!) allowing transfer from play into wind and back, dropping into record from play, but not back. The pause control can be used for stopping a function, but not restarting it. The eject button has to be pushed firmly for the cassette door to open. A centre indented horizontal slider is

This deck has three heads allowing off-tape provided for input balance, and a second slider provides replay gain, also controlling output from the 1/4" stereo headphone lack - which gives adequate volume for all normal headphone types. A timer play/record switch is fitted, whilst pushbuttons select Dolby on/off. Dolby B or C, ferric/chrome/metal (no IEC numbers are marked), computerised tape caliincorporated here, together with a switch bration for bias, level and equalisation, pre-set which sets the internal clock for 50 or 60Hz calibration, source/tape monitoring and meter characteristics. A display on the front panel Record level is controlled by two push but indicates the operation of the 'BEST' circuitry

> The microphone inputs (1/4" mono jacks) were reasonably quiet and sensitive, and no problems were experienced here. The line inputs were slightly insensitive, but were quiet. and produced no clipping problem. Maximum output levels were reasonably high, but from a fairly high impedance, 3.8k ohms.

Replay azimuth was none too accurate, but elapsed or tape position, while the clock subjectively, stereo images were very stable. controls, working with the memory allow auto Head and guide heights were accurately set. Hum was totally inaudible on replay, and hiss levels were good, without Dolby, whilst noise reduction improvements were well optimised. Replay amplifier distortion and clipping marains were excellent.

Automatic 'BEST' setting-up was used throughout the tests. Maxell UD penned very good charts with and without Dolby, except for a rise at very low frequencies which seemed

exaggerated with Dolby C. this being noted subjectively. The overall quality, though, was very good up to moderate recorded levels, very high levels being a little distorted across the audio range. Low frequency MOLs and high frequency saturation results were only fairly good, whilst overall noise was very good without Dolby, but Dolby noise reductions were not quite good enough. Modulation noise was just average although stability was excellent The Dolby C circuits worked reasonably well.

TDK SA pseudochrome penned good charts throughout but with a tendency to a slight shelf down above mid frequencies very low frequencies again being up. The entire programme was therefore marginally muffled, yet thought very smooth. Low frequency MOLs were reasonable, but with, we suspect. a replay time constant error producing only a fair high frequency saturation performance. 3.15kHz also being only fair. This replay equalisation error of course helped overall noise without Dolby, but noise reduction with Dolby in was below optimum. Distortion was considered good only up to moderately high levels, high levels sounding poor. Modulation noise was just average. Dolby C worked guite well dynamically

TDK MA metal did not give good low frequency MOLs, and high frequency saturation too was only fair. Although overall noise was again good. Dolby improvement was once more not quite optimum. The overall response sounded very smooth, very low frequencies being better, whilst the charts reveal little boost at extremely high frequencies. Again, distortion was considered good up to moderate levels, but poor at high levels, both the low frequency MOLs and high frequency saturation being disappointing. 'BEST' seemed to optimise overall responses well, but the replay equalisation error was most unfortunate and clearly affected the entire overall performance of this deck, which is a little disappointing.

Wow and flutter measured incredibly well, with some of the best figures we have ever noted, whilst speed was also very accurate. Spooling was average, and back tension very constant, although forward tension, surprisingly, was slightly jerky. The volume control took six seconds to go from minimum to maximum - slow, but fun to use. Although this machine has some good features, the replay equalisation error unfortunately causes some poor overall measurements, but the deck can just be recommended.

GENERAL DATA

Replay azimuth deviation from average. Replay noise chrome position CCIR/ARM

 Speed average.
 + 0.3%

 Meters under-read.
 1dB on 8ms

 Overall Dolby C 10kHz sat ferric L/R ref DL.
 - 7/ - 8dB

Overall distortion ferric L/R for 5% dist + 4.6/ + 5 4dB @ 315 Hz ref DL..... Overall 10kHz sat chrome position L/R ref DLv. - 8.5/ - 8.5dB Overall Dolby C 10kHz sat chrome position L/R ref DL.... Overall dist chrome position L/R for 5% dist Overall distortion metal L/R for 5% dist NR improvement Dolby B/C. 9.2/17.8dB Modulation noise ferric broad/close ref 3kHz tone – 37/ – 34dB Modulation noise chrome broad/close ref 3kHz tone . - 37/ - 34dB Line input noise floor ref 160mV/DL (CCIR/ARM)..... – 79.6dB Noise reduction system......Dolby B/C Tapes used......Maxell UD/TDK SA/TDK MA Typical retail price.....£425 OVERALL FREQUENCY RESPONSES - 20dB, ref Dolby level 100 200 50 500 Maxell New UD. Dolby C in TDK SA

TDK MA. Dolby C in

100 200

50

NAD 6050C NAD Ltd, Cousteau House, Greycaine Road, Watford WD2 4SB Tel (0923) 27737



This reasonably priced deck from NAD incorporates both Dolby B and Dolby C noise reduction systems. Both phono line input and output sockets and a five-pole DIN input/ output socket are fitted on the rear panel. Separate rotary record level controls are fitted for left and right channels — a concentric one would have been preferred. A three-positioned tape selector switches ferric/chrome/metal. the positions also being marked with IEC numbering — an excellent point — with another switch selecting Dolby off, B and C. A pushbutton switches the MPX filter on or off and a centre-indented rotary control adjusts bias. The tape counter is a mechanical type with zeroing button.

Metering is with a row of miniature lamps in a bargraph display, having only fair discrimination, but reading transients very accurately. The maximum level that can be indicated is rather low though.

Deck functions include transfer from play into wind and back. Holding the 'wind' key depressed gives cueing, which is excellent. The pause control stops and re-starts tape movement. Only the record button need be pressed to start recording. This deck was much liked ergonomically, being very simple. The cassette compartment is open, with a cover supplied.

The microphone inputs (1/4" mono jacks) had

extremely quiet (excellent). The DIN input circuitry was superbly designed with almost no trace of noise, even when Dolby C was used. The line inputs had average sensitivity (impedance being 40kohms), and were very quiet indeed also having no clipping problem. Output levels were average, from a fairly low impedance. Headphones are driven from a 1/4" stereo jack, with fixed output - but low impedance headphones were too loud, while high impedance ones were too quiet.

Replay azimuth was fairly accurate, but head height was very slightly out. Replay hum was only very slightly noted on the right channel, whilst hiss levels were lower than average. Replay amplifier distortion and clipping measurements were excellent.

Maxell UDXL I ferric gave excellent MOLs and adequate high frequency saturation results, improving with Dolby C. Overall noise was average with good Dolby improvement, modulation noise being adequate. Overall responses were very good on the right, but the left channel showed a slight high frequency droop, worsening with Dolby C. Subjectively, the left channel response droop was heard, but other than this quality was thought excellent throughout.

Maxell UDXL II pseudochrome gave poor low frequency MOLs, but good high frequency saturations, with background noise good adequate gain and the amplifiers were throughout. Modulation noise was average. Frequency responses this time were very good on the left, but high frequencies were up on the right, showing poor internal bias balance setting. The sound quality was liked throughout, if the recording level was held back, but high levels distorted noticeably. Dolby C helps so much here and if levels do not exceed full scale deflection on the meters. overall distortion should be low.

Maxell MX metal gave only fair low frequency MOLs, but phenomenally good high frequency saturation, thus showing considerable under-biasing, and insufficient record equalisation. Overall responses were very good at mid and high frequencies on the right channel but the left was down at high frequencies. Low frequencies drooped down surprisingly with Dolby C in. Noise throughout was very good. A positive overall Dolby calibration error was noted. Responses seemed reasonable though, and distortion only came in with high recording levels, so if the meters are watched carefully distortion will be avoided. Slight record current limiting was noted at very high 10kHz levels.

Whilst wow and flutter DIN measurements were all very good, continuous judders were audible which were very disturbing. A second sample seemed very much better though. Speed was rather fast (the second sample being just slightly fast) and spooling time rather slow. Forward tensions were slightly high, but steady on the second sample. The Dolby C circuits had a slightly better dynamic distortion performance than average and were thus good.

I particularly admire much of the electronic design in this deck and provided recording levels were watched carefully, the overall sound quality was sufficiently good for this model to be warmly recommended. NAD haved promised to check the left-to-right bias balance and deck clutch mechanism much more carefully, and perhaps the record head could have been slightly down in left channel high-frequency output on the sample we tested. So I can just place this machine in the best buy class since its price is reasonable. Check however the various points that have I criticised on any deck offered to you.

GENERAL DATA Replay azimuth deviation from average	19°
Line input sensitivity	mV
Replay noise ferric CCIR/ARM weighted (NR out) – 60.)dB
Replay noise chrome position CCIR/ARM	
Replay amp clipping ref DL+ 14.	5dB
Max replay level for DL	mV
Speed average+0.	ס% 7%
Meters under-read0dB on 8	ms
Overall Dolby C 10kHz sat ferric L/R ref DL	
Overall distortion ferric L/R for 5% dist	
@ 315 Hz ref DL	BdB
Overall Dolby C 10kHz sat chrome position L/R	ŧuΒ
ref DL	ödΒ
Overall dist chrome position L/H for 5% dist @ 315Hz ref DI + 38/+34	ldB
Overall 10kHz sat metal L/R ref DL + 2.5/ + 1.5	dB
Overall Dolby C 10kHz sat metal L/R ref DL + 4.5/ + 3.5	δdΒ
@ 315Hz ref DL+5.2/+4.8	BdB
Overall noise ferric NR out (CCIR/ARM) ref DL 50.4	dB
Overall noise chrome NB out (CCIB/ABM) ref DI - 53 (od B Sd B
NR improvement Dolby B/C	dB
Overall noise metal NR out (CCIR/ARM) ref DL – 51.0	dB
Modulation noise ferric broad/close ref 3kHz tone – 36/ – 29	dB
Modulation noise chrome broad/close ref	
3kHz tone	D d B
Spooling time (C90)	23s
Dynamic range ferric/chrome/metal	dB
Tapes used Maxell UDXL I/Maxell UDXL II/Maxell Maxell Maxell UDXL II/Maxell Maxell Max	etal
Typical retail price	159
OVERALL FREQUENCY RESPONSES	
– 20dB, ref Dolby level	
	N
	H
	¥1
	11
v 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	20k
Maxell UDXL I, Dolby C in	
	+
10dB	
20 50 100 200 500 1k 2k 5k 10k	ZÜk
	11
T X	
	-
20 50 100 200 500 1k 2k 5k 10k	20k

Nakamichi ZX7 Hi-Fi Markets, Cousteau House, Greycaine Road, Watford WD2 4SB Tel (0923) 27737



Senior member of the latest Nakamichi series, the ZX7 incorporates three heads (discrete) allowing off tape monitoring, together with Dolby *B* and *C* noise reduction. Separate left and right recording level controls are fitted, whilst a ganged rocker master gain control is provided, similar to that on the *LX5*. Phono line input and output sockets are provided on the rear panel, together with a DC output socket for Nakamichi 'black boxes', and a remotecontrol socket.

Meters are LED bargraph type, with very good discrimination and excellent peak-reading capabilities, and with a slow fall-back time making peaks easier to see. Rotary switches select tape/source monitoring, MPX on/off, Dolby off or *B* or *C* in, 70 or 120μ S equalisation, and memory/timer function. A ganged output gain control also adjusts headphone levels — output from the 1/4" stereo jack providing reasonable levels with all normal headphone types.

Pushbuttons select ferric/chrome/metal (these positions being confusingly labelled), built-in calibration tones (400Hz and 15kHz), and manual azimuth enable (recording azimuth can be adjusted). Rotary controls are provided for record calibrate and bias adjustment for all three tape types, and these can be used for setting up almost any tape optimally with the internal tones.

Deck functions operate very smoothly, and

provide the ability to go from play into wind and back (cueing is by pushing pause while winding), and dropping into record, with record mute available. The counter is digital. Overall responses, when Dolby C was in use, always seemed better when aligned with Dolby C selected, but azimuth indications were rather slow and a little irritating. Cassette loading was simple, but the compartment rather unusual.

The line inputs were very sensitive, and no clipping or noise problems were noted. Maximum output levels were quite high, and from a reasonable impedance. The replay azimuth was fairly inaccurate, but heads and guide heights quite well set. Replay amplifier hiss and hum levels were commendably low, whilst distortion and clipping performance was excellent. A slight lift though seemed to be present at extremely high frequencies.

Maxell *UD* ferric tape gave excellent low frequency and 3.15kHz MOLs, with an astonishing high frequency saturation performance for the tape type. Overall noise was average with good Dolby improvements, whilst frequency responses throughout were excellent and well extended (note that the deck was aligned with Dolby *C* in when *C* was in use). Modulation noise was minimal, which is excellent. Overall quality was considered superb, and this is amazing for a medium quality tape, putting to shame metal tape on many other decks. The Dolby *C* circuits, however, did introduce slight high-level transition distortion on French horn.

Maxell UDXL II penned good charts, but they would have been better if we had fiddled a bit with external tones. Low frequency MOLs and high frequency saturations measured well, and overall noise was average, but with slightly below optimum Dolby C noise reduction. Modulation noise was again excellent, as was high frequency stability throughout. Overall sound quality was again excellent at all normal levels.

Maxell *MX* metal gave good MOLs and high frequency saturations were very good. Responses were excellent with Dolby out, but with Dolby C in, the use of the internal tones for calibration resulted in a slight 10kHz dip, 15kHz being flat. Overall noise levels were average, with a good Dolby Improvement. Sound quality was considered superb throughout.

Wow and flutter measured superbly well, and absolutely none was audible. Speed was very accurate, and spooling fast, with play tensions stable. One of the record gain controls went faulty during tests, but the importers quickly put this right for us.

This deck allows a wide variety of tape types to be used, and whilst the internal calibration tones are useful, the 15kHz one should haps have been at a slightly lower frequency, which would have allowed a better control of Dolby C responses. A slight tweak, though, put matters right subjectively, and since this deck produced some superb overall quality, and was liked ergonomically, it must be considered a best buy, and strongly recommended, although its price is high.

GENERAL DATA

Worst audible replay hum component...... – 73dB (150Hz) Replay noise ferric CCIR/ARM weighted (NR out).... – 58.6dB Replay noise chrome position CCIR/ARM weighted (NR out).....-63.0dB Replay amp clipping ref DL + 15.6dB Max replay level for DL.....1.135V Wow and flutter average (peak weighted DIN).....0.06% Speed average.....+ 0.3% Overall 10kHz sat ferric L/R ref DL. - 1.5/ – 2dB Overall Dolby C 10kHz sat ferric L/R ref DL. + 0.5/0dB Overall distortion ferric L/R for 5% dist @ 315 Hz ref DL.....+6.8/+5.8dB Overall 10kHz sat chrome position L/R ref DL.....-3/-3.5dB Overall Dolby C 10kHz sat chrome position L/R Overall dist chrome position L/R for 5% dist @ 315Hz ref DL.....+6.2/+5.2dB Overall 10kHz sat metal L/R ref DL....+0.5/+0.5dB Overall Dolby C 10kHz sat metal L/R ref DL...+2.5/+2.5dB Overall distortion metal L/R for 5% dist Overall noise chrome NR out (CCIR/ARM) ref DL – 53.0dB Modulation noise chrome broad/close ref 3kHz tone ... - 41/ - 40dB Line input noise floor ref 160mV/DL (CCIR/ARM)..... – 79.6dB Spooling time (C90).....1m 22s Dynamic range ferric/chrome/metal..... 77.5/77/79.5dB Noise reduction system......Dolby B/C Tapes used......Maxell UD/Maxell UDXL/Maxell Metal Typical retail price £675 when reviewed, now £660 **OVERALL FREQUENCY RESPONSES** - 20dB. ref Dolby level



Maxell MX

REVISED AND REPRINTED

Nakamichi 1000ZXL

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Hi-Fi Markets, Cousteau House, Greycaine Road, Watford WD2 4SB Tel (0923) 27737



This is the most incredible cassette deck we have available for all normal types. Many push buttons ever checked, and it contains just about every facility that one could possibly require, which is hardly surprising at its unbelievable price! It is housed in a beautifully finished (very large) rosewood case, and is basically a dual-capstan front-loader. It has microprocessor control of all the normal cassette deck functions, but does not permit dropping into record from play. Cueing is possible during wind when pause is depressed. A be selected, and playback of up to 30 commands of various tracks in any order. It is of course a threehead deck with source/tape monitoring, but also has the most superb automatic tape alignment stores retaining parameters when required (battery line in/out sockets, and eight phono sockets for interconnection with any external noise reduction systems. A captive mains lead is complemented by an earth terminal, and remote control sockets are fitted for both mechanical and tape location memories, for interconnection with computerised programming equipment. Very silky-acting slide faders adjust L/R line in and mike inputs (a third centre-injection mike channel is also provided with a mono fader). Similar replay gain sliders also adjust headphone levels, plenty of volume being

select all deck, memory and other auto functions. whilst rotary pointer switches provide remote timer start, normal memory functions, test tone on/off, three positions of bias (allowing optimisation for MF, HF or best overall performance), 70/120uS equalisation, a selection of subsonic and MPX filtering positions, external NR or Dolby on/off, metering peak hold or peak etc., and tape/source monitoring. The metering is superb, microprocessor memory allows fifteen locations to two rows of fluorescent LEDs showing not only peaks with switchable hold, but VU levels at the same time: these were capable of indicating transients very accurately. The auto-equalisation provision allowed the optimisation of virtually any facility, which even includes auto-azimuthing, four tape type tried on the deck, with amazing results, even poor tapes usually giving an acceptable back up is provided). On the back panel are phono overall performance, while good ones were truly exceptional. The ¹/₄" jack socket mike inputs had reasonable sensitivity, and an amazing overload margin. Line input sensitivity was very adequate and no clipping problem was encountered.

