HI-FI CHOICE

TURNTABLES AND TONE ARMS

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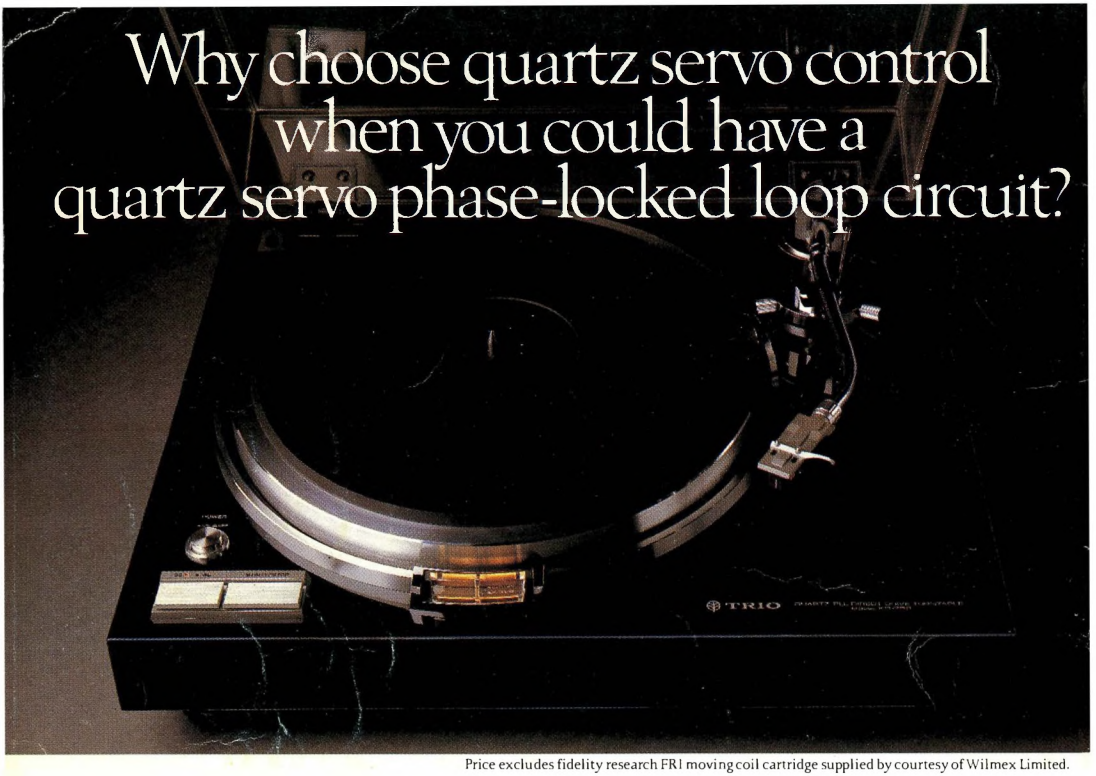
Why choose quartz servo control when you could have a quartz servo phase-locked loop circuit?



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If you want maximum performance from your Hi-Fi, then you must get a direct-drive turntable with quartz servo control.

At least, that's what most Hi-Fi manufacturers would have us believe.

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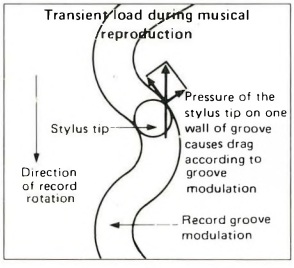
The Trio KD-750 uses a quartz servo phase-locked loop circuit, which not only keeps the turntable running at the right speed, but actually *improves* the tonal quality as well.



It's all based on the study of "transient load fluctuation," which can be explained as follows.

Transient load refers to the braking effect which varies according to amplitude and time.

It is produced when the stylus tracks a groove which has a modulation with a large dynamic range of 400Hz to 1KHz.

The resulting fluctuation causes severe deterioration in reproduced sound quality.

With this in mind, the Trio KD-750 turntable has been specially designed with a very high moment of inertia of 550 Kg/Cm,² which subsequently reduces the transient load fluctuation to less than 0.0003%.

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By the Trio KD-750.

TRIO

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HFC 11

Hi-Fi Choice No 12 Contents
Turntables & Tonearms 2 by Martin Colloms

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Product index

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How to use this book

The *Hi-Fi Choice* series of publications are intended to provide the most comprehensive and detailed examination of the models available in every hi-fi product category. Each project involves extensive lab testing and generates a considerable amount of data, so this page is included to help the reader to obtain ready access to the data he requires and best suits his needs.

This particular volume contains a considerable number of products, some of which are available in slightly different versions to the models reviewed. So to make it easier to find a particular model or a representative alternative we have included a *Product Index* that lists as many variants as we have been able to find, while referring the reader to the appropriate entry.