The replay azimuth was surprisingly inaccurate, but is easy to standardise. Head guide heights were satisfactory, but the replay head height was wrong. No hum problems were noted, and all replay hiss measurements were good. Up to 1 Volt output was available for Dolby level and the replay amp clipping margin and distortion measurements were excellent. The replay response probe tests showed an almost perfect response throughout.

Maxell XLIS produced excellent MOLs and a superb HF saturation performance, and frequency responses were also very flat from 20Hz to 22kHz with only marginal deviations occurring with Dolby. The panel thought the quality throughout was absolutely superb, with no criticism whatsoever, the XLIS sound being decidedly better than metal tapes used on most decks. Overall basic noise was average, but the dynamic range fantastic. since extremely high levels could be achieved.

Maxell XLIIS, whilst again giving superb overall results, was actually no better in the lab, noise being quieter but MOLs lower than with XLIS. Thus with the recording level slightly reduced, the panel found the quality virtually identical (note the incredible pen charts).

I have already used 'superb' to describe performance on ferric, but Maxell metal was even better, achieving +11.9dB over DL at 333Hz, and yet almost DL at 10kHz for saturation. This allowed incredible dynamic ranges to be reached, and even digital master tapes copied through this deck sounded little different on replay unless we A/B switched continuously. Basic noise, however, was average, but with a good Dolby improvement. Stereo positioning throughout was beyond reproach, as was tape stability. The wow and flutter measurements, too, were extremely good, and wow could barely be detected even when comparing with the digital master on piano. Speed was very accurate with the speed control on its centre position (allows $\pm 6.5\%$ deviation). Spooling was very fast, but not even the slightest damage ever occurred. All torque measurements were excellent. and erasure very good throughout.

I feel I have run out of superlatives for perhaps the first time ever in this review. for there was virtually nothing at all wrong anywhere with this deck, a superb scientific instrument, which produces the finest possible results with the cassette medium. It may well contain some facilities that vou would hardly ever use, but it is still tremendous fun having them! Obviously, this machine cannot be recommended as a best buy at around $\pounds 1,275$, but it receives the strongest recommendation that I could possibly give a deck. If you can afford it, you will not be other than delighted with its magnificent sound quality, which at best is almost as good as the better semi-professional reel-to-reel decks using excellent tapes at 19 cm/S. Perhaps it is remarkable enough that we actually obtained some very good overall quality from cheap, but good, budget cassette tapes, including TDK D, Maxell UL, while even Scotch ferric fared well after autoazimuthing etc.

GENERAL DATA

Replay azimuth deviation from average	+69°
Mike input sensitivity/clipping	193uV/2.4V
Line input sensitivity/clipping70).8mV/>10V
Replay response ferric 63Hz av L/R	+0.4dB
Worst audible replay hum component6	6dB (150Hz)
Replay noise ferric CCIR/ARM weighted (Dolby out)	58.2dB
Dolby improvement	10.3dB
Replay noise chrome position CCIR/ARM weighted (Dolby out)	61.8dB
Dolby improvement	10.0dB
Replay amp clipping ref DL	>+16.5dB
Max replay level for DL	1.05V
Wow and flutter average (peak weighted DIN)	0.067%
Speed average	+0.3%
Meters under-read 2	.5dB on 8ms
Overall 10kHz sat ferric L/R ref DL,	-1.4/-1.6dB
Overall distortion ferric L/R for 5% dist @ 333Hz ref DL	+7.6/+8.1dB
Overall 10kHz sat chrome position L/R ref DL	-5.8/-4.2dB
Overall dist chrome position L/R for 5% dist @ 333Hz ref DL	+5.6/+5.9dB
Overall I0kHz sat metal L/R ref DL	-2.1/-1.0dB
Overall distortion metal L/R for 5% dist@ 333Hz ref DL+1	1.1/+11.0dB
Overall noise ferric L/R Dolby out(CCIR/ARM) ref DL5	0.0/-49.9dB
Dolby improvement	10.2dB
Overall noise chrome L/R Dolby out(CCIR/ARM) ref DL5	2.2/-52.1 dB
Dolby improvement	10.1 dB
Overall noise metal L/R Dolby out(CCIR/ARM) ref DL5	1.5/-51.3dB
Dolby improvement	10.2dB
Line input noise floor ref 160mV/DL (CCIR/ARM)	81.3dB
Spooling time (C90)	
Dynamic range ferric/chrome/metal	68.6/73.7dB
Noise reduction system.	Dolby
Tapes used Maxell XLIS; Maxell XLIIS;	Maxell MX
I ypical retail price £1,275 when reviewed	, now £1,835



Overall frequency responses (-23dB, Dolby in)

Pioneer CT-4 Pioneer High Fidelity (GB) Ltd. Field Way, Greenford, Middx, UB6 8UZ Tel 01-575 5757



The Pioneer CT-4 offers only basic facilities. but includes both Dolby B and C noise reduction. Phono line input and output sockets are on the rear panel whilst 1/4 " mono jacks are fitted on the front for microphones – there is no mic/line switch. The record level control is a large friction-locked concentric rotary type. which was found delightful to use. Pushbuttons select Dolby off, B or C MPX or off, and ferric/chrome/metal cassettes (this tape selection uses just two buttons, with no IEC numbering). The tape counter is mechanical. with the normal reset facility. Cassette insertion is very simple and easy.

Deck functions include direct transfer from ' play into wind with music search, play being selected again from this mode by the search facility. Only the record button needs be pressed to enable recording, and one can just about go from play to record but with a clank. Pause (rather clanky) stops and restarts and there is record mute button.

Metering is with LEDs which under-read slightly, level discrimination being very poor. The 1/4" stereo jack for headphones produced too much volume for low impedance headphones and yet too little for high impedance models.

sensitivity but were very quiet, whilst line inputs were fairly sensitive, and again quiet with no clipping problem. Output levels were digital distortion plots. Overall noise measured

about average, from a fairly low impedance. Replay azimuth was extremely accurately set. with head/quide heights reasonably accurate. head penetration on the lower limit of tolerance. Replay amplifier noise levels measured well, and amplifier distortion was good although the clipping margin was just adequate.

Sony BHF budget ferric produced very good charts without noise reduction, but both Dolby B and Dolby C produced sharp cut-offs below 15kHz, 315Hz MOLs were reasonable, though unbalanced, but high frequency saturations were fairly poor, even for a modest tape. Overall noise was very good with good Dolby noise reductions, but replay equalisation seemed to be down at high frequencies. The sound quality was thought to be very good throughout for a budget tape, although some IM distortion was apparent between low and high frequencies on peaks. Modulation noise was average.

TDK SA pseudochrome produced very good overall responses up to 10kHz, but again showed fall-off at extremely high frequencies. which was rather audible on programme. Low frequency MOLs were adequate, but high frequency saturation was poor, causing The microphone inputs had just adequate considerable high-frequency compression. even with Dolby C. Clear signs of recordcurrent saturation were evident from the

well though with modulation noise fairly good A - 1dB Dolby record calibration error was noted

TDK MA metal gave very poor MOLs, whilst high frequency saturation results were fairly poor unless Dolby C was switched in. Overall noise was average though. Responses without Dolby showed a slight presence hump but were otherwise fairly smooth, but with Dolby C the hump was exaggerated although extremely high frequencies were reasonable. The overall quality was very good indeed up to modest peak recording levels for metal, but high levels sounded rather distorted, and the tests showed clear signs of record magnetisation. current limiting and clipping. The Dolby C circuits had rather more dynamic distortion than usual, and were not up to average performance unfortunately, although most programme material would be unharmed.

Wow and flutter measured reasonably well. and was not ever disturbing on the programme. Speed was inconsistent between record and play, the latter being correct, but some cassettes seemed to cause too low a replay pitch. Spooling time was slowish, and forward tension was noted to be very variable, although back tension was satisfactory. The mechanism did not seem to be robust enough. and was sometimes a little erratic

This deck could produce some verv reasonable overall sound quality if the recording levels were held back a little, and the meters were at least better than VUs, and so a recommendation seems very fair as the price is competitive – although the Dolby C circuits were not of the best. Pre-recorded cassettes sounded slightly muffled and so I am afraid that this deck does miss a 'best buy'.

GENERAL DATA

Replay noise ferric CCIR/ARM weighted (NR out).... – 60.4dB Replay noise chrome position CCIR/ARM weighted (NR out).....-Replay amp clipping ref DL......+ 13.2dB Speed average.....+0.1% Overall distortion ferric L/R for 5% dist @ 315 Hz ref DL....+5.4/+3.4dB Overall Dolby C 10kHz sat chrome position L/R – 8.5/ – 9.5dB ref DL..... Overall dist chrome position L/R for 5% dist @ 315H z ref DL......+5.0/+4.6dB Overall 10kHz sat metal L/R ref DL......+5.0/+4.6dB Overall 10kHz sat metal L/R ref DL.....+1/-0.5dB Overall distortion metal L/R for 5% dist Overall noise chrome NR out (CCIR/ARM) ref DL. . . . – 53.2dB9.8/16.6dB Modulation noise chrome broad/close ref ... - 39/ - 33dB 3kHz tone..... Line input noise floor ref 160mV/DL (CCIR/ARM).... - 76.4dB Spooling time (C90). 2m 20s Dynamic range ferric/chrome/metal......72.5/74/74dB Tapes used.....Sony BHF/TDK SA/TDK MA OVERALL FREQUENCY RESPONSES - 20dB, ref Dolby level Sony BHF TDK SA, Dolby C in

TDK MA, Dolby C in

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Revox B710 F.W.O. Bauch Ltd. 49 Theobald Street, Borehamwood, Herts WD2 4RZ Tel 01-953 0091



The B710 is Revox's first cassette deck design. and its general styling and functions closely follow their reel to reel tradition. It is a threehead deck, allowing off tape monitoring, with Dolby B noise reduction only. The mechanical parts are superbly designed and made, and include many unique engineering features.

The back panel phono line inputs and outputs, along with a five-pole DIN socket which allows switchable replay muting whilst recording. Separate replay gain presets are provided for left and right channels. Two remote control sockets are fitted, and the mains lead is detachable. Separate rotary sockets are fitted, and the mains lead is detachable. Separate rotary friction-locked record level controls are provided for the microphone and line/DIN inputs, a ganged headphone gain control also giving plenty of volume with all normal headphone types from the 1/4" stereo jack.

Metering is provided with LED-type bargraph displays, with good discrimination, and excellent fast transient accuracy. Switches select source or tape monitoring, Dolby on or off, and MPX filter on or off. Push-sensitive buttons select counter mode (elapsed time or numbers), run-up, and zero, these also offering various auto-play and cycling functions. Deck functions allow transfer from play into wind and back, dropping in and out of record, the pause control stopping and starting on record only. All deck functions operate very well indeed, although the auto-leader-jump system occasionally caused a problem with prerecorded cassettes (these stopped at the end of the leader and had to be restarted).

A spring loaded hinged door at the top of the front panel reveals the counter/timer, memory controls (set, start, stop and clear), switchable remote timer start (play or record), equalisation (70 μ S, 120 μ S or automatic), and pushbuttons for tape types 1, 2 and 4, or auto (tape positions are labelled with IEC numbering only, and are confusing). Cassette insertion was slightly awkward, requiring the cassette to be pushed home on to the open mechanism. A detached lid is supplied with the deck, but this was not liked.

The microphone inputs (1/4" mono jacks) were very sensitive indeed, were very quiet and were much liked. The DIN input worked very well indeed, whilst line inputs were very sensitive, but slightly noisy, although no clipping problem was noted. Maximum output level was fairly high, and from a very low impedance, which would be useful for studios. Replay azimuth was slightly out, whilst head heights were set very precisely. Replay amplifier hiss measurments were excellent but hum was very slightly noticed in the noise. We could not detect any replay distortion/clipping problem (our jig would not work here).

The original specified tapes were not

aligned for optimally, and after our alignment GENERAL DATA (bias, record eq and internal levels) Maxell UDXL I gave excellent pencharts, low frequencies being well extended. Overall noise measured well, with modulation noise phenomenally good. Low frequency MOLs and high frequency saturations were reasonably well balanced, but 3.15kHz MOL was only adequate. Overall sound quality was excellent at best, but setting up was fairly critical on this.

Maxell UDXL // pseudochrome gave good MOLs and saturation results, whilst responses were ±1dB from 30Hz to 17kHz, referenced to 315Hz. With Dolby, the presence valley was on exaggerated, which was noticeable (slight bias breakthrough?). Overall noise was very good. but Dolby did not give the full improvement. Modulation noice was again very low, and overall sound quality was excellent throughout.

TDK MAR metal gave excellent MOLs and saturations (after careful alignment) but responses showed a presence valley. exaggerated again by Dolby. Overall noise was average, whilst sound quality throughout was superb. although the presence valley heard slightly.

Wow and flutter was amazingly low, and speed very accurate, while spooling was very fast. Tape tensions were average. This is a very expensive machine, but if you take the trouble to have it aligned carefully for your favourite tape types, it can offer a magnificent performance. It would be of particular use to studios, and semi-professionals, and thus receives a recommendation, but its high price for the facilities offered keeps it out of the best buy class.

Incidentally, the remote control socket can Maxell UDXL I, Dolby B in be interconnected with its equivalent on the Revox receiver, with which it is very compatible. Most impressive was the superb workmanship and design of the deck mechanism, of which Revox can be very proud.

Update

Shortly after this review went to press a Dolby C fitted MkII version of the B710 was made available.

Replay azimuth deviation from average
Line input sensitivity40mV
Worst audible replay hum component – 69dB (150Hz)
Replay noise ferric CCIR/ARM weighted (NR out) – 58.6dB
Replay noise chrome position CCIR/ARM
weighted (NR out)
Replay amp clipping ref DL
Max replay level for DL755mV
Wow and flutter average (peak weighted DIN)0.05%
Speed average+0.2%
Meters under-read
Overall 10kHz sat ferric L/R ref DL
Overall Dolby C 10kHz sat ferric L/R ref DL
Overall distortion ferric L/R for 5% dist
@ 315 Hz ref DL
Overall 10kHz sat chrome position L/R ref DL6/-5dB
Overall Dolby C 10kHz sat chrome position L/R ref DL
Overall dist chrome position L/R for 5% dist
@ 315Hz ref DL+6.0/+5.8dB
Overall 10kHz sat metal L/R ref DL
Overall Dolby C 10kHz sat metal L/R ref DL
Overall distortion metal L/R for 5% dist
@ 315Hz ref DL+8.6/+8.0dB
Overall noise ferric NR out (CCIR/ARM) ref DL 50.4dB
NR improvement Dolby B
Overall noise chrome NR out (CCIR/ARM) ref DL 53.8dB
NR improvement Dolby B9.0dB
Overall noise metal NR out (CCIR/ARM) ref DL – 51.2dB
NR improvement Dolby B9.0dB
Modulation noise ferric broad/close ref 3kHz tone – 44/ – 40dB
Modulation noise chrome broad/close ref
3kHz tone
Line input noise floor ref 160mV/DL (CCIR/ARM) – 71.6dB
Spooling time (C90)
Dynamic range ferric/chrome/metal
Noise reduction system
Tapes usedMaxell UDXL I/Maxell UDXL II/TDK MA-R
Typical retail price

OVERALL FREQUENCY RESPONSES - 20dB, ref Dolby level







Sonv TC-D5M Sony (UK) Ltd. Pyrene House, Sunbury Crescent, Sunbury-on-Thames, Middlesex TW16 7AT. Tel Sunbury 87644



A remarkably compact top-loading stereo portable, the TC-D5M either works off internal batteries or with an external mains adaptor (6 volts). Dolby B noise reduction is fitted. A side panel provides the mounting for phono line ins/outs, and 1/4" mono jacks for microphones. A 20dB microphone attenuator switch is fitted. The machine only weighs 1.7kg.

The two round VU meters under-read transients badly, but a peak reading light came on, even on fast transients, at 4.5dB over Dolby level. A switchable built-in limiter is provided. which is most useful, and the miniature record level control is a friction-locked concentric rotary (it is difficult to adjust the channels separately). The battery check button is useful, and this also lights up the VUs for a few seconds. A recessed 1/4" stereo jack, complemented by a headphone gain control, gives ample volume into low impedance headphones, but clipping was very evident at normal levels into high impedance ones. A built-in small mono speaker is also controlled by the headphone gain when no phones are plugged in, an excellent facility, whilst line outputs are at a fixed average level. Underneath the cassette compartment lid are switches selecting normal/chrome or ferrichrome/metal tape types, the cassette lugs switching appropriately. A Dolby on/off introduced by Sony's Dolby B circuit. switch is provided together with an eject

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miniature counter with zero button is mounted in front of the cassette compartment. Deck functions allow play into wind and back, whilst pause stops and re-starts (operating mechanically).

The microphone inputs were very sensitive and very quiet, and so ideal. The line inputs were also quite sensitive, were just slightly noisy but had no clipping problem. Input hiss levels were adequate for Dolby B, but would be inadequate if Dolby C were added without redesign. Replay azimuth was fairly accurate, and head and quide heights surprisingly well set. Replay amplifier distortion and clipping margins were all good, whilst reply noise measurements were all excellent.

Sony AHF ferric gave very good low frequency MOLs, but high frequency saturations were only fair, showing slightly the wrong compromise in biasing and equalisation internally. Frequency responses were really excellent up to 13kHz and overall noise measurements were good, with modulation noise reasonable. Subjective sound quality was excellent up to fairly high recording levels, with compression noted at very high frequencies, though, for example on brass transients, and so high levels should not be attempted. Slight noise modulation was

Sony UCXS pseudochrome gave adequate button. Cassette loading was simple. A MOLs and saturations, whilst overall noise measurements were good. Overall responses were incredibly flat to 10kHz, rolling off very gently above this frequency. Modulation noise was average. Sound quality was again good at normal levels, but high levels were distorted. We tried the limiter which greatly helped distortion of course, having no transient attack problem, but again recovery was a little too fast, causing slight ducking.

Sonv Metal gave a very poor low frequency MOL performance, whilst high frequency saturations were excellent, and so again it seems that the bias/equalisation compromise was incorrect. Responses were very good on the left channel, but the right track was slightly under-equalised at high frequencies, the droop being exaggerated with Dolby B in. Overall noise measurements were good. Sound quality was very open at high frequencies, but low frequencies were not clean enough for metal and if only Sony had better compromised the alignment, results would have been so much better. Disappointing then, on metal. Slight noise modulation was noted throughout with Dolby B. and I wish Sony could put this right for I have moaned about their Dolby circuits for some years.

The first sample supplied was excellent on wow and flutter, but a second sample was tested because the first one had an equalisation problem. The second one gave reasonable measurements most of the time. but occasionally a high reading was noted, some ridging occurring in spooling with this sample. Speed was quite accurate, but spooling time was extremely slow, there being no auto-stop (this could waste the battery). Forward tension was a little low and variable. and back tension was also jerky.

We all liked using this deck very much, and the wow is probably good on most samples. Some very good stereo 'live' recordings were made on it, but the price seems a little high, and the metering rather crude. It can nevertheless be recommended as a good little portable, but surely a Dolby C version must be forthcoming soon, which would be worth waiting for. Recommended, then, but not a best buy. Don't forget that higher impedance headphones are not suitable, unfortunately.

SENERAL DATA
Replay azimuth deviation from average
Vorst audible replay hum component
Replay noise chrome position CCIR/ARM
weighted (NR out)
Max replay level for DL
Vow and flutter average (peak weighted DIN)0.09%
Aeters under-read
Overall 10kHz satferric L/R ref DL
Overall Dolby C TOKHZ sat ferric L/R fer DL
@ 315 Hz ref DL
Overall Dolby C 10kHz sat chrome position L/R ref DL – 5.5/ – 5.50B
ref DL
@ 315Hz ref DL
Overall 10kHz sat metal L/R ref DL + 0.5/ + 1dB
Overall Dolby C 10kHz sat metal L/R fet DL
@ 315Hz ref DL+3.4/+3.8dB
Verall noise ferric NR out (CCIR/ARM) ref DL – 51.0dB
Overall noise chrome NR out (CCIR/ARM) ref DL – 54.0dB
NR Improvement Dolby B
IR improvement Dolby B9.4dB
Aodulation noise terric broad/close ref 3KHz tone – 38/ – 30dB Aodulation noise chrome broad/close ref
3kHz tone
Line input noise floor ref 160mV/DL (CCIR/ARM) – 72.2dB Spooling time (C90)
Dynamic range ferric/chrome/metal67.5/68.5/65dB
apes usedSony AHF/Sony UCX-S/Sony Metal
ypical retail price£295
OVERALL FREQUENCY RESPONSES
– 20dB, ref Dolby level
20 50 100 200 500 1k 2k 5k 10k 20k
Sony AHF
R
20 50 100 200 500 1k 2k 5k 10k 20k
Sony UCXS, Dolby B in
20 50 100 200 500 1k 2k 5k 10k 20k

Sonv TC-K555 Sony (UK) Ltd, Pyrene House, Sunbury Crescent, Sunbury-on-Thames, Middlesex TW16 7AT. Tel Sunbury 87644



This well laid-out new deck from Sony incorporates a combination head allowing off tape monitoring. Dolby B and C noise reduction is included, together with an excellent tape counter, which indicates time elapsed from a zero point in minutes and seconds, working even during spooling. If zero is at the end of a tape then all readings are 'minutes and seconds to go'. Phono line input and output sockets are mounted on the rear panel. The record level control is a frictionlocked rotary, which felt particularly smooth. and this is complemented by a ganged replay gain control for headphones only. The 1/4" stereo jack provides ample volume.

Metering is with a fluorescent bargraph display, reading from -40dB to +8dB with reasonable discrimination. This display gives a very fast attack time and is excellent. A centre indented preset adjusts bias on ferric only, and pushbuttons select ferric/chrome/ferricchrome/metal (IEC numbers are marked as well). Dolby on or off. B or C. MPX filter on or off, tape or source monitoring, counter reset and memory. A switch selects remote timer start (play or record). A remote control socket is fitted on the front panel. Deck functions allow direct transfer play into wind and back. with auto rewind and play and dropping into record. The pause control stops and restarts tape movement. Deck functions were much liked, and cassette insertion was very simple.

No microphone inputs are provided. The line inputs have good sensitivity, and the input circuits add only very slight noise. The output impedance from the deck is a little high. although levels are average.

Replay azimuth was extremely accurate, but the head was marginally out of true vertically. Very slight 50Hz hum was just noted on the left replay channel, whilst hiss levels were around average. Replay amplifier distortion and clipping performances were excellent.

Sony AHF ferric produced guite good low frequency MOLs and excellent high frequency saturation, showing a good compromise of overall adjustment. Responses with bias nominal showed very sight high frequency droops, but with bias at -1 responses sounded very smooth indeed, rated superb, as was sound quality up to moderately high levels, distortion setting in rapidly above these. Noise measured reasonably with good Dolby improvements, modulation noise being fairly low.

Sony UCXS pseudochrome also gave guite good low frequency MOLs, and very good high frequency saturation - but 3.15kHz MOLs were only adequate. Noise was reasonable throughout, modulation noise being rated very low, which is good. Responses showed high frequency lift, though this was not disliked. Distortion seemed quite low up to fairly high levels, the sound being very open and much

liked, although high levels were distorted.

Sonv Metal gave reasonable low frequency MOLs, and excellent high frequency saturations. Responses sounded quite flat, although the lower presence region did show a slight valley on the charts. Noise measurements were all reasonable, whilst the subjective quality throughout was much liked, showing metal tape to work well.

Although wow and flutter measured well, the clutch mechanism was slightly jerky causing the odd judder (this was not serious though).

Speed was accurate, and spooling time average. Forward tension was rather jerky, but back tension showed only small cyclic variations. Dolby calibrations throughout were reasonably accurate. The Dolby C circuits were better than average, showing that Sony have dramatically improved upon their earlier Dolby C designs.

We all liked this machine very much, for not only were many points of the ergonomics excellent, including a superb counter, good metering and good facilities, but the overall sound quality was often rated superb on all types - though levels will need watching slightly on ferric and chrome. Highly recommended as an obvious best buy.

GENERAL DATA

Replay azimuth deviation from average
Line input sensitivity
Replay noise ferric CCIB/ARM weighted (NR out)56 8dB
Replay noise chrome position CCIR/ARM
weighted (NR out) 60.2dB
Replay amp clipping ref DL+ 17.8dB
Max replay level for DL
Wow and flutter average (peak weighted DIN)0.08%
Meters under read OdB on 8ms
Overall 10kHz sat ferric L/R ref DL.
Overall Dolby C 10kHz sat ferric L/R ref DL
Overall distortion ferric L/R for 5% dist
@ 315 Hz ref DL+ 5.8/ + 5.6dB
Overall 10kHz sat chrome position L/R ret DL 4/ - 4dB
ref DI $\pm 15/-1dB$
Overall dist chrome position L/R for 5% dist
@ 315Hz ref DL+6.0/+5.6dB
Overall 10kHz sat metal L/R ref DL+ 0.5/+ 0.5dB
Overall Dolby C 10kHz sat metal L/R ref DL+ 4/ + 4dB
@ 215Hz rof DI
Overall noise ferric NB out (CCIB/ABM) ref DI – 50 4dB
NR improvement Dolby B/C
Overall noise chrome NR out (CCIR/ARM) ref DL – 53.6dB
NR improvement Dolby B/C9.4/18.0dB
Overall noise metal NR out (CCIR/ARM) ref DL – 52.0dB
NR Improvement Dolby B/C
Modulation noise chrome broad/close ref
3kHz tone
Line input noise floor ref 160mV/DL (CCIR/ARM) – 78.4dB
Spooling time (C90)
Dynamic range terric/chrome/metal
Tapes used Sony AHE/Sony LICX-S/Sony Metal
Typical retail price
OVEDALL EDECIJENCY DESDONSES
- 20dB ref Dolby level





Sonv TC-FX1010

Sony (UK) Ltd, Pyrene House, Sunbury Crescent, Sunbury-on-Thames, Middlesex TW16 7AT. Tel Sunbury 87644



This new Sony deck is unusual in that despite its three heads, off tape monitoring is not possible, although the automatic tape settingup function and auto peak level attenuator do use all three heads for their operation. All controls on the front panel are touch sensitive from -56dB to 0dB in five seconds), and a balance control allowing four steps to swing to left or right. Phono line input and output sockets are provided on the rear panel, whilst a 1/4" stereo jack is provided for headphones on the front. There is a touch-operated stepped ganged level attenuator which affects line output levels (average at maximum but from a fairly high impedance) and headphone level (plenty of volume available). A pip tone button allows a pip to be heard whenever a function control is touched, so one can count pips to check on the degree of gain change for example.

Touch sensitive functions also include: Dolby off, *B* or *C*; MPX filter on/off; tape type (IEC types 1 to 4, with partly auto switching); auto tape calibration; auto attenuation (programme levels monitored by special replay head circuit which controls record level steps); status memory for four settings; write and check functions; timer record or play; counter reset and memory (the counter is superb, as on the TCK 555); eject, and deck transport

Ľ functions. The deck allows direct play into

wind and back, pause stopping and re-starting, and record muting. An MOL balance facility allows the overall response to be varied from +1 to -1 dB at 10 kHz after tape calibration. No microphone inputs are provided.

Metering is with fluorescent bargraph types, including the record level (which can go display, which indicates transients very accurately. If the pip tones are selected, the meters indicate over-recording with a pip and, if auto attenuate is also selected, will step down the record level appropriately. An indicator tells you if the replay level is nonlinear with record. Input attenuation is indicated in dBs digitally. All functions are indicated by LED displays. This deck has a very high audiophile guotient, even switching itself off when it gets bored with waiting!

The line inputs had average sensitivity, but input noise was only adequate for Dolby C. Replay azimuth was fairly accurate, head and quide heights reasonable. Replay amplifier distortion was satisfactory, but the clipping margin excellent. No replay hum was noted. but the 50Hz measurement was only fairly good, hum components probably being masked subjectively by the higher than average replay hiss which also added to the overall tape noise. Some of the hiss was probably microprocessor noise breakthrough.

Sony AHF ferric produced good low frequency MOLs but just adequate high frequency saturation, responses being much

flatter than average, and well extended (all charts are with MPX in). Overall noise was not too good, but Dolby improvements were good fortunately. Modulation noise charts were reasonable. With auto attenuation switched in. the entire programme sounded well, except for high frequency compression being slightly criticised. The auto-attenuation circuits coped with the high levels very well by attenuating them guite subtly, this action being barely audible. The Dolby C circuits were better than average.

Sony UCXS pseudochrome gave reasonable MOLs and saturations throughout, background noise being adequate, with good noise reduction improvements. Responses measured well, and modulation noise was low. The subjective sound quality was rated superb and very much liked.

Sony Metal gave very good MOLs and reasonable high frequency saturations. Responses were excellent without Dolby, but showed a slight presence hump with Dolby in. Overall noise was average here, with good Dolby improvements, whilst the subjective quality was again much liked throughout, showing metal performance to be very good but not quite superb.

Wow and flutter measured very well and none was heard on the normal programme material. Speed was extremely accurate but spooling slightly slow. Tensions were surprisingly steady.

This deck was very difficult to assess in the lab since the microprocessor operation of gain steps caused it to argue with our computer but it should not argue with you! It is so unconventional in ergonomics, that whilst we all liked it, you might not, so you must check this before you order one. I warmly recommend it as a best buy, but to sum up its remarkable features in this short review has been unusually difficult. Its overall sound quality was marvellous, and the microprocessor operations all worked well and reliably, particularly the auto attenuator/pip functions and excellent meters. A remote control socket and an AC mains outlet are included on the back panel. The review sample was an early 110V one; 240V models are usually better on noise performance and I hope this applies here.

GENERAL DATA Replay azimuth deviation from average..... Worst audible replay hum component..... - 68dB (150Hz) Replay noise ferric CCIR/ARM weighted (NR out). ... - 52.8dB Replay noise chrome position CCIR/ARM weighted (NR out)....-56.4dB Replay amp clipping ref DL + 17.1dB Wow and flutter average (peak weighted DIN).....0.08% Speed average.....-0.1%
 Meters under-read.
 .0dB on 8ms

 Overall 10kHz sat ferric L/R ref DL.
 - 8.5/ - 7.5dB
 Overall distortion ferric L/R for 5% dist+6.6/+6.6dB @ 315 Hz ref DL....+ 6.6/+ 6.6dB Overall 10kHz sat chrome position L/R ref DL....- 6.5/- 6dB Overall Dolby C 10kHz sat chrome position L/R - 4/ - 3.5dB ref DL.... Overall dist chrome position L/R for 5% dist Overall Dolby C 10kHz sat metal L/R ref DL.....+2/+3dB Overall distortion metal L/R for 5% dist+8.0/+8.0dB @ 315Hz ref DL.. Overall noise ferric NR out (CCIR/ARM) ref DL. - 48.0dB Modulation noise ferric broad/close ref 3kHz tone - 40/ - 34dB Modulation noise chrome broad/close ref - 40/ - 35dB 3kHz tone..... Line input noise floor ref 160mV/DL (CCIR/ARM)..... - 76.4dB Spooling time (C90).... .2m 04s Dynamic range ferric/chrome/metal......74/77/79dB Noise reduction system......Dolby B/C Tapes used......Sony AHF/Sony UCX-S/Sony Metal Typical retail price.....£360 **OVERALL FREQUENCY RESPONSES** - 20dB, ref Dolby level 20 Sony AHF

50 100 200 500 Sony UCXS, Dolby C in Sony Metal, Dolby C in

Harman (Audio) UK Ltd, Mill Street, Slough, Berks SL2 5DD

Teac V-80

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A fairly basic three-head deck, the V-80 uses a combination record/playback head which allows for off-tape monitoring. Only Dolby B noise reduction is included. Pushbuttons select Dolby on or off, ferric, pseudochrome or distortion was only fair, although the clipping metal tape types (no IEC numbers are marked), source or off-tape monitoring, tape memory on or off, line or mic inputs, counter mode importers, and low frequency MOLs and high-(numbers or elapsed time) and counter clear. A three-position switch selects remote mains timer start for play or record. The large rotary record level control is a friction-locked concentric type which is complemented by a miniature replay gain control. This also affects headphone levels, the 1/4" stereo jack supplying ample volume for all normal headphone types. The deck functions are touch sensitive types which allow transfer from play into wind and back, but will not allow dropping into record, the pause control only stopping play or record, not restarting. A record mute button is fitted. Cassette loading was simple but there were two rather sharp corners on the door.

The microphone inputs (1/4" mono jacks) had just adequate sensitivity but were quite quiet. The line inputs had average sensitivity, and low input noise, and no clipping problem was encountered. Output levels were average and from a fairly low impedance. Replay azimuth was fairly accurate, but the setting of the record head tape guide was not too accurate and so track alignment was slightly in error. Some 50 and 150Hz hum was noted on the right channel, which did not measure well, hiss levels also being a little high. Replay amplifier margin was excellent.

Sony BHF ferric was stipulated by the frequency saturations measured quite well for the tape type - but responses were well down at high frequencies. This was noted subjectively, distortion being rated good for a budget tape. Overall noise was not too good, but Dolby improvement was good. Maxell UD would have been better throughout but was not recommended by Teac. Modulation noise was guite good, but the measurement was upset by some tape judders which also affected other tests occasionally.

TDK SA was recommended for the pseudochrome tape position, but was clearly very muffled, so TDK SA-X was used instead. This gave good 315Hz MOLs, fair at 3.15kHz and reasonable 10kHz saturation. Overall noise measured reasonably, whilst responses were very poor when measured two-head (record. wind-back then replay), but better subjectively when monitored three-head. RF bias breakthrough into the record Dolby chip was suspected. Distortion was audibly quite good, but the presence valley was noticed! Modulation noise was reasonable.

TDK MA metal gave very good MOLs and saturations. Responses were reasonable without Dolby, but became irregular with Dolby B in (bias breakthrough again). Subjectively, though the overall response (heard three-head) was acceptable, and distortion was far better than usual throughout, receiving praise. Overall noise was average. A Dolby record calibration error of -1.1 dB was noted on the left channel.

Although wow and flutter measured well, a rather jerky forward tension produced occasional judders, particularly on Sony BHF, speed being very accurate though. Spooling time was average. Tensions showed some jerking throughout.

Assuming that the record bias breakthrough problem (which affected the Dolby-in pen charts) was peculiar to the review sample, and since this model could at best produce some very good overall quality it can be recommended as an inexpensive three head deck with some excellent metering. The meters only read up to 5dB above Dolby level, but with good discrimination, and reading transients accurately. I feel that Teac need to be a little bit more careful with alignment and bias throughout, and thus this machine misses a best buy.

CENEDAL DATA

Beneral Daria Replay azimuth deviation from average. 19° Line input sensitivity. 95mV Worst audible replay hum component. 6 1dB (150Hz) Replay noise ferric CCIR/ARM weighted (NR out) – 55.2dB Replay noise chrome position CCIR/ARM
weighted (NR out) -59.2dB Replay amp clipping ref DL +15.5dB Max replay level for DL 560mV Wow and flutter average (peak weighted DIN) 0.08% Speed average +0.2% Meters under-read. 0.08 on 8ms Overall 10kHz sat ferric 1 /R ref DI -71 - 5dB
Overall Dolby C 10kHz sat ferric L/R ref DL
@ 315 Hz ref DL+5.8/+6.0dB Overall 10kHz sat chrome position L/R ref DL+5.5/-2.5dB Overall Dolby C 10kHz sat chrome position L/R ref DL Overall dist chrome position L/R for 5% dist
@ 315Hz ref DL+ 6.8/+6.4dB Overall 10kHz sat metal L/R ref DL 1.5/-1dB Overall Dolby C 10kHz sat metal L/R ref DL Overall distortion metal L/B for 5% dist
(a) 315Hz ref DL
NR improvement Dolby B
Modulation noise chrome broad/close ref 3kHz tone
Spooling time (C90)
Tapes usedSony BHF/TDK SA-X/TDK MA Typical retail price£180
CVERALL FREQUENCY RESPONSES



TDK MA, Dolby B in
Technics RS-M216

National Panasonic (UK) Ltd 300-318 Bath Boad, Slough, Berks Tel Slough 34522



This budget two-head deck incorporates just simple facilities, with only Dolby B noise reduction. But it offers very good deck controls (solonoid operated) and is encased in metal. The rear panel has phonos for line input and output, the mains being lead is two-core attached. Metering is with moderately fast peak-reading fluorescent bargraph displays for each channel, with reasonable discrimination. The record level control is a large splitconcentric rotary, switchable to mic or line inputs. No replay gain control is provided, the 1/4" stereo headphone jack giving greatly excessive volume into low impedance headphones and too much even into high impedance ones.