The *Consumer Introduction* is an attempt to deal with some of the technical considerations of disc replay and record deck design in non-technical language, while also providing some advice for the novice who would like to make the best possible use out of the book but is unsure where to start.

The *Technical Introduction* describes the tests that were undertaken and explains why particular measurement techniques were used. Many of the traditional measurement techniques used to assess turntables are incapable of fine discrimination between models, and do not reflect the differences that can be heard under controlled but 'typical use' conditions; consequently we have attempted to derive more meaningful results by using rather more sophisticated techniques. This in itself has pitfalls, as there are as yet no 'standard' test conditions for aspects of performance such as 'environmental sensitivity' that can dramatically affect and frequently dominate the performance of a system, albeit in a somewhat unpredictable way. Successful interpretation of this sort of data requires considerable experience of the different mechanisms that combine to produce it, so while the results may be interesting in themselves they are somewhat experimental and should be taken with caution and in the light of the interpretation.

The *Reviews* themselves include description, data, and interpretation thereof in sufficient detail to allow necessary qualifications to be made; while we attempt to assist readers by using a 'recommended' flash and summarising our findings elsewhere in the book, this invariably involves over-simplification and requires us to make value judgements that in some cases relate merely to particular choices of compromises (for this reason also we have decided not to include a distinct Best Buy category this time around). To avoid the danger of misconstruing such a summary, the reader is advised to consult the complete reviews as much as possible.

The *Conclusions* section discusses the findings of the project in general terms, examining the relative effectiveness of the methods employed in different designs, taking an overview of the market as a whole, and contrasting the results with those found in the earlier project some eighteen months before.

In the *Best Buys and Recommendations* section we pick out some of the designs in different price brackets that appear to offer a good overall balance of performance for their price. This includes some models from the previous book which have been covered in summary form. Naturally our recommendations are based on our own interpretation of the relative importance of different aspects of performance, and the reader should try to establish how these coincide and conflict with his own, and interpret accordingly. It is also an incontrovertible fact that 'value for money' will always depend on how an individual values his money!

The *Overall Comparison Chart* is an equally useful (and for the same reasons dangerous) method of summarising the findings contained in the book. By presenting abbreviated data in tabular form, it is easy to establish which models within the book have a particular characteristic in common, and therefore it is very useful for shortlisting models according to a particular profile. The entries under price (throughout the book) are particularly subject to variability and change, although we have done our best to ensure that they are representative at the time of going to press; our value for money judgements have been made according these prices, so may need to be re-interpreted if relative prices change.

Note also that separate tonearms and motor units are necessarily assessed under optimum conditions with the best ancillaries, and will only necessarily attain our assessed performance criteria (especially sound quality) under such conditions.

Finally, at the back of the book, there is a short *Glossary* which we hope will help relieve bafflement and frustration at the inevitable use of technical terminology in the book.

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Apart from wrecking your delicate stylus, dirty records give you scruffy, scratchy sound reproduction.

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What price protection?

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3M

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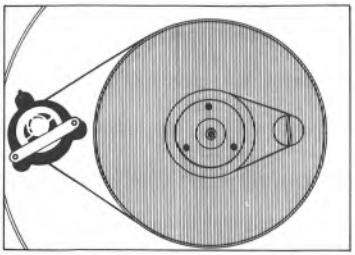

New Belt drive system

A completely new belt drive technique using a servo ontrolled electronic system with Automatic Pitch Control at adjusts and compensates for any record cleaning device d ensures no speed variation whatsoever.

The advantages are electronic speed selection, faster art, no motor hum, exceptional rumble figures nweighted, better than −48dB, weighted, better than 68dB), and long life expectancy of the motor.

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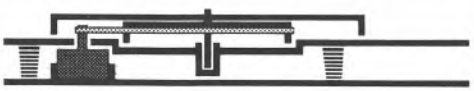
This is how the new system works. A triple T rotor from the C motor carries the pulley on the same shaft as the 72 pole chogenerator. The frequency of the generated AC voltage is exact measure of the speed of the motor and is used as a ntrol.

The signal passes through a frequency to voltage converter d is changed to DC. This is compared with a reference 31/3 or 45 r.p.m.) and any deviation is instantly corrected by integrated circuit controller.



New Suspension.

The new Ortho-inertial suspension system uses both rizontal and vertical springs of a special design, plus ball gment damping to eliminate low frequency disturbance d vibration that can at best affect your enjoyment – at orst cause the stylus to jump out of the record groove.

New plug in arm.

Uses the new acclaimed Thorens Isotrack plug-in arm system but with easier and simpler cartridge mounting facilities. Plus new low resonance tone arm tube with special treatment using split wave technology.

There is even a version of the plug-in arm fitted with a very impressive moving coil cartridge – TMC 70. It's hand made and individually tested.