Deck controls permit transfer from play into wind, with cueing, and the pause control stops and restarts both on playback and record. For recording, only the record button need be pressed which is unusual. The tape counter was rather crude and jammed several times during the tests. Cassette loading was simple and effective. The front panel also includes a normal, chrome and metal tape selector, which was poorly labelled, and a Dolby on/off switch.

Two 1/4" mono jack sockets are provided on the front panel for microphone inputs, and these proved reasonably sensitive and surprisingly quiet, the audio quality also being excellent here. The line inputs were slightly insensitive but input noise was minimal and no

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clipping problem was noted. Input and output impedances should present no problems and output levels were reasonable.

Replay head azimuth was fairly accurately set, but the head was slightly off its correct height and guides were also marginally in error. Replay amplifier noise measured adequately, with hum levels well down. Replay amplifier distortion and clipping margins were good and no problems were experienced in playing back pre-recorded cassettes.

TDK D tape was originally recommended by Technics for the ferric position, but proved to be over-biased and well down at high frequencies, so Maxell New UD was substituted. The 315Hz and 3.15kHz distortion plots were very good for the tape type, but 10kHz saturation measurement was poor showing the machine to be over-biased and over-equalised here. Overall noise measured extremely well with and without Dolby and modulation noise was adequate. The A/B levels were reasonably accurate and responses showed around a 1dB shelf up at high frequencies, with response curtailing rapidly above 15kHz (built in MPX filter). Low frequencies rolled off rapidly from 50Hz unfortunately. Stability was very good.

TDK SA pseudochrome was found rather muffled and so we substituted SA-X which showed a marginal drop in response around 2kHz, but otherwise was very flat, other than

some bass loss again with Dolby in or out. The 315Hz MOL was frankly very poor, although high frequency saturation was amazingly good - showing that the chrome position was under-biased and under-equalised. Overall noise and Dolby improvement were average A/B sensitivity was again correct for SA-X. High frequency stability was slightly poorer than average because of the under-biasing Modulation noise was better than average on SA-X.

TDK MA metal proved to have very poor MOLs at 315Hz, but very good high frequency. saturations, and so we suspect some slight head saturation as well as the tape being under-biased, Ironically, 3,15kHz MOLs were actually better than the 315Hz ones, thus proving our criticisms. Overall results on metal tape were audibly excellent provided a rather low recording levels were not exceeded - but dynamic range was thus only good rather than very good. Overall noise on metal was inherently only adequate anyway, but with good Dolby noise reduction. A/B saturation sensitivity being well matched. Responses with Dolby out were excellent and only a marginal presence valley was noted with Dolby in, apart from the same very low frequency loss as before

Wow and flutter measured very well indeed. especially for a budget deck, and speed was only marginally slow. Spooling times were average. Forward tension was slightly jerky and back tension a little variable but no actual problems were encountered in operation. No problems were noted with erasure or crosstalk.

Whilst either low or high frequencies on the various tape types were not too well optimised for distortion, this machine can give some surprisingly good flat responses overall and with the mechanics being basically good, this model is of reasonable value for money although it only includes Dolby B noise reduction. Helped by good meters and deck functions, it can be recommended in the budget class, but I do not really consider it as metal compatible because of its very poor low frequency MOL performance. What a pity that it misses Dolby C though, and the meters do encourage users to keep peak levels down.

Update

As this review went to press Technics announced a Dolby C version of the 216 designated the RS-M226 which sells for £110.

GENERAL DATA

Replay noise chrome position CCIR/ARM Speed average +0.7% Overall distortion ferric L/R for 5% dist+6.6/+6.2dB @ 315 Hz ref DI Overall 10kHz sat chrome position L/B ref DL.... -2/-25dB Overall Dolby C 10kHz sat chrome position L/R ref DL. Overall dist chrome position L/R for 5% dist @ 315Hz ref DL.....+5.0/+3.4dB Overall distortion metal L/R for 5% dist+3.6/+3.0dB @ 315Hz ref DI Overall noise ferric NR out (CCIR/ARM) ref DL. – 51.6dB Overall noise metal NR out (CCIR/ARM) ref DL..... – 50.6dB Modulation noise chrome broad/close ref

OVERALL FREQUENCY RESPONSES

Typical retail price.....£89



Cechnics RS-M260

National Panasonic (UK) Ltd, 300-318 Bath Road, Slough, Berks Tel Slough 34522



content. Three heads allow off-tape monitoring during recording with a button selecting source/tape: other buttons select mike/DIN or line input and Dolby in/out (MPX being permanently in). Deck functions do not permit direct transfer from record to wind etc., but going straight from play to wind allows cueing whilst wind remains depressed, the machine reverting to play when the wind button is released; a pause control stops and starts play/record functions. A record-mute button is provided together with a normal tape counter. A rotary switch selects ferric, ferrichrome, pseudo-chrome and metal tape types, and the friction-locked split concentric record level control was found easy to adjust. The replay gain control also varies headphone levels, the $\frac{1}{4}$ " stereo jack socket providing only just adequate volume into higher impedance models, but plenty into lower impedance 'phones with adequate clipping margins. Eighteen groups of triple LEDs on each channel give record level monitoring, and peaks were read very accurately; the circuits were better than those on the RS M250. but with the same useful type of peak holding capability.

The mike inputs on $\frac{1}{4}$ " mono jack sockets were fairly insensitive, although the clipping margin was reasonably adequate. Slight noise degradation was

This model is fairly similar to the RS M250, being noted via the 5-pole DIN socket, and the replay a front-loader using a metal case with plastics pins did not mute on record. The line inputs were quite sensitive, no clipping problem was noted, and input noise measured at an extremely low level which is excellent. The record and playback heads are in one housing, known as a combination type head. Replay azimuth was a little in error as delivered, the combination head had a very slight tilt on it, and the erase head guide was found marginally low. No replay hum problem was heard, but replay hiss levels were slightly worse than average. despite showing a good Dolby improvement. The replay amplifier distortion measurement at +6dB was fairly good, but the clipping margin was only adequate for a three-head deck (although only metal tapes recorded at a very high level in other decks might have been on the verge of clipping).

> Maxell UDXLI ferric gave extremely good MOLs at 333Hz, and 10kHz saturation measurements were satisfactory, so results were clearly even better than those on the RS M250. The pen charts were reasonably flat overall and actually sounded very flat to the panel, the sound quality being considered very good throughout and decidedly better than average, though the marginal EHF rolloff was just noted. Overall weighted noise measurements were rather average, though certainly acceptable and with a good Dolby improvement. Stability and stereo positioning were good

but not perfect.

In contrast UDXLII gave only just adequate 333Hz MOLs but good HF saturation measurements (the 333Hz MOLs should ideally have been about 2.5dB better). The panel criticised distortion as being poor, although the HF end was clean. Overall responses were reasonable on other tapes, and we felt it was such a pity that the machine could not have been a little better on distortion. Overall noise measured quite well, again with a good Dolby improvement, but if this sample is typical we cannot recommend pseudochrome on this deck.

The original review sample gave very poor MOLs on UDXLII and on TDK MA, but a second sample was provided from normal stock which was rather better with both these tapes (results shown for second sample). MA gave a good overall sound quality with a flat overall response but could not quite take the high levels it should have done; MOLs fell short by perhaps 2dB although HF saturation was excellent. Overall noise was average for metal.

Wow and flutter measurements were very good, and only very marginal wow was detected on programme which is a very satisfactory result. Speed was extremely accurately set, and spooling time was average. Play/record torque was just slightly high, although spooling torque was very satisfactory and erasure, even on metal, was very good.

The fact that this deck is a three-head model with excellent metering, plus the achievement of excellent quality on UDXLI (also acceptable on UDXLII and TDK MA) allows it to be rated as a best buy, as it did not really have any serious problems. We did like its ergonomics and one soon gets used to the slightly limited deck functions (the pause control being a plus point). This deck is only $\pounds 20$ more than the RS M250, and most certainly is very good value for money. Happily Technics were very efficient in supplying a second sample, which was clearly better and presumably more typical than the original one assessed (which we discovered had actually been a prototype production model, rushed to the U.K. for photographic purposes).

GENERAL DAT

ENERAL DATA
eplay azimuth deviation from average ., ,
ike input sensitivity/clipping 295uV/32mV
ine input sensitivity/clipping
eplay response ferric 63Hz av L/R +0.4dE
orst audible replay hum component63dB (150Hz)
eplay noise ferric CCIR/ARM weighted (Dolby out)56.5dB
olby improvement
eplay noise chrome position CCIR/ARM weighted (Dolby out)60.3dE
olby improvement
eplay amp clipping ref DL+11.7dB
ax replay level for DL
ow and flutter average (peak weighted DIN)
beed average0.1%
eters under-read:
verall 10kHz sat ferric L/R ref DL6.7/-7.6dB
verall distortion ferric L/R for 5% dist @ 333Hz ref DL +7.5/+7.5dB
verall 10kHz sat chrome position L/R ref DL5.4/-5.6dB
verall dist chrome position L/R for 5% dist @ 333Hz ref DL. +4.0/+4.2dB
verall 10kHz sat metal L/R ref DL0/-0.2dB
verall distortion metal L/R for 5% dist@ 333Hz ref DL +6.3/+6.5dB
verall noise ferric L/R Dolby out(CCIR/ARM) ref DL49.8/-50.3dB
olby improvement 9.9dB
verall noise chrome L/R Dolby out(CCIR/ARM) ref DL53.3/-53.8dB
olby improvement
verall noise metal L/R Dolby out (CCIR/ARM) ref DL51.5/-52.2dB
olby improvement
ne input noise floor ref 160mV/DL (CCIR/ARM)81.0dB
pooling time (C90)
vnamic range ferric/chrome/metal
oise reduction system
apes used
reign retail price



Overall frequency responses (-23dB, Dolby in)

echnics RS-M275XC

National Panasonic (IJK) Ltd 300-318 Bath Boad, Slough, Berks Tel Slough 34522



Technics have a foot in both noise reduction camps with their new model since it includes dbx. Dolby B and Dolby C noise reduction systems, making comparisons fascinating. The review sample was a 110V early production one rushed from Japan to me almost at the last minute. Phono line in/out sockets are mounted on the rear, whilst a 1/4" stereo headphone jack is found on the front. the miniature ganged replay gain control also adjusting headphone volume (there is plenty of gain for low impedance headphones, but adequate volume only for high impedance ones).

The friction-locked record level control employs a lever for one of the channels, which we thought guite good. A five-position switch selects noise reduction off. Dolby B or C, or dbx, this being usable also for taping dbx discs. A centre-indented miniature bias pot complements the completely automatic internal bias and equalisation switching for different cassette tape types (not for slightly exaggerated by Dolby C, and greatly so ferrichrome though).

counter mode (elapsed time or numbers) and music programme search, intro-search, and counter reset. A remote record or play timerstart facility is provided.

The fluorescent bargraph metering underread very fast transients only slightly, but the discrimination was only fair.

The microphone inputs (1/4" mono jack sockets) were reasonably sensitive and quiet. the line inputs also being guite sensitive with reasonable input noise on the left channel, but some microprocessor 'hash' being introduced on the right above intermediate input level settings. There was no clipping problem.

Replay azimuth was a little inaccurately set. but head and guide heights guite reasonable. Marginal hum was noted on the right replay track but replay hiss measurements were very good. Replay amp distortion measurements were acceptable, but with the clipping margin excellent.

Maxell UDXLIS ferric gave excellent low frequency MOLs. The left high frequency saturation result was only adequate, whilst the right channel was fairly good. The left channel was in fact slightly over-biased internally. which caused the response to be slightly down under all conditions, whilst the right was good. The left-to-right response imbalance was by dbx. Overall noise was fair without noise Pushbuttons control memory repeat, reduction, very good indeed and more than enough with Dolby C, and amazing with dbx (in the absence of programme!). Modulation noise was average without dbx, but with dbx subjectively bad. Sound quality throughout was very strongly criticised when using dbx, which produced bad noise modulation including breathing, considered worse than

any other noise reduction system. However, distortion was generally rated very good indeed. dbx effectively allowing higher recording levels - though high frequency saturations were no better

TDK SA pseudochrome gave reasonable low frequency MOLs and again high frequency saturation on the left was only fair, but better on the right. Noise measured reasonably, all noise reduction systems giving appropriate over improvements. Responses without noise Over reduction were good on the left, but up at high frequencies on the right, but responses with Ove Dolby C showed presence humps, the reproduced sound appearing to be a little unbalanced with high frequency transients pulling slightly to the right. Distortion at high levels was criticised, but was very good up to reasonable levels, with modulation noise being better than average.

TDK MA metal produced only fairly good low frequency MOLs (metal should be better), whilst high frequency saturations were good. The left channel had a problem somewhere. 3.15kHz MOL being poor, with evidence of record amplifier current clipping at high frequencies, which was puzzling. Overall responses were good without noise reduction. but rather strange with Dolby C and with dbx. the latter as usual greatly emphasising errors. particularly at low frequencies, with a severe very low frequency cut. Overall noise measurements were all satisfactory. Overall sound quality was at least good throughout, being very like that of the master tape at best with Dolby C, the Dolby C circuits being slightly better than usual.

Wow and flutter measured extremely well. and speed was accurate. Spooling time was average, tape tensions varying slowly although creating no problem, slight residual tension being provided on stop. The inclusion of dbx and Dolby C seems a rather odd marketing experiment, and the price is correspondingly rather high, although the ergonomics were liked, and the performance with Dolby C could be really excellent. The full dbx noise reduction was limited on the right channel because of input noise. We suspect a faulty record head on this early sample.

We all disliked dbx intensely but if you really must have it then this deck is well worth trying. and comparing dbx with Dolby C is fascinating if judged fairly. You may not be worried about dynamics pumping, breathing and exaggerated response anomalies, and so the deck receives a recommendation but cannot be a best buy. You must make up your own mind though about *dbx*. Our view is that once you have heard the problem it will always be there for you!

GEN Rep

GENERAL DATA Replay azimuth deviation from average. 26° Line input sensitivity. 85mV Worst audible replay hum component. -61dB (150H2) Replay noise ferric CCIR/ARM weighted (NR out). -59.0dB Replay noise ferric CCIR/ARM -62.0dB Max replay level for DL. -62.0dB Max replay level for DL. -60.0dB Wow and flutter average (peak weighted DIN). .006% Speed average. -0.1% Meters under-read. .018 Bon 8ms Overall Dolby C 10kHz sat ferric L/R ref DL. -7.5/ - 5.5dB Overall Dolby C 10kHz sat ferric L/R ref DL. -7.5/ - 5.5dB Overall Dolby C 10kHz sat chrome position L/R ref DL. -7.5/ - 5.5dB Overall Dolby C 10kHz sat chrome position L/R ref DL. -7.5/ - 5.5dB Overall Dolby C 10kHz sat metal L/R ref DL. -1.5dB Overall dist chrome position L/R for 5% dist @ 315Hz ref DL. -1.5dB Overall Dolby C 10kHz sat metal L/R ref DL. -1.5/ - 0.5dB Overall Dolby C 10kHz sat metal L/R ref DL. -2.5/ + 5dB Overall dist chrome NR out (CCIR/ARM) ref DL. -52.6dB NR improvement Dolby B/C/dbx -8/17.0/29.2dB Overall noise feric NR out (CCIR/ARM) ref
- 20dB, ref Dolby level
R
•
10:08
20 50 100 200 500 1k 2k 5k 10k 20k
Maxell UDXL I
TDK SA







CASSETTE TAPES

Hi-Fi Choice re-assessed cassette tapes as part of issue No. 29 to give the reader some idea of the differences between brands and to enable him/her to choose the tape best suited for a cassette deck. The summaries of Angus McKenzie's comprehensivetestson over60 tapes are printed below for quick reference but some additional explanation seems in order.

The tapes are now grouped as follows with Group 1 including all tapes intended for use in the ferric or 120 us equalisation position, Group 2 includesall chrome or pseudo-chrome formulations, Group 3 was to include the ever decreasing population of ferrichrome tapes but the one tape which gave acceptable sound (Denon DX5) suffered unacceptable print-through. Group 4 covers the metal tapes. It may be that you know of cheaper tapes which are not included in this survey but our experience has been that these tapes are an expensive waste of time suffering from problems like shedding of the magnetic coating or jamming. These tapes should not be confused with the better'own brand' tapes from companies likeWoolworths, Dixonsor Boots why buy from well-known manufacturers but have their own name on the product.

Cassette tape types

The first tapes used ferric oxide coating and were designed to play-back with 120 us equalisation, marked on most machines as normal, ferric or position I equalisation setting. Tapes made from chromium dioxide were introduced about ten years ago in an attempt to improve the high frequency performance; international agreement was secured for 70 us equalisation playback for these tapes. Chrome tapes were both difficult to produce and suffered from poor maximum level potential in the mid and low frequencies. Improved formulations have been marketed HDX and (Agfa's Superchrome BASF's chromdioxid Super II). Though chrome tapes often have quieterbackground than the pseudochromes their Maximum Operating level (MOL) is usually rather poor at one point or another. However chromium dioxide formulations are making a come back.

Experiments were made with ferric tapes for use in the chrome position to get the best of chrome performance with the ease of ferric tape manufacture. These pseudo-chromes can be more sensitive in the mid frequencies than chrome tape and have a high frequency response roughly equal to that achieved with the superchromes. All modern decks are now aligned for these tapes during manufacture but many older machines cannot either supply the extra bias required or their tape heads saturate.

The Group 3 tapes are dual layer tapes called ferrichromes, but market research suggests that they now only form a rapidly shrinking part of the tape market. These tapes were originally intended to be used with a bias between ferric and chrome bias but deck manufacturers, rather than offer an additional bias position, began to suggest that ferric bias and chrome equalisation would work. Invariably it didn't! Many decks now have no ferrichrome or position III setting.

Pure metal or metal alloy tapes were first introduced onto the UK market during 1979 but were only available in small quantities and at high prices, not to mention short lengths. There are still many modern decks which are called metal compatible but turn in better performance with pseudo-chrome tape because they are incapable of recording the very high levels necessary to benefit from metal formulation. An improved high frequency response from your machine with metal tape may be compromised by worse low frequency performance. The advent of Dolby C has improved the high frequency performance of normal tapes and dropped hiss levels by dB over Dolby B so the necessity for metal tapes is somewhat reduced. The most up-to-date metal compatible machines with Dolby C give truly excellent results now with suitable Group 4 tape.

What is bias?

The audio signal exists in a record tape head as a modulated current. Forthiscurrent to magnetise the tape with minimum distortion it is necessary to pass a supersonic current through the head at between 75 and 150kHz; this is known as RF (radio frequency) bias, or more simply as bias.

As bias is increased an optimum setting is reached for low distortion. first at high frequencies then, as bias is further increased, at lower frequencies. If the tape is optimised for quite lowfrequencies(333Hz standardfrequency) then the high frequencies (typically measured at 10kHz) become degraded. Immediately you can see that setting bias is a compromise between acceptable low and mid frequency performance and low distortion and a good response at high frequencies.

Where does equalisation come in?

Equalisation refers to the cutting or boosting of certain frequencies by the amplifier circuits in the cassette

deck both during record and replay. This is done to obtain a flat frequency response from the tape in use. For reasons of technical convenience the equalisation curve is referred to by a time constant (ferric EQ -70 us).

us). Variable bias and EQ can be used further to optimise the tape's response though most decks are fitted with switchable fixed-value bias and EQ.

Notes on using the comparison table

The old groups 1A and 1B have now been condensed to group 1, IEC I reference tape being regarded as standard throughout and performance generally relating to the com-parison with IEC I. Thus 'std' (standard) refers to a tape which is basically IEC I compatible in the relevant parameter. Many words are used to describe degrees of quality, the basic order being superb, excellent, very good, good, fairly good or quite good, average, fair, fairly poor, poor, very poor and bad. It will be seen that several tapes from the last edition have different adjectives this time. Although this is sometime due to product changes, it may also be due to a stricter appraisal of mechanics. Modern cassette decks are usually biased near the relevant IEC standard. Tapes having a bias requirement called 'low' will usually show a muffled quality on modern decks, although they may be satisfactory on older models, particularly those of European manufacture.

Maxell UDXLII used to be used as a reference for Group 2, for all parameters. This has now been changed to the new IEC II reference tape type from BASF. This tape has a lower sensitivity than almost all pseudochromes but is nevertheless used as reference also for 315Hz sensitivity. Noise levels are quoted to the same relative standard as Group 1. Please note that Group 3 tapes are omitted from these tables, since they are not recommended for one reason or another, as an entire group, and also omitted are several older and unsatisfactory tape types from other groups.

Group 4 metal tapes are all judged against the latest samples of TDK MA, chosen recently as IEC IV reference, but with the noise columns assessed in comparison with Groups 1 and 2. 315Hz MOL, 3.15kHz MOL and HF saturation have now been made relative also to groups 1 and 2, whereas bias, sensitivity and response are referred to TDK MA. All mechanical properties mentioned throughout the tables are relative and may be compared directly.

OVERALL COMPARISON CHART: CASSETTE TAPES

		Bias	MF sensitivity	HF response (ref bias)	315Hz MOI	3.15kHz MOI	10kHz saturation	Stability	Wow and	Back- ground noise	Print- through	Mod. noise	Mechan- ical ouality	Recom- mendation*	Typical price* (C90)
GROUP 1				(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,											()
Agfa Fel	C60	low	standard	down	f. good	good	good	fair	fair	average	excellent	f. poor			
Agta Fel-S	C60	sl. high	low	up	good	v. good	v. good	poor	poor	low	v. poor	average	-	_	
BASF LH Extra I		low	standard	down	v. good	v. good	v. good	average	good	f. high	good	average	good	yes	_
BASF LH Super I		sl. high	standard	up	excellent	excellent	v. good	v. good	fair	high	poor	f. good	v. good	yes	
Denon DXI		low	standard	down	f. good	_	f. good	good	good	f. high	f. good	-	fair		
Denon DX3		low	standard	v. down	good	_	f. good	good	good	average	fair		fair		_
Fuji FL		low	low	down	fair	-	f. good	good	good	average	excellent	-	good	-	_
Fuji FX1		standard	sl. low	flat	good	-	good	good	good	f. low	v. good	-	good		£1.97
Fuji FR1		standard	standard	flat	excellent	excellent	v. good	good	-	average	fair	average	good	yes	
Hitachi LN		low	v. low	down	f. poor	_	f. good	good	good	f. high	v. good	_	good	_	-
Hitachi UD		standard	sl. low	flat	v. good	v. good	v. good	good	excellent	f. low	f. good	average	v. good	yes	
Hitachi ER		standard	standard	sl. down	v. good	_	good +	v. good	v. good	average	good		v. good	yes	
Hitach SR		sl. high	sl. high	up	excll.+	excll. +	v. good +	v. good	excellent	f. high	f. good	f. good	v. good	yes	-
Marantz MF1		low	standard	v. down	good +	good	good	good	f. poor	f. high	v. good	fair	fair		
Maxell UL		low	v. low	down	f. poor	-	f. good	good	good	f. high	v. good		good		£1.10
Maxell UD		standard	sl. low	flat	v. good	v. good	v. good	good	excellent	f. low	f. good	average	v. good	yes	£1.54
Maxell UDXLI		standard	standard	sl. down	v. good		good +	v. good	v. good	average	good		v. good	yes	£1.90
Maxell XLIS		sl. high	sl. high	up	excll. +	excll.+	v. good +	v. good	excellent	f. high	f. good	f. good	v. good	yes	£2.35
Mernarex MRXI		sl low	standard	down	v. good	good	good +	average	fair	average	v. good	f. poor	average	-	-
Philips Ferro		v. low	v. low	v. down	poor	f. good	fair	poor	fair	average	excellent	f. poor	average	-	-
Philips Ultra-Ferro		low	standard	down	v. good	v. good	v. good	good	f. poor	f. high	v. good	average	fair	-	-
Plonær N1		standard	v. low	flat	fair	good	good	good	v. good	average	v. good +	fair	fair	-	_
Plonser N2		sl. low	low	sl. down	good	v. good	good	good	excellent	f. low	fair	fair	good		-
Scotch Master I		standard	standard	flat	excellent	v. good +	v. good	good	good	high	fair		good	-	-
Sony BHF		sl. low	standard	down	good	v. good	v. good	good	-	f. high	excellent	fair	good	yes	£1.33
Sony AHF		standard	standard	flat	v. good	excellent	v. good	good	good	f. high	good	fair	good	-	£1.56
TDK D		standard	sl. low	sl. down	f. good	good	good	v. good	good	f. high	v. good	f. good	v. good	yes	99p
TDK AD		standard	sl. low	flat	good	v. good +	v. good	good	average	low	fair	f. poor	v. good	yes	£1.39 •
TDK ADX		standard	standard	flat	excellent	excellent	v. good	good	-	f. low	fair	f. poor	v. good	yes	

GROUP 2

Agta Crll		standard	sl. low	flat	golid	fair	fair	fair	v. good	ex. low	poor	f. good			
Agfa Crll-S		high	sl. high	up	v. good	fair	f. good	poor	good +	ex. low	poor	good +		-	-
BASF CRII		standard	standard	flat	good	f. good	f. good	v. good	v. good	v. Iow	fair	good	good		£2.25
BASF CR Super II		standard	high	sl. up	excellent	fair	good	good	excellent	ex. low	poor	good	good	yes	-
Denon DX7		standard	sl. high	flat	good	-	f. good	good	good	v. low	-	-	fair	-	£2.09
Fuji FXII		standard	sl. hign	sl. up	good	-	good	good +	good +	low	good		good	-	£2.09
Fuji FRII		sl. low	high	sl. down	v. good	good	good	good	-	low	f. good	average	v. good	yes	
Hitachi EX		standard	sl. high	flat	good	f. good +	good	v. good	v. good	low	good	-	v. good	yes	-
Hitachi SX		standard -	- high	sl. up	v. good	good	v. good	v. good	excellent	low	f. good	average	v. good	yes	-
Marantz MC2		low	sl. high	down	v. good	fair	f. good	average	-	v. low	poor	average		-	-
Maxeli UDXLII		standard	sl. high	flat	good	f. good +	good	v. good	v. good	low	good	-	v. good	yes	£2.00
Maxeli XLIIS		standard +	· high	sl. up	v. good	good	v. good	v. good	excellent	low	f. good	average	v. good	yes	£2.40
Memorex High Bias II		standard	standard	flat	fair	f. good	good +	good		v. low	f. poor	fair			£2.00
Phillips Ultra Chrome		low	standard +	down	v. good*	fair	f. good -	average	good	ex. low	poor	average +	good	-	
Pioneer Cl		standard	sl. high	flat	good	f. good +	good	v. good	v. good	v. low	f. poor	average	v. good		_
Scotch Master II		sl. low	high	down	v. good	f. good	good	v. good		v. low	fair				-
Sony CD Alpha		standard	sl. high	flat	9000 +	-	good	average +	good	v. low	v. good		v. good		£2.13
Sony UCX-S		standard	v. high	flat	excellent	good	good	v. good	excellent	low	v. good	f. good	good	yes	£2.85
TDX SA		sl. low	high	sl. down	good	good	good	v. good	v. good	low	fair	f. good	v. good	yes	£1.69
TDK SA-X		standard +	v. high	up	v. good	good	excellent	v. good	v. good	low	fair	f. good	v. good	yes	£2.76
GROUP 4															
Agfa Metal	C60	standard	standard	flat	excellent	excellent	excll. +	poor	-	low	excellent				-
BASF Metal IV		low	standard	down	excellent	good	excll. +	fair		low	excellent	f. good	-		
Denon DX-M		sl. Iow	standard	sl. down	excellent	good	superb	average	good	low	excellent		v. good	yes	
Fuji Metal		sl. low	standard	flat	excellent		superb	average	good	low	excellent		good +	-	£3.89
Hitachi ME		standard	sl. high	flat –	superb+	excll. +	superb+	v. good	good	average	excellent	-	v. good	yes	
Maxell MX		standard	sl. high	flat –	superb+	excll. +	superb+	v. good	good	average	excellent		v. good	yes	£3.70
Memorex Metal IV		standard	standard	flat	superb	excellent	superb+	good		f. low	excellent	fair			
Philips Metal		standard	standard	flat	excellent	excellent	superb +	poor	-	low	excellent		-	_	
Ploneer M1	C60	sl. low	standard	sl. down	excellent	v. good +	superb	average	v. good	f. low	excellent	fair	v. good	-	
Scotch Metafine		low	high	down	superb	excll. +	superb +	good**	_	low	excellent				
Sony Metal		sl. low	standard	flat	excellent	-	superb	good	good	low	excellent		good	-	£3.69
TDK MA		standard	standard	flat	excll. +	excellent	superb	good	good	low	excellent		v. good	yes	£3.90
TDK MA-R		standard	standard	flat	excll. +	excellent	superb	good	good	low	excellent	-	v. good	-	

*Recommendations must be taken in the context of the reviews, and as explained in the text other tapes may be worth considering. Prices are for C90s, quoted where obtainable as we went to press, and should be taken only as a rough guide. **See text.





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HEADPHONES

Headphones, like loudspeakers and pickup cartridges are transducers, which means that they are devices which convert electrical energy into mechanical vibrational energy that couples to the human ear and is perceived as sound. Unlike loudspeakers, headphones do not have the volume of air of a room in which to work but this means that they require less energy to drive the small volume of air in the ear cavity.

Comfort

As headphones are probably the only item of consumer electronics that are worn about the person, comfort is a big deciding factor in their choice and purchase. The major division is between those' phones which rest on the pinnae (the 'flaps') of the ear and those which go around the ear to rest against the side of the head. The two types are described as being supraaural (sitting on the ear) and Circumaural (going around the ear). These two designs closely correlate with the open backed or dynamic type headphone and the closed back type respectively. The two types of 'phone are rated differently for user comfort depending greatly upon whether the user minds or indeed likes the greater isolation and 'closed in' feel of the circum-aural type. This effect is quite apart from the general comfort of the 'phone as afforded by its padding and the 'clamp' of the headband.

Sealed or not

The open-back 'phone does not cut down sound from the outside environment to any great extent, and when driven, sound will 'spill over' from this type of 'phone to the outside. The benefit of this type of headphone is that they don't produce the shut-in' ear-claustrophobia that puts many people against headphones in general. Closed back 'phones are good at shutting out noise from the listener and this may be a big point in their favour if you wish to use headphones while others in the room are for example watching TV. The other theoretical benefit of closed 'phones is that they couple better to the ear at low frequencies and some listeners prefer the quality of bass that they produce.

Driver design

Headphones have been designed around a surprising number of different transducer principle, including the electrostatic, electret, thin-film magnet and conventional moving coil driver types. The moving coil driver is much the same as those used in loudspeakers where a current-carrying coil is free to move in the gap in a magnet and as the current changes the coil oscillates in the gap at the required frequency, driving the air in front and behind the diaphragm to which it is attached.

The electrostatic'phone is perhaps the second most common type after the moving coil. Here a thin electrically conductive diapragm has the audio signal electrically modulated on to it to cause it to be alternatively attracted and repelled by the highly charged electrodes between which it is placed. The electrodes are perforated to let the sound of the vibrating diaphragm through into the ear. These headphones require an energiser box which provides the necessary high voltage to polarise the electrodes don't worry the currents involved are minute and so such phones pose no danger to life). These energisers are run off the loudspeaker terminals of the amplifier and are always provided with duplicate loudspeaker terminals to enable the phones and speakers to be switched between, though it is better if you can run the energiser off a second set of outlets and not attach speakers to your system through extra connections. You may decide it is more convenient to have the switching at the headphone box however.

Plugging in

The various types of drivers used in headphones, bar those used via the loudspeaker terminals and an energiser, are all suited to be connected to the 300 ohm standard socket fitted to most amplifiers. The low impedance designs can however be run off the loudspeaker sockets but in order that the listener is not deafened the amp must be used with the volume right down. The problem then is the residual noise of the amp coupled with the difficulty in adjusting the volume. To overcome this problem a stepdown series resistor is introduced to step down the power of the amp. This is the origin and functioning of the standard amp headphone socket.

The observation can be made that most headphones work well with most amps but this is why it is important for you to check out the 'phones you intend to buy on a sample of the amp or tape deck you use at home your's may be the exception to the general rule. The result would not be catastrophy but more likely limited maximum volume or high levels of distortion. Some tape recorders however cannot provide sufficient power to drive the less sensitive (and the less well matched) designs and if it appears that such problems would arise in use then our reviews will comment on that aspect of performance.

How do they sound?

It has to be faced that some headphones will not perform properly on some heads, particularly closed back

designs relying heavily on good coupling to the skull around the ear to provide their bass. This also means that it is sometimes very difficult to measure headphones correctly and to be certain that they have coupled properly to the dummy ear mic-rophone used for test. The headphone reviews in this issue are from two different periods of Choice measurements and each uses a different combination of reviewing instruments. The older reviews use a B&K artificial ear and a Neumann dummy head rig while the more recent results are taken from improved measuring techniques achieved with a damped felt plate coupler with a 12mm capsule mike instead of the dummy ear and the reviewer's own head in place of the Neumann. For the latter measurements a tiny 3mm probe mike was used at the entrance to the ear canal after calibrating the technique by measuring a sample of six different ears. So beware the differences when comparing reviews. The 'ideal' response plot shown on the graphs were developed from this work and this dotted 'ideal' curve gives a close of approximation to the perceived flat frequency response. The closer the real curves fall to this ideal the more netural the headphones will sound.

The listening test part of the reviews is taken from the aggregate comments of a group of listeners to 'average out' the effects that one head may have on one type of 'phone.

Choosing headphones

Taste is a bigger factor in headphone choice than in the choice of any other piece of hi-fi equipment. Shortlisting headphones is the first point. What do you want headphones to be able to do? How loud do you want them to go? How much isolation need they offer from external noise? If you know you will be bothered by closed phones, or know that you specifically want closed 'phones for their bass quality, then such information will help you draw up a shortlist of products.

The next stage is to get 'hands on' experience of the headphones. Comfort is the most important aspect; check that the headband is suitably padded and that there is a sufficient side pressure to hold the headphones against *your* head without them slipping, but equally without them pinching.

Finally, you must try driving the 'phones on equipment similar to your own to check that they will reach the levels you require and that their colouration is acceptable. It is also worth remembering that what is acceptable to one listener may not be suitable for another.

AUTHORITY

Each issue of *Hi-Fi Choice* is authored from cover to cover by an expert audio technician. Usually one of international



repute. And that particular edition is 'his baby'. His name is on the spine. His reputation is on the line. This approach gives Hi-Fi Choice its unparalleled authority Each issue

CARTRIDGES & HEADPHONES Over 90 cartridges tested. Headphone reviews offer 'dummy head' A MAJOY measurements plus listening tests.

represents project for the author requiring hundreds

of man hours of labour combined with a lifetime's experience.