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Adjustable speed with stroboscope built into the outer rim of the platter. The dust cover, with spring loaded hinge is integrated in the base.

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Other important new features on these latest Thorens decks include a non-suspended front panel where all controls are located, a trip and lift mechanism on the TD 115 and remarkable performance figures – rumble unweighted, better than −48dB, rumble weighted, better than −68dB, wow and flutter ± 0.05%, pitch control ± 6%.

One thing that never changes, however the legendary Thorens reputation for reliability and superb engineering.

TD 110/TD 115

Rumble unweighted	better than −48dB
Rumble weighted	better than −68dB
Wow and flutter	± 0.05%
Pitch Control	± 6%

Write for full details and illustrated literature on the new Thorens range and the name of your nearest Thorens dealer.

METROSOUND **THORENS**

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Editorial Introduction

Last time we covered turntables and arms in a book that also included cartridges, and the result gave our binders quite a hard time! In the light of this 'product explosion' we felt it was necessary to exclude the forty or so cartridges from this volume in order to increase the turntable and arm count to around the hundred

A further reason for splitting the turntable and cartridge issue was of course a similar pressure of new cartridge models, yet at the same time we were reluctant to take this step because of the significance of cartridge/arm compatibility to the overall sound of a turntable system. However there was no way we were ever going to *fit* all these products into one issue, so the only alternative was to undertake the two projects sequentially, tying up the compatability in the cartridge issue. In order to give full value for money and cover an area that will interest many people, yet one that we feel will does not warrant a complete issue of its own, we will be including reviews of some 40 Headphones with an expected total of 60 Cartridges.

In addition to increasing the scope of this issue in terms of numbers of turntables covered, we have also improved and refined our evaluation techniques. This is not to imply that they are anything like perfect — far from it — but a finer degree of discrimination has been applied during the listening tests, and the standards and relevance of the measurements have also been improved. I have not been particularly closely involved with the listening tests myself this time around, apart from the usual editorial responsibility of keeping a weather eye open, yet I feel it is not entirely without significance that the results for products of which I have had some experience tend to agree fairly closely with my own impressions. Any slight differences of opinion are more a matter of degree than disagreement, despite the fact that I know my own prejudices, preferences and perceptions differ somewhat from the reviewer's in various ways; this in turn gives me considerable confidence in the general findings. It is worth pointing out that *Choice* is not and has never intended to be an audiophile's handbook. The audiophile will continue to argue the finer points of turntable mats, cartridge connecting wires, and the like, until the cows come home; we feel that our duty lies more to the baffled consumer, and we feel it is important not to adopt an over-purist 'holier and thou' approach in our assessments.

Our criteria for including models for assessment was to be as catholic as possible, and we have managed to include a great many interesting new products. Unhappily some models of potential significance could not make the deadline, and one or two were omitted on grounds of availability. Amongst the former were the new range of turntables from ADC, which may well be unfortunate in view of the good performance of the LMF1 tonearm, and the latest range from Micro-Seiki, whose turntables also did well in the last volume. At the request of the manufacturer, whose demand continues to exceed supply to an embarassing degree, we have again not included the Rega turntables, the long-established Lenco brand is not being distributed in the UK currently, while both Syrinx and Breuer arms were also omitted on grounds of non-availability. While I am aware that there is a dillettante interest amongst some concerning the latest 'sudden death playoff' between cult hi-fi components, I consider it irresponsible to review — and possibly have to recommend — products that we know in advance will be unavailable; this will merely result in frustration for the reader and the retailer.

All the models with full reviews have been tested completely this time around, whether they were included in the last book or not. A handful of models that were in the previous edition, but were not retested (for a variety of reasons) and which should still be widely available, have been included in summary form at the end of the review section and incorporated into the other overall summary parts of the book, making allowance for the changes in test conditions.

The Choice format is unique in offering a perspective on the hi-fi wood in any product category. but perhaps inevitably is not as able as a less comprehensive publication to portray the finer details of the trees. Mindful of this, we have not, for example, drawn fine distinctions between Hadcock, Mayware and Decca unipivot arms; having tried to point out generalisations, it is then up to the consumer and retailer together to optimise a system to the former's personal taste.

The author has requested me to point out that he has prepared reports as a private consultant to the manufacturers of the following turntables in this report: Philips *877,* Monitor Audio *ET500*, STD *305D*. Naturally every effort has been made to avoid any bias in the appropriate reports as a consequence, but we nevertheless feel it is important to declare this possible source of prejudice.