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Every model reviewed in *Hi-Fi* Choice is exhaustively tested. Tested in the laboratory, of course, using computerised state-of-the-art equipment. But tested, just asimportantly, by a listening panel under



TURNTABLES & TONEARMS Covers some 90 'super-fi' turntables and arms, linear-tracking decks and conventional players



the supervision of the author. Comparative testing of audio equipment can never be

> benchtest results. In the last analysis, hi-fi is as much about 'feel' as anything. The listening panel



I FI CHOIC

AMPLIFIERS Budget favourites to American 'monsters', and all the important British designs. - 60 Act - 14 Sell - 14 Sell - 16 Sell - 16 Sell - 17 Sell - 5 - 620

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plays a vital part in coming to a synthesis of balanced conclusions.

CONSISTENCY

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All models tested in any one

issue of Hi-Fi Choice undergo a series of controlled, consistent laboratory, mechanical and listening panel evaluations.

It is the consistency of test conditions which give real meaning to our final recommendations both in a technical sense and in



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our straight forward buying advice to the consumer.

FORMAT

Each issue of *Hi-Fi Choice* carries full test reports on an average of 70 or more models in a single product category. More than any other hi-fi publication in the world.

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Audio-Technica 0.5

Audio-Technica (UK) Ltd. Hunslet Trading Estate Low Boad Leeds Tel (0532) 771441



Audio-Technica 0.3

Next up in the AT 'Point' series is the 0.3. Here sensitivity was rather better than for the 0.1 at a high 103dB, this achieved with a higher 43ohm impedance. Capable of decent midband sound levels the 0.3 nonetheless gave high distortion when driven hard at low frequencies. The bass rolloff meant that a 90dB level at 40Hz resulted in 12.0% distortion, though at 1kHz the 0.1% measured was fine. The frequency response was not unpromising above 600Hz, but it showed a prematurely humped lower midrange centred on 250Hz. falling off at 9db/octave below 200Hz. Consequently the 40Hz point was nearly 16dB below the reference level.

Placed 'below average' on audition, the sound was fairly good in absolute coloration terms, but was both dulled and mid-dominant, with a chesty, thickened effect. Real bass was notable by its absence, which was felt to be a serious problem. Taken overall, the 0.3 could not be recommended.

Audio-Technica 0.5

Finally we have the 0.5, the most expensive model. This offers the same sensitivity and impedance as the 0.3, and high sound levels were possible though with significant distortion at low frequencies - for example, 13% at 40Hz. However 0.1% measured at 1kHz distortion over the rest of the range was comparatively good. Frequency response was Frequency response, IEC artificial ear (AT 0.5)

notably improved compared to the 0.3, with more upper-midrange energy and minimal mid emphasis or 'humping', although it did roll off early at low frequencies - being, for example - 12dB at 40Hz.

Auditioning placed the 0.5 in the 'average' class; in numerical terms it rated slightly above the 0.1. The sound was notably deficient in bass but at least it was free of chestiness or boom. Slight nasal coloration was heard, but otherwise the effect was open with good treble detail and clarity A reasonably good headphone, but one which does not set any new standards for value.

GENERAL DATA: AT 0.3

Frequency response 100Hz-5kHz, rel, 500Hz
(deviation from mean curve) + 4dB, - 4dB
Frequency response overall within ± 5dB
(deviation from mean curve)
Impedance
Sensitivity for 2.83V (via 330 ohms for jack) at
500Hz; (equivalent to 1 watt/8 ohms) 103dBlin/101dBA

Connection and lead length
Weight and comfort
Typemoving coil, supra-aural, open
Sound insulationlittle
Loudnessaverage
Subjective qualitybelow average
Price (typical, inc. VAT) £18 when reviewed, now £16.50

GENERAL DATA: AT 0.5

	Frequency	response	100Hz-5kHz,	rel. 500Hz
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Audio-Technica ATH7 and ATH8

Audio-Technica (UK) Ltd. Hunslet Trading Estate Low Boad, Leeds Tel (0532) 771441



These elegant electrostatic headphones are supplied with a drive box which needs connection to amplifier speaker terminals: bypass loudspeaker switching is also provided. Of moderate weight they nevertheless proved comfortable with extended use, while the quality of construction and finish was very high. Using electret film diaphragms, these 'phones were sensitive and could be driven to very high sound levels. The bass reproduction was particularly powerful, which is most unusual for an electrostatic design, as premature rattles are often encountered. An overload warning light was provided to prevent 'phone and listener ear damage. Of supra-aural fit, they were open-backed and provided negligible sound isolation.

The frequency responses demonstrated exceptional correlation with the trend envelopes. The midrange was uniform with the bass well extended and free of the all too commonly encountered hump, while the high frequencies were smooth. well maintained and extended, with good output to 20kHz. Subjectively the ATH-7 did not do quite as well as these measurements might have indicated: for example, the sound was not as 'open' as for the Stax models. On the other hand, their smoothness, clarity and high resolution of detail were much appreciated as was the fine bass depth and power. Stereo imagery was also to a high standard.

On the basis of its overall quality the ATH-7 may be recommended. The slightly more expensive ATH-8 was also tested and found to be very similar if sounding a touch more 'open'. At some f60.00 extra this comes with a more elaborate 'box' with power indicators and can also be recommended

GENERAL DATA

Frequency response 100Hz-5kHz, rel 500Hz _(deviation from mean curve)+1dB, -1dB									
Frequency response overall within ±5dB (deviation from mean curve) 20Hz to 20kHz									
Impec	lance								ohms
Sensit	ivity fo	r 2.83V	/ (via 330) ohms	for Jac	k) at			
_ 500	Hz; (ed	quivaler	nt to 1 wa	att/8 of	nms)		1090	Blin/107	dBA
Woigh	ection a	nd lead	i iength.				amplifie	er leads,	2.5 m
Type.	it and t	.onnort			electre	et conde	nser sun	ra-aural	open
Sound	insulat	tion							none
Loudr	ess							very	good
Subje	ctive qu	ality							good
Price	(typical	, inc V	AT)						£70
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20	Hz 5	0 10	200	50	00 1	< 2k	5k	10k	20k
Frequ	iency i	respon	se IEC	artific	ial ear	, 'idea	l' envelo	pe dash	ed



Frequency response real ear, 'ideal' envelope dashed

REVISED AND REPRINTED

Bang & Olufsen (UK) Ltd, Eastbrook Road, Gloucester GL4 7DE Tel (0452) 21591



These unusual looking headphones employ the orthodynamic principle of operation, a plastic film with lightweight surface coil and magnetic drive. The successful soft inner headband technique is used, together with rather stiff controls to permit locked adjustment of pad angles and axis. While they were pretty comfortable, the side pressure was judged too high and could not be reduced by prestressing (a useful dodge with steel sprung headbands.)

The lower than average impedance (a very uniform 140 ohms) meant that the sensitivity was lower than the voltage specification might indicate, and to produce a decent sound level using nominal 330ohm impedance amplifier sockets the volume setting needed to be well up. Consequently these 'phones are not suited to tape deck outputs. The low frequency range was excellent, exhibiting good power and a cutoff below 20Hz, with no audible distortion; the quality of ear seal did not affect this unduly.

Lab measurement showed an interaction with the artificial ear at around 8kHz, which varied with position, but which would also seem present on the dummy head graph, relative to the 5 and 15kHz regions. This anomaly aside, an interestingly close correspondance to our 'ideal' was shown by the curves for this model, and the response was clearly very extended and generally well balanced and even.

This character was confirmed by audition, the U70 proving to be quite clean and neutral with good

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extension at low and high frequencies. However, the stereo effect was not quite as airy and ambient as for some of the 'open' phones, and some slight veiling of detail was occasionally noted.

B&O

Worthy of best buy status, these are fine headphones which excel on normal domestic program, and offer some useful acoustic isolation. For long term monitoring though they are probably a bit tight, and they also need a fair amount of driving. GENERAL DATA

Frequency response 100Hz-5kHz, rel. 500Hz

500Hz: (aquival	5 v (via 550 c)	/8 ohme)	ick) at	AdBlin/80dBA
Connection and les	ad length	./0011113).		iack 3m
Weight and comfo	rt		300g	above average
Type		orthody	namic supra-a	ural semi-open
Sound insulation			anne, supra a	moderate
Loudness			good, ne	eds fair driving
Subjective quality				v. good.
Price (typical, inc	VAT)			£39
1				11
1dB		-ht	M.	
12			==	1
•				1, 1-1,
			AA	S.A.
S				
20 Hz 50 10	200	500 1k	2k S	ik 10k 20k
	ma			
Frequency response	nse IEC ar	tificial ear	, 'ideal' enve	elope dashed

Frequency response, Neumann Dummy Head, 'ideal' curve dotted.

Beyer DT440

Beyer Dynamic (GB) Ltd, 1 Clair Road, Haywards Heath, Sussex RH16 3DP Tel (0444) 51003



This well styled 'phone was lighter than its size 'or might at first suggest, and proved comfortable for all those who tried it. Of the 'open' type little noise 'exclusion was provided, the ear pads being of a soft grey foam material. The pressure appeared to be just right, and because a tight seal was not required they were not over-critical of positioning.

Nominally 600 ohms, the impedance varied little over the frequency range, and the good sensitivity allows their use with virtually any normal source. The low frequency range was reasonably extended to 35Hz with moderate but not serious distortion aubible on sine wave drive below 100Hz. Our first sample was faulty but as the second developed a similar buzz after only a few hours use, we are left to wonder about power handling/reliability aspects. Decent sound levels were however easily attained.

Artificial ear measurement gave an excellent correspondance with the theoretical 'ideal' curve except for a shelf boost of an average 5dB over the entire treble band. Otherwise the response was clearly smooth, and the dummy head also provided comparatively close correlation with this result, with the inflexibility of its plastic 'ears' producing a little more bass loss than would actually occur with normal use.

On audition this model rated as 'good' which was fine for the price. It was favoured for its open, airy sound at low and mid frequencies, fine stereo, and low levels of coloration, but some mention was made of the excessive, albeit even, treble; if this were solved, its rating could well have been even higher.

A recommended buy, the DT440 sounded best with a few notches of treble cut, the overall sound quality as well as level of comfort being highly favoured. A restyled model the DT441 was also checked and auditioned in the latest tests, and results were substantially identical. GENERAL DATA

-F	requency response 100Hz-5kHz, rel. 500Hz
	(deviation from mean curve)+6dB, -1dB
F	requency response overall within ± 5 dB,
	(deviation from mean curve) 32Hz to 3kHz
Iı	npedance
S	ensitivity for 2.83V (via 330 ohms for Jack) at
	500Hz; (equivalent to 1 watt/8 ohms) 104dBlin/103dBA
C	Connection and lead length jack*, 3m
v	Veight and comfort
Т	ype moving-coil, supra-aural, open
S	ound insulation little
L	oudness
S	ubjective quality
p	rice (typical inc VAT) f32 when reviewed now f30

Yon LS or DIN



Frequency response, B&K4153 Artificial Ear, 'ideal' curve dotted.

JVC (UK) Ltd, Eldonwall Trading Estate, 6-8 Priestley Way, London NW2



HP404

A conventional, moderately priced headphone, the 404 weighs approximately 120g excluding cord and is thus fairly lightweight. Head pressure was not too high and wearing comfort was satisfactory. Moving-coil diaphragms are used in the drive units, and the construction is semi-open, affording marginal exclusion of external sounds.

At 94dB these phones were not very sensitive and moreover possessed quite a low impedance of 14.5ohms - which could prove unsuitable for a number of tape decks and preamps which offer only restricted output. Distortion levels were satisfactory, especially considering the fact that these relatively insensitive phones needed more drive than usual to meet the test sound level. A distortion figure of 1.5% was recorded at 40Hz, with 0.2% at 1kHz. The frequency response met ± 2dB limits from 45Hz to 600Hz, above which point the output decayed to a lower level, about 5dB down, the treble then being fairly well maintained at this level to 16kHz. Some peaks and troughs were however present in the treble range.

Probably the best of the JVC phones reviewed in this edition, the 404 scored an 'average' mark on audition. Bass was quite tight and extended, and the general balance fairly good. Some coloration was evident in the midrange — a degree of nasality and hardness with an 'enclosed' feeling. While the treble lacked detail, it was otherwise satisfactory. Frequency response, IEC artificial ear (HP404)

Though unexceptional, these reasonably comfortable phones were at least not too far from the required standard and at the price merit recommendation.

JVC HP707

We also tried the more expensive 707, a 'closed' design which was judged fairly comfortable. Sensitivity, was measured at 103dB. Impedance measured 54ohms, and the 707 proved capable of producing high sound levels. Distortion was much lower than for the open 'velocity' type headphones, measuring 0.33% at 40Hz and less than 0.1% at higher frequencies. Although the measured frequency response was erratic, it did correspond fairly well with the ideal envelope. The low frequency band was humped around 80Hz, with a peaky prominence around 2.0kHz.

Rated below average on audition the 707 was guite colored with a thick, 'shut-in' guality. The bass was quite deep and fairly uniform but bass output was found excessive to the point of boominess, while hardness was evident in the mid making the sound fatiguing at high levels. The treble lacked smoothness, sparkle or detail. Overall, the sound was clearly unnatural and did not rate a recommendation.

GENERAL DATA: JVC HP404 Frequency response 100Hz-5kHz, rel, 500Hz

(deviation from mean curve)
Frequency response overall within ± 5dB
(deviation from mean curve)
Impedance
Sensitivity for 2.83V (via 330 ohms for jack) at
500Hz; (equivalent to 1 watt/8 ohms)
Connection and lead length
Weight and comfort
Type
Sound insulationa little
Loudnessbelow average
Subjective qualityaverage
Price (typical, inc. VAT)£13





A lightweight slimline design, this Japanese headphone proved comfortable for all panelists — a welcome discovery. Despite their thiness, conventional moving-coil diaphragm transducers were fitted whose 'velocity' mode of operation meant (in common with the (257) that a tight ear seal was not required. The impedance was nominally 83 ohms, and varied little over the range, while the sensitivity was about average, though possibly a little low for some tape decks in view of the impedance value. Subjective evaluation of the low frequency range indicated a clean, quite powerful response extending to 30Hz. One transducer failed during testing and was relaced.

Lab measurement was quite promising, revealing a extended low frequency range together with an average characteristic close to the ideal, albeit with some irregularities, the most severe being at 1.6kHz and 8kHz. On the Neumann head both these features again appeared but this time as peaks, althoug the latter were in fact modified by the test ear loading. In general the Neumann curve also suggested more treble output than was felt to be the case.

Listening tests revealed a reasonable frequency response balance, albeit on the dull side and correlating more closely with the B&K results than with the dummy head. Some coloration was noted in the upper niid, together with some sibilance and fizz, but overall the model was quite well received and was marked above average; as such, these comfortable headphones clearly merit recommendation.

ENERAL DATA
requency response 100Hz-5kHz, rel. 500Hz
(deviation from mean curve)+2.5dB, -12.5dB
requency response overall within $\pm 5 dB$,
(deviation from mean curve)
npedance
ensitivity for 2.83V (via 330 ohms for Jack) at
500Hz; (equivalent to 1 watt/8 ohms) 100dBlin/94dBA
onnection and lead length jack, 2.0m
/eight and comfort
ype moving-coil, supra-aural, semi-open
ound insulation moderate
oudness
ubjective qualityabove average
rice (typical, inc VAT)£22

Ross RE258

Tel 01-278 6371

Ross Electronics, 49/53 Pancras Road, London NW1 2QB

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S



Sennheiser HD410

Hayden Laboratories Ltd, Churchfield Road, Chalfont St Peter, Bucks SL9 9EW Tel Gerrards Cross 88447



exchanged and all parts are readily removed for repair - many other headphones need to be scrapped if faulty or requiring repair.

Update

The model 400 is no longer available.

Sennheiser HD420 Hayden Laboratories Ltd, Churchfield Road, Chalfont St Peter, Bucks SL9 9EW Tel Gerrards Cross 88447



The '410 is yet another Sennheiser lightweight open air phone weighing 80g, and offering good wearer comfort. In fact the '410 is a version of the 400 with detachable leads, and costs only a couple of pounds more than that model. Sensitivity was better than average at 101dB linear and the impedance was also high at 540ohms, which will make it suited to a wide variety of source equipment. Capable of good sound levels, distortion was held to 2.0%, 40Hz reducing quickly with increasing frequency, and at 1kHz a fine 0.4% reading was obtained.

The frequency response was notable for its lack of peaks and dips if not for its accuracy. The output humped at 130Hz with an early bass rolloff measuring -6dB at 40Hz. The response also tilted downwards above 200Hz giving a slightly dull effect though, the general shape was not far from the ideal envelope dotted in on the graph.

On audition the 410 was placed in the 'average' category which was commendable at the price. The sound was considered slightly dull with a boxy tendency in the upper bass, but conversely it was also clear and sweet with a reasonably uncoloured mid range. It receives a strong recommendation as regards value for money and along with the still-current '400, it must qualify for a Best Buy rating. Here it is also perhaps worth mentioning Sennheiser serviceability — headphone cables are easily

GENERAL DATA

Frequency response 100Hz-5kHz, rel. 500Hz

(deviation from mean curve)+3dB, -5dB	
Frequency response overall within \pm 5dB	
(deviation from mean curve)	
Impedance	
Sensitivity for 2.83V (via 330 ohms for jack) at	
500Hz; (equivalent to 1 watt/8 ohms) 101dBlin/98dBA	
Connection and lead length	
Weight and comfort	
Typemoving coil, supra-aural, open	
Sound insulationlittle	
Loudness	
Subjective quality	
Price (typical inc. VAT) £21 when reviewed now £16.95	5



Frequency response, IEC artificial ear (HD410-HD400 should be identical)

Fully re-tested in this issue, the moderatelypriced moving-coil HD420 is a relatively lightweight model, at 140g. The usual Sennheiser foam-cushion ear pads are here replaced by a beige velour type fabric, and the **GENERAL DATA** use of a soft support headband separate from the tension band gave a high level of wearer comfort.

Specified at a nominal 600ohm impedance, the HD420 measured close to this spec at 530ohms, and the sensitivity was good at 99dB linear. Decent sound levels were possible, with satisfactory 3.0% distortion at 40Hz, and less than 0.1%. 1kHz.

The frequency response looked as if it were designed for the IEC iig - perhaps it was! More or less flat from 70Hz to 5kHz, with relatively minor deviations at higher freauencies, the frequency response extended to 17kHz, measuring - 14dB at 45Hz. In response terms at least the HD420 rated as one of the best.

Fortunately, the HD420 also received a high rating on audition, and was felt to be tonally well balanced, with a wide subjective frequency range and good stereo representation. Clarity was high and coloration reasonably low, the coloration effects noted mainly comprising a slight metallic effect with some treble uneveness and mild 'fizz.' We had no hesitation in awarding this model Best Buy rating for the second time around.

Frequency response 100Hz-5kHz rel 500Hz
(deviation from mean curve)
Frequency response overall within + 5dB
(deviation from mean curve)
Impedance
Sensitivity for 2.83V (via 330 ohms for jack) at
500Hz; (equivalent to 1 watt/8 ohms)
Connection and lead length
Weight and comfort140g, good
Typemoving coil, supra-aural, open
Sound insulationlittle
Loudness
Subjective quality
Price (typical, inc. VAT)



Frequency response, IEC artificial ear, 'ideal' envelope dashed

+4dR - 4dR

Sennheiser HD222

Havden Laboratories Ltd. Churchfield Road, Chalfont St Peter, Bucks SL9 9EW Tel Gerrards Cross 88447



These 'phones were designed in response to strong public demand for a circum-aural sealed-back enclosed model, giving good noise isolation. The HD222 is therefore intended as an alternative to the 'open' HD420, but unfortunately the Sennheiser trademark of an open and ambient sound quality has been sacrificed in the process. Still relatively lightweight, these moving-coil headphones were judged comfortable, as the head pads were quite soft and did not rely on excessive side pressure. As the low frequency performance was somewhat dependent on the quality of head sealing, the real-ear response proved better than the test rig, which in this instance must have been poorly sealed.

Capable of providing good volume, the low frequency range could be driven to slight distortion under heavy bass inputs. The design objective was achieved in that the sound insulation was good, but the sensitivity was fairly low and would be inadequate for some tape decks, though satisfactory for most amplifiers.

The response curves were none too promising. with lumpy characteristics on both curves, exhibiting prominence at 150Hz and 6kHz with the output proving deficient at 2-3kHz and above 12kHz. Fortunately the subjective results were rather better than these measurements might have suggested, and a slightly above average score was obtained. The sound proved unfatiguing, but with impaired stereo ambience and a distant, almost 'hollow' quality in the midrange, while an uneven frequency response was also demonstrated.

For a closed-back model the result was reasonable at the price, but fell below the open-back equivalent in terms of sound quality.

GENERAL DATA Frequency response 100Hz-5kHz, rel 500Hz (deviation from mean curve)..... Frequency response overall within ±5dB 60Hz to 6kHz (deviation from mean curve) ... essentially 550 ohms Impedance Sensitivity for 2.83V (via 330 ohms for Jack) at 500 Hz; (equivalent to 1 watt/8 ohms) 100 dBlin/98dBA Connection and lead length jack, 3m

..... above average Subjective quality. Price (typical, inc VAT)..... £33



Frequency response IEC artificial ear, 'ideal' envelope dashed



Frequency response real ear, 'ideal' envelope dashed



Following the success of their inexpensive HD400/410 models, this year Sennheiser have introduced an even less costly design called the HD40. Weighing around 25% less than the HD400, these phones were if anything even more comfortable. It does seem, in fact, that Sennheiser have succeeded in cutting both weight and cost of their headphones with each successive model, although at around 70g, even the HD40 does not quite come into the ultra lightweight class.

Another moving-coil supra-aural type, they offered negligible isolation of external sounds. Their sensitivity was average at 96dB, with a typically high Sennheiser impedance of 550ohms. Distortion was a little worse than for the 410; we recorded 10% at 40Hz and 1.3% at 200Hz, this reducing finally to a figure of 0.07% at 1kHz.

The frequency response was rather lumpy with a humped 150Hz range, and the linear open mid to presence region followed by a treble hump at 4-8kHz. The response fell off quickly outside the 50Hz-15kHz limits.

On audition this economy headphone scored an 'average' rating. Showing a touch of exaggerated 'loudness control', it was considered a trifle boomy and tizzy. Although quite good detail was present with moderate mid coloration, the treble sounded a bit forward and out of perspective. Nonetheless, at the price the performance was a commendable one, and makes the HD40

Sennheiser H

Havden Laboratories Ltd. Churchfield Road. Chalfont St Peter. Bucks SL9 9EW Tel Gerrards Cross 88447

worthy of recommendation.

Update

The recommendation of the HD40 was based on incorrect price information, at its typical price of £12.95 the HD40 reaches Best Buy status.

GENERAL DATA

Frequency response 100Hz-5kHz, rel. 500Hz
(deviation from mean curve)
Frequency response overall within + 5dB
(deviation from mean curve)
Impedance
Sensitivity for 2.83V (via 330 ohms for jack) at
500Hz; (equivalent to 1 watt/8 ohms)
Connection and lead length 6mm jack 3m
Weight and comfort
Type moving coil supra-aural open
Sound insulation
Loudness
Subjective quality
Price (typical ine V/AT) C12.05
Frice (typical, inc. VAT)



Frequency response, IEC artificial ear, 'ideal' envelope dashed

Sonv MDR4T and MDR70T

Sony (UK) Ltd, 134 Regent Street, London W1 Tel 01-439 3874



Sonv MDR4

Although the MDR3 is still available, it is in effect replaced by the new models in the range. The MDR4, is even lighter than the MDR1 — by some 5g. They also have reduced earpad pressure, offering well above average wearer comfort. Possessing a similar impedance to the MDR1 at 35ohms, the '4 was a little more sensitive, measuring an average of 98dB. Interestingly, low frequency distortion was greater, with a potentially serious 30% at 40Hz, and still measuring 5.0%, 100Hz; clearly these phones could not be driven too hard on bassheavy material. However, midband distortion was fine. Frequency response was not dissimilar to the '1, but it differed in that the bass was a little more extended and the entire treble was reduced by several dB - whereas the '1 lay on the 'bright' side of the ideal envelope, clearly the '4 was on the dull side.

Excepting the low bass, auditioning placed the 4 in the 'above average' category. Tonally these phones were well balanced with a clean, open and highly-detailed midband plus fine treble articulation. The stereo effect was good, and although the bass was undeniably deficient and none too clean when driven hard, the MDR4 nonetheless merits recommendation.

Sonv MDR70

The MDR70 is one of the more luxurious phones in the range (the similar *MRD50*s are supplied as standard with the top line Execu-

tive Walkman). Higher compliance 30mm moving-coil dome units are used to provide an extended frequency response, the '70 using a higher efficiency samarium cobalt magnet to achieve greater sensitivity. The MDR70 in fact measured a high 105dB at a kind 53ohms, and would boost the sound level of a portable stereo many times, or make some low output headphone sockets capable of substantial sound levels. Distortion was under good control measuring 5.0% at 40Hz and reducing quickly at higher frequencies to less than 0.1% at 1kHz. Frequency response was very good, with a satisfactory bass extension and a central response tailored to lie quite closely within the ideal envelope, the output maintained smoothly to 16kHz.

Rated good on audition mild criticisms were made of a 'pinched' effect in the mid with slight wiriness on strings and a 'shy' extreme bass, although in general, bass lines were satisfyingly clear. The balance was a touch dulled, and yet the treble was clean and well detailed - making the MDR70 a certain candidate for strong recommendation.

CENERAL DATA: SONV MOR 70

Frequency response 100Hz-5kHz, rel. 500Hz
(deviation from mean curve)
Frequency response overall within ± 5dB
(deviation from mean curve)
Impedance
Sensitivity for 2.83V (via 330 ohms for jack) at
500Hz; (equivalent to 1 watt/8 ohms) 105dBlin/104dBA
Connection and lead length
Weight and comfort,
Type
Sound insulationlittle
Loudnessvery good
Subjective quality
Price (typical, inc. VAT) MDR70
Price (typical, inc. VAT) MDR4T £17



Frequency response, IEC artificial ear, 'ideal' envelope dashed



Sony MDR1, MDR4, MDR50, MDR70 & MDR80

The MDR3 was Sony's first successful open ultra-light weight headphone, developed for use with the Walkman personal stereo cassette player. It has now been joined by a whole GENERAL DATA range of related models, one even smaller and lighter than the MDR3, and several in the luxury class.

All the models in the range are 'open' types. using tiny lightweight capsules and soft foam earpads which rest lightly on the ear and give a high level of wearer comfort. All come with 2.5m plugs and 6mm adapters.

Offering a saving in cost against the earlier MDR3. the MDR1 weighs a miniscule 30g without cord and in each tiny drive unit employs a 23mm diameter plastic dome diaphragm. Sensitivity was a little below average at 95dB, but the impedance was as specified at 32ohms. Some distortion was evident at low frequencies, and in fact distortion measured 10% at 40Hz but reducing to 0.1% at 1kHz - this figure holding good over the rest of the range. The frequency response was imperfect, especially with regard to the restricted bass, but it showed reasonably good agreement with the target curve and moreover was free of the usual ragged peaks and dips. A tolerable hump at 5kHz was present, while at the bass end, response fell swiftly below 100Hz.

On audition, the 1 rated 'above average'.

Frequency response 100Hz-5kHz, rel. 500Hz	
(deviation from mean curve)	
Frequency response overall within + 5dB	
(deviation from mean curve)	
Impedance	
Sensitivity for 2.83V (via 330 ohms for jack) at	
500Hz; (equivalent to 1 watt/8 ohms)	
Connection and lead length 2.5/6mm jack. 3m	
Weight and comfort	
Type	
Sound insulationlittle	
Loudness fairly good	
Subjective qualityabove average	
Price(typical_inc_VAT) £12	



Frequency response, IEC artificial ear, 'ideal' envelope dashed



which was very good for the price. A touch 'thin' in balance, with deficient bass and some hardness on strings, it was otherwise very smooth, detailed and open with fine stereo and a good treble quality A Best Buy status is certainly appropriate here.

Stax Lambda

Wilmex Ltd, Compton House, New Malden, Surrey KT3 4DE Tel 01-949 2545



Finally we come to the top of the line '80 which differs in small details from the '70, weight being increased by 15g to 60g. In the drive unit a copper clad aluminium voice coil is employed, with a high-molecular-weight (12μ m thick) 30mm diameter plastic-dome diaphragm. A stronger, angled capsule swivel system was used, and wearing comfort was undeniably good.

As with the '70, the sensitivity was high at 104dB, and not significantly compromised by the 43ohm impedance. Distortion was a little poorer, measuring 10.0% at 40Hz, and still 1.5% at 100Hz, but improving to less than 0.1% at 1kHz.

In our opinion the frequency response was poorer than for the '70, with a 4dB high bass hump appearing at 180Hz, while the bass rolloff was greater below 100Hz and the lower presence band depressed. Treble response was lumpy from 5kHz to 13kHz, and fell quickly away above 14kHz.

On audition the '80 scored below the '70 but still merited an 'above average' placing. Open and clean in the mid, the bass sounded reasonably good, its excess helping to counteract the 'forward' treble. Overall the '80 was slightly too bright in an unbalanced manner but it nonetheless possessed some subtle qualities, and is certainly well worth trying the strength of our recommendation, though, is clearly moderated by price, which is high compared with others in the range.

GENERAL DATA

Frequency	response	100Hz-5kHz,	rel. 500Hz	

Sony MDR807

Tel 01-439 3874

Sony (UK) Ltd. 134 Regent Street, London W1

Impedance
Sensitivity for 2.83V (via 330 ohms for jack) at
500Hz; (equivalent to 1 watt/8 ohms) 104dBlin/106dBA
Connection and lead length 2.5/6mm jack. 3m
Weight and comfort
Type
Sound insulation little
Loudnessvervgood



envelope dashed



Costing some $\pounds 130.00$, this large headphone of open frame construction is related in concept to the even larger Sigma. It sits almost flat on the head. whereas the Sigma directs the sound at a more natural forward angle towards the ear, and in consequence the Lambda should and does sound brighter by comparison. An electrostatic model. two drive boxes are available, namely the SRD-X $(\pounds70.00)$ and the SRD-6 $(\pounds40.00)$. The 'X box may be powered by mains or battery (eight 'C' cells), being fed via a standard jack plug, so it can therefore be used with portable equipment. It does however suffer from a limited dynamic range particularly at low frequencies, and in my view this is a serious weakness, although its bandwidth and fidelity are superior to the '6 at modest sound levels. It is also very sensitive, but a volume control is provided to take account of this. The SRD-6 is the standard self-powered transformer box, possessing a fine performance and allowing as much volume level as you could wish for, but it does require power amplifier connection.

No sound insulation was provided, and the *Lambda* proved quite noisy for other room occupants. It was considered to be very comfortable, with the measured response curves exhibiting good correspondence with our targets, although the bass was not particularly extended, exhibiting a mild hump around 80–100Hz. The real-ear curve suggested extra energy in the last two treble octaves, and this was confirmed on the listening tests, with surface noise sounding prominent as a result.

The bass reproduction was slightly 'thick' but superior to that of the *Sigma*, while the overall fidelity was very fine. The qualities of openness, freedom from mid coloration transparency, and high musical detail were present in full measure, while the stereo presentation was better than almost all the models in the review save the *Sigma* (whose more natural frontal presentation was judged to be superior).

Aside from the upper brightness which a tone control could easily correct, the sound was to such a good standard that recommendation was mandatory despite the price. Note that we preferred the cheaper SRD-6 adaptor box.

GENERAL DATA

Frequency response 100Hz-5kHz, rel 500Hz
(deviation from mean curve)+3dB, -3dB
Frequency response overall within ±5dB
(deviation from mean curve)
mpedance
Sensitivity for 2.83V (via 330 ohms for Jack) at
500Hz; (equivalent to 1 watt/8 ohms)
116dBlin/114dBA (SRDX); (102.5/100SRD-6)
Connection and lead lengthamplifier leads, 2.3m
Weight and comfort 400g, very good
ype electrostatic, circum-aural, open
ound insulation negligible
.oudness
Subjective quality very good
Price (typical, inc VAT) £175 when tested, now £224 with new SRD7*

*See Update — Stax Sigma







Frequency response real ear, 'ideal' envelope dashed

Stax Sigma

Wilmex Ltd, Compton House, New Malden, Surrey KT3 4DE Tel 01-949 2545



This headphone has already received some mention in the technical introduction in connection with the forward off-axis placement of its large electrostatic diaphragms relative to the ear. Selfpowered via a SRD6 transformer unit, the Sigmas proved quite insensitive, although 15-30 watt rated amplifiers were nonetheless ample. Despite their visual bulk, these over-the-ear phones were quite comfortable and they truthfully approximated to the term 'ear speakers'.

Their unconventional acoustic loading (a sort of open baffle radiator) could have caused measurement problems, but in practice this did not seem to be the case. On the artificial ear the response to 1.5kHz was smooth and free of major deviation, with the low frequency limit set at about 30Hz (this agrees with the subjective appraisal which also showed inaudible distortion at reasonable sound pressures.) However, the 2-5kHz band was clearly depressed by some 7dB or so, before recovering towards 10kHz, the latter part somewhat exposed relative to the adjacent areas. Reasonable correlation was obtained on the Neumann head, though a bass hump was indicated at 60Hz and the shape was somewhat altered in the 750Hz to 8kHz range.

Auditioning ranked this model highly with some panelists putting it above all others by virtue of its spacious, coherent and ambient stereo, free of ear clamping mechanics. One or two other listeners however were aware of a tendency to bass lift and a mild fizz in the high treble, together with a trace of mid suckout.

Overall it was felt that the Sigmas represented a Frequency response. B&K4153 Artificial Ear, 'ideal' curve dotted

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significant advance in headphone design, and while they should be auditioned before purchase, they are nonetheless recommended.

Update

A new energiser, the SRD7 at £69, is now recommended for both these 'phones and the Lambdas.

GENERAL DATA

Frequency response 100Hz-5kHz, rel. 500Hz
(deviation from mean curve)+4dB, -9dB
Frequency response overall within $\pm 5 dB$,
(deviation from mean curve)
Impedance
Sensitivity for 2.83V (via 330 ohms for Jack) at
500Hz; (equivalent to 1 watt/8 ohms) 85dBlin/79dBA
Connection and lead lengthpower unit, 2.2m
Weight and comfort approx 400 g, above average
Type self-powered electrostatic, circum-aural, open
Sound insulation
Loudness
Subjective quality
Price, (typical, inc. VAT) £250 when tested, now £281 with new SRD

Frequency response, Neumann Dummy Head, 'ideal' curve dotted.



Yamaha HP3

Hi-Fi Markets, Cousteau House, Grevcaine Road, Watford, Herts, WD2 4SB Tel (0923) 27737



looked, and in comparison with the HP1/2, its headband resulted in greater ear pressure. Since the HP2 appears to employ the same innards, we feel that their improved wearer comfort could be worthwhile despite the slightly higher cost. The HP series of headphones are all well made and finished, and use flat film diaphragms with spiral coils of very low mass - a sort of magnetic film transducer. Of supra-aural design, the capsules are semi-open and provide only a little sound insulation. Their sensitivity was below average, and as a result some cassette decks may not drive these phones to high volume levels. At high levels the sound exhibits negligible low frequency distortion, with a smooth and comparatively well-extended bass register.

The frequency response of the HP3 showed Frequency response IEC artificial ear, 'ideal' envelope dashed some family resemblance to that of the previously reviewed HPI, notably in its flat bass and mid frequency range, with a suggestion of excess around 1kHz and then a smooth resonance-free but depressed treble. The result was equivalent to a (-3) or so of treble cut setting on an amplifier tone control, and may therefore be corrected if so desired.

The subjective performance resulted in an 'above average' rating, which is fine at the price. The stereo presentation was good with the overall character relatively uncoloured, but with some dulling and with an impression of mid prominence; the effect was smooth and slightly 'shut-in'. Compared with the HP1, the bass showed a little Frequency response real ear, 'ideal' envelope dashed

less extension while the treble was not quite so airv.

The HP3s may be recommended, but we suspect that most purchasers would opt for the similar but more comfortable HP2 at ten pounds more.

GENERAL DATA

Frequency response 100Hz-5kHz, rel 500Hz
(deviation from mean curve)+2dB, -4dB
Frequency response overall within ±5dB
(deviation from mean curve)
Impedance
Sensitivity for 2.83V (via 330 ohms for Jack) at
500 Hz; (equivalent to 1 watt/8 ohms)
Connection and lead lengthiack, 2.4m
Weight and comfort
Type
Sound insulation
Loudness
Subjective quality. above average
Price (typical, inc VAT).









Yamaha HP Hi-Fi Markets, Cousteau House, Greycaine Road, Watford, Herts WD2 4SB Tel (0923) 27737

GENERAL DATA

Impedance.

Frequency response 100Hz-5kHz, rel. 500Hz

Sensitivity for 2.83V (via 330 ohms for jack) at

500Hz; (equivalent to 1 watt/8 ohms) 102dBlin/98dBA

Type.....orthodynamic, supra-aural, semi-open Sound insulationsome

Subjective quality.....above average Price (typical, inc. VAT)

Frequency response, IEC artificial ear, 'ideal'

envelope dashed



The HP1 headphones were introduced several years ago now, guite some time before the success of the current breed of open lightweight models, and in their time they set a new standard for smoothness, bass coloration, comfort and visual design. Strongly recommended in previous issues, the HP1 has been fully re-tested this time round, for it is always instructive to re-evaluate earlier trend-setters in the light of new developments.

Still rated as 'fairly good' on comfort, the HP1's 250g weight nonetheless seemed a little heavy now. The drive unit principle used is orthodynamic - the magnetically-driven thinfilm diaphragm resembles that of an electrostatic although not driven by electrostatic forces. The earpads are supraaural and semi-open, with some isolation of external sounds and only moderate sound leakage from the capsules.

Easy to drive, and possessing a 1400hm impedance of great uniformity, the sensitivity was high at 102dB. These phones can be driven to even dangerously high levels without distortion, and low-frequency power handling was particularly good - this is shown by the 0.25% distortion recorded at 40Hz while by 1kHz the figure had fallen well below 0.1%.

The measured frequency response confirmed our developing awareness of the tonal balance of this model, namely that it possessed a rather dull and depressed treble noticeably so by comparison with the latest

designs. The characteristic was generally very smooth, the whole treble region 1.5-15kHz was depressed by up to 5-8dB.

On audition for this issue the HP1 nonetheless still managed to attain an 'above average' rating - sufficient to earn it a recommendation, but no longer meriting Best Buy status. The midrange could sound oppressive with a thickened quality, but the treble was smooth and detailed, if depressed. On the whole the HP1 provided good stereo, with the bass particularly clean and well extended.

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GLOSSARY

ABR: Auxiliary bass radiator; a reflex type bass-loading for loudspeaker systems, which uses a speaker-like 'cone' without motor, instead of a port.

AM: Amplitude modulated; see 'Medium Wave'.

Acoustic breakthrough: Sound that gets into the turntable and hence the cartridge from the air and thereby creates a risk of acoustic feedback (see separate entry).

Acoustic feedback: If any sound in the room can find its way through the body of the record deck to the cartridge stylus, then that sound will be reproduced from the loudspeakers, along with the wanted programme material. If too much of this sound from the loudspeakers is picked up by the cartridge in this way then a vicious circle of acoustic feedback will be created. Active: Speaker systems which contain electronic crossovers and where the drive units are connected directly to power amplifiers.

Alignment protractor: A device used to minimise the lateral tracking error of a cartridge/arm combination.

Amplitude: Size or magnitude; hence the amplitude/frequency response, known normally simply as the frequency response, which describes the relative loudness of the system at different frequencies with a constant input voltage. **Anechoic:** Without echo; a special room or 'chamber' with thick sound absorbing materials on all surfaces to prevent reflections.

Arm mass: More accurately called *effective* arm mass, because it is *not* the weight of the arm on a pair of scales. It is the mass of the arm and cartridge combination that appears to be concentrated at, and thus felt by, the stylus tip which is tracking a record groove. There is nothing inherently good or bad about arms with light or heavy effective mass; what matters is the manner and choice of their combination with cartridges of different compliance and the low frequency resonance produced by such combination.

Azimuth: With reference to tape and cassette recorders, the alignment of head gap to tape path.

Balance: 1) The overall relative loudness perceived at different frequencies (eg bass, treble) 2) the accuracy of the match between the two channels of a stereo transducer (eg cartridge or headphone).

Bandwidth: A range of frequencies with presumed defined upper and lower limits. **Bass:** Lower part of the frequency spectrum, typically below 150Hz.

Belt drive: The motor has its rotational speed geared down to the required platter speed (331/3 rpm for LP discs) by a rubber or similar resilient belt which runs round a small pulley on the motor shaft and a large pulley attached to or part of the platter. Bextrene: A plastics material frequently

used for bass and midrange cones. Bias: (turntable/arms) Because the cartridge on a pivotal arm is being drawn

across the record surface by the stylus tracking at an angle offset from the pivots, groove friction produces an imbalance of lateral force. Bias is the application of a compensatory lateral force acting in the opposite direction.

Bias: (*tape*) This refers to a high frequency current passing through the record head which allows the audio current also passing through the head to produce reasonably linear magnetisation of the tape at all levels permitted by the combination of each machine with the tape. The lowest level of bias is required for ferric cassettes, a slightly higher one for ferrichrome, an even higher one for chrome or pseudochrome, and the highest for metal.

Binaural: Closed system recording/replay technique using headphones and 'dummy head' microphones.

Bituminous damping: A cabinet damping technique whereby heavy impregnated felt pads are attached to the internal cabinet surfaces.

Bottoming: The stylus scraping on the distorted rounded bottom of the groove due to incorrect stylus geometry.

Cantilever: The thin rod or tube that connects the stylus to the armature and hence that cartridge body.

Capacitance: An element of electrical impedance that is particularly important when matching pickup cartridge, arm leads and amplifier input characteristics to achieve a flat frequency response from discs.

Clipping: This is reached when a circuit is overloaded and overdriven, resulting in bad waveform distortion and audibly unpleasant effects.

Coloration: A general term used to describe the audible effects of distortions, particularly in loudspeakers and record players. These are usually caused by frequency response irregularities and/or resonances.

Compatibility: The selection of interdependent components to achieve optimum system performance; notably arm/cartridge mass/compliance matching, cartridge electrical loading, or headphone compatibility with amplifiers.

Compliance: A measure of the springiness of the cantilever/armature seen from the stylus, expressed in compliance units (cu), where 1 cu = 10^{-6} cm/dyne.

Crossover: An electrical circuit which uses combinations of inductors, capacitors and resistors to divide the signal from the power amp into the required frequency bands and with any necessary equalisation for feeding to the individual drive-units of the speaker system.

Crosstalk: The leakage from one channel to the other in a two channel stereo system. **Cutter:** Mechanism used to cut recorded signal onto lacquer master; consists of turntable, lathe, cutting head, cutting and servo amps.

DIN: German standards body, responsible amongst other things for a popular range of standard plugs and socket specifications.

Damping: A means of controlling resonances by means of a resistive medium (electrical, mechanical, or acoustic depending on situation).

Decibel (dB): A logarithmic unit that is convenient for expressing ratios that span a wide range on a linear scale. For simplicity it can be regarded as a measure of relative loudness.

Direct drive: This type of turntable motor has one moving part, the platter/centre spindle. The other part of the motor is fixed to the chassis or plinth.

Distortion: Literally this can mean any deviation from the original, but usually refers to harmonic rather than intermodulation distortions when not specified.

Dolby processing and deprocessing: This

refers to changes introduced in recording and playback in order to achieve noise reduction.

Doping: A techique involving the application of damping to a loudspeaker driver cone in order to assist in controlling resonances.

Downforce: The weight, measured at the stylus, which holds it down in the groove.

Drive unit (Driver): The term used to distinguish the loudspeaker unit itself, be it bass, midrange, treble or fullrange in application, from the complete loudspeaker system which combines drive units, cabinet and crossover into a total design.

Dropouts: Momentary reductions of programme level due to inadequate head/tape contact caused by oxide particles shedding off the tape onto the head gap, or inadequacies in tape transport or tape.

Dynamic range: The ratio in dBs between the quietest sound that can be successfully recorded and the loudest which can be accepted without serious distortion on an average programme.

Effective mass: The inertia, or masscontrolled resistance to movement, of a device, particularly important with regard to tonearms.

Efficiency: The amount of acoustic power delivered for a given electrical input power. Electret: Effectively a permanently charged capacitor, it is used as the transducing element in certain cartridges and headphones.

Electrostatic: A principle employed in some headphone transducers using static electricity effects to set up a polarising field within which the modulated transducer medium moves.

Elliptical stylus: A specially shaped stylus profile that makes the 'plan view' radius along the length of the groove smaller than the 'elevation view' contact radius viewed from the front.

Equalisation: (general) The deliberate modification of frequency response, usually in response to some engineering limitation or deficiency. **Equalisation:** (tape) This refers to the

Equalisation: (*tape*) This refers to the necessary change in frequency response required of an amplifier so that an overall flat frequency response is obtained from a tape medium. Equalisation is required both on record and replay. Any tape recorded on a good cassette recorder should have the same inherent response when played back on another correctly set up machine, since all playback equalisations should have been standardised. These standards are normally specified by the time constants of the circuits involved, eg 70 μ s or 120 μ s (see 'Microseconds').

FM: Frequency modulated; often used to describe radio transmissions of high fidelity potential.

Farad: Measure of capacitance.

Ferrite rod: A short rod type aerial used for AM reception; may be fitted internally or externally to tuner or receiver.

Ferro-fluid: A magnetic fluid which is introduced into the voice-coil gap to provide damping and/or improved cooling. Filter: A circuit (normally) used to restrict the bandwidth of a system; may be fixed or switchable.

Frequency range or spectrum: Can refer to any particular group of frequencies, but commonly applied to the audible band from 20 to 20,000 cycles per second (Hz),



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GLOSSARY

extending from the deepest bass to the highest audible harmonics.

Frequency response: The variation in output over a frequency range, particularly of a transducer; can be expressed as a range with decibel limits, or depicted graphically. Hz (Hertz): 1 Hz = 1 cycle per second and is

a measure of frequency which corresponds to musical pitch (the higher the frequency the higher the pitch.)

HF: High frequency.

Harmonic: Harmonics are the whole number multiples of a base frequency called the fundamental.

Harmonic distortion: The addition of unwanted harmonics to a signal.

Hum: A low frequency interfering sound produced by break-through or interference from mains wiring or circuitry.

IHF: American Institute of High Fidelity, an important standards body.

IEC: An international standards body.

Impedance: Measure of resistance (and reactance) in alternating (ie audio) signals; this is of some importance in the compatibility of both cartridges and headphones with amplifiers. For convenience's sake is measured in ohms.

Integration: Used to describe the success with which the output from two drive units combine to give smooth output through the crossover region.

Intermodualtion (IM): A form of distortion arising from two or more signals producing non-harmonic signals that correspond to the sum or difference of the two frequencies.

Kilo (k): prefix meaning one thousand. **LED:** Light Emitting Diode; an indicator light. LF: Low frequency.

Lateral friction: The resistance to movement of an arm and cartridge combination in the horizontal plane (ie across a record), caused by friction in its bearings.

Linear: A transducer that produces an output that exactly portrays its input over the required operating range is described as linear, and is hence distortion free. Hence also nonlinearities (distortions).

Line-contact: A special stylus profile that extends the ellipse, increasing contact length up and down the sides of the groove.

Load or loading: The impedance (including resistive and reactive components, ie ohms, mH, pF) seen by one component looking back to its interconnected component; of importance in compatibility of cartridge/amp, and amp/headphone. 'Loudness': An equalisation circuit fre-

quency switchable on amplifiers which is designed to compensate for presumed hearing characteristics at low listening levels by boosting bass and treble.

MOL: Maximum operating level of tape normally referring to 5% distortion of 315Hz or 3.15kHz. Medium wave: An AM transmission band

incapable of high fidelity signals. **Micro** (μ): Prefix for units meaning one

millionth of.

Microseconds (µs): The time constant of a resistor capacitor combination involving a frequency reponse change (equalisation). Midrange, Midband: The central part of the

audible frequency range where the ear is most sensitive.

Milli- (m): Prefix for units meaning one thousandth of.

Modulation: The audio signal is 'stored' by means of modulations within a medium, eq the 'wiggles' in the groove of a plastic disc, or the magnetic coding on a tape.

Modulation noise: An additional noise added to tape noise, which increases with the degree of modulation of the tape. caused by the properties of the magnetic coating. This noise has most of its energy near the modulation frequency (causatory tone)

Moving-coil: A transducer (eg cartridge or headphone) where the signal is generated by the movement of a coil within a magnetic field.

Moving magnet: The most common form of cartridge transduction, where the magnet moves while the coils are held relatively stationary.

Multiplex filter (MPX): A circuit which introduces severe attenuation at supersonic frequencies to decrease interference encountered with the output from some stereo FM tuners.

Nano (n): Prefix meaning a thousandth of a millionth of.

Noise: Random unwanted low level signals. Noise modulation: An unwelcome breathing effect that can be heard on some programme material, produced by poor noise reduction systems, or circuits.

Octave: Two-to-one ratio of pitch or frequency Offset angle: The angle measured between

the centre line of the pickup cartridge and the line which joins stylus and arm pivot point.

Ohm: Unit of electrical impedance (including reactance) or resistance; also kohm, where 1 kohm = 1,000 ohms.

Overhang: The extent to which the cartridge stylus extends beyond the centre of the platter is critical, and controlled by fore and aft adjustment of the cartridge on the arm.

Passive: The most common type of system, where drivers and crossover are driven from a single power amplifier.

Peak recording level: A level above which distortion becomes apparent. This distortion is introduced when the oxide particles almost reach magnetic saturation, and thus will accept no more level.

Phono: The most commonly used plug/socket combination in audio components.

Pico (p): Prefix meaning one millionth of a millionth of.

Port: An opening in a cabinet which is tuned to characteristics of the bass driver and the enclosure volume to provide reflex type bass-loading. Power amplifier: The part of an amplifier

that provides power to drive the loudspeakers; usually integrated, it is sometimes a separate component.

Pre-amplifier: The part of an amplifier that accepts the input signals, sorts them, applies any necessary equalisation, and then passes the signal to the (normally integral) power amplifiers.

Presence: A quality of forwardness or immediacy in a sound balance, generally re-lated to an upper-middle frequency response boost.

Print-through: A pre- or post-echo of a loud signal created by magnetisation occuring from one layer to adjacent layer after the tape has spooled or been recorded.

Q: A measure of the magnitude and shape of a resonance; the higher the Q, the sharper and more severe in amplitude the resonance.

Reflex: A system of bass loading (using port or ABR) which offers improved efficiency and bass power handling at the expense of subsonic control compared to a sealed box.

Rumble: The low or medium frequency sound produced mechanically by any moving parts in a turntable, mainly the motor and platter bearings.

Sensitivity: The volume of sound output for a specific electrical voltage input.

Separation: As between the two channels of a stereo pickup; see crosstalk.

Shibata: A special stylus extending the elliptical to a 'line-contact' type of profile. Side-thrust: A force acting on cartridges in pivoted (ie not parallel tracking) arms, due to the stylus/vinyl 'friction' acting along the line of the offset angle; hence bias or sidethrust compensation.

Signal-to-noise, signal/noise, S/N: The dif-ference in total output when an applied signal is removed.

Stylus: The specially shaped piece of diamond in contact with the groove and connected to the cantilever.

Subsonic: Below the audible range, ie below 20Hz.

Square wave: A signal which consists of a fundamental plus a (theoretically infinite) series of odd (3rd, 5th etc) harmonics in a precise phase and amplitude relationship.

It is useful for examining transient performance, symmetry, resonance control and 'ringing'.

THD: Total harmonic distortion.

Tracing: The following of the groove modulations by the stylus; hence for example tracing distortion, caused by the inability of a spherical stylus to trace the high frequency inner grooves on a disc.

Trackability: The ability of the cartridge to cope with large amplitude modulations (or of the arm and cartridge to follow the groove itself properly).

Tracking error: The discrepancy between the truly tangential angle at which a record is cut and the slightly off-tangential angle at which it is tracked by a stylus on a pivoted arm during some parts of the arm's travel.

Transient: Signal of very short duration.

Transmission line: Complex in construction and hence fairly uncommon, this bass-loading technique has much in common with reflexing.

Treble: Upper part of frequency spectrum, typically above about 3kHz.

Tweeter: A small drive unit designed to operate over the high frequency range.

Ultrasonic: Frequencies above audibility, ie greater than 20kHz; also *supersonic*. Vertical tracking angle (VTA): The angle at

which the plane of motion of the stylus is set with respect to the vertical when viewed from a side elevation of the cartridge. Should match the 20° cutter standard.

Weighting: A factor or function that is applied to a measurement to increase its relevance and usefulness; eg the weighting curves applied to headphone frequency response measurements to take account of head, ear, and other related effects.

Woofer: A drive unit that operates over the bass portion of the audio range.

Wow and Flutter: Low and high frequency pitch variations (from poor tape transport of turntable platters with speed drift).

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