Paul Messenger

General Description and Evolution

The best place to begin is to discuss what a turntable consists of, and what precise meanings we shall be attaching to terms used in the rest of the book. Strictly speaking the word *turntable* refers to the rotating platter only, but there are few models marketed in this format these days; the term we will use to describe a turntable only is *motor unit* (and this will almost invariably be complete with base or plinth, cover, and arm mounting board.) An essential companion to the motor unit is the *tonearm* or *pickup arm*, and there are rather more of these available as separate units. By far the most common form of presentation however is the *record deck, integrated player* or *turntable system* which combines the motor unit and tonearm in a plinth, and this can allow the system to perform such functions as controlling the tonearm movement automatically. This integration should give designers tremendous benefits in optimising the performance of motor, arm, and cartridge, to achieve the best possible performance, and the benefits here can be great. But in practice, few manufacturers appear to take this very seriously. Quite a number of systems are supplied fitted with cartridges, but in the great majority of cases these have been selected for cheapness rather than optimum performance in the context of the system; in such cases it would be misleading to assess the performance of the combination, and we have used our discretion in the tests.

So there are three basic categories of products that this book is dealing with: the integrated player, the motor unit and the tonearm. These are rather different to the record player or gramophone of yore; in almost every case they will need the addition of a cartridge and must then be connected to an amplifier or receiver and pair of speakers to give music reproduction. Superficially it may seem a retrograde step to replace the simplicity of one box with the complex interconnections of four or five, so its worth taking a skimpy look at the evolution of the record player. The single box has been with us since the early days of the acoustic gramophone, originally sprouting a horn and later with the horn built into the box. This naturally evolved into the record player that was such a familiar sight a decade or two ago, and the more ambitious radiogram versions were imposing pieces of furniture indeed.

The first big change came with the advent and popularisation of stereo which required two separate sound sources. Boldly the radiogram sprouted speakers at each end of the box to become the stereogram, but without a massive piece of furniture it was impossible to get adequate separation, and as public taste became more discriminating and aware of various inherent limitations of the record player format, the 'hi-fi system', which had hitherto been the preserve of the hobbyist, became a mass-market phenomenon. Amongst the constraints of the record player is the problem of feedback between turntable and speakers, as the close proximity and physical connection of these is highly undersirable; secondly, to get good stereo it is necessary to use speakers that are quite closely matched acoustically, and the use of one built in speaker plus a satellite extension for the second channel makes this impossible; thirdly, the best place to site speakers for stereo is very rarely the most convenient place from which to operate the system, so for ergonomic reasons the split up was desirable, too; in fact there are a number of other reasons why record players as completely integrated units are undesirable, but it would serve little purpose to go into it at any further length here.

But why, one might ask, are we not currently using music centres, modules and the like? Why do we not detach the speakers and leave the rest of the electronics etc in one box? Well these alternatives do indeed exist, and are very largely the descendants of the radio and stereograms of ten years earlier. In contrast the separate record deck evolved from the enthusiast end of the market, where one traditionally bought or constructed for oneself motor units, tonearms, plinth systems and cartridges separately. The demand for a similar standard of performance with easier setting up and operation led to the development of integrated players, although it is probably true to say that the very best results are still to be found by optimising (or using a good dealer's knowledge to optimise) the best separate components from the manufacturer who has continued to specialise. It is no exaggeration to say that all extra complexities introduced to make integrated units more easy to use compromise the absolute performance of the system to some extent, yet on the other hand the security of automatic operation, particularly in a family environment, may be preferred by many users.

Looking to the future, the most obvious trend in hi-fi is the introduction of rack-mounted 'component systems', which are an attempt to fuse the flexibility of the separates system with the con-

venience of the music centre. This continuing desire for flexibility is the essence and *raison d'être* of the system built up from individual components, and whatever marketing format may be adopted, there will always remain the choice of separate components at the very heart of hi-fi, so that the individual has the chance to make his own selection based on his own priorities and budget.

Choosing the right turntable system.

The most important and yet in many ways the most difficult thing to do, is to specify one's objectives. What does one require from a turntable? The ultimate in sound quality? The ultimate in convenience? 'Idiot' or baby-proofing? In the majority of cases probably none of these things. Yet if thoughts are not given to objectives then the result may well be disappointment. The majority of people will not necessarily be searching for the ultimate of anything, will rather be working within a budget, and having specified a budget will start to look for certain desirable features. Hopefully they will also take the time and trouble to listen to the goods that they are intending to buy for listening.

Too often hi-fi components are chosen exclusively by reading catalogues and magazines, as this is the easiest way, and for many years the sound quality aspects of turntables has been widely ignored in the hi-fi world; and yet this will be the most important feature of all for many people. We have tried to report on the sound quality of the turntables as we perceived them under our particular conditions in the course of these reviews, which are hopefully 'typical', but will by no means be universal and cannot possibly be absolute. We have also attempted to measure some of the phenomena that have been observed, using test techniques that we believe are meaningful even though these are *not* yet 'typical'. But the mechanisms that account for sound quality differences are not entirely understood, and involve compromises as well as simple straight objectives. And the results of listening tests may vary according to the system or the room in which the system is used. For example, it is well known that the sound quality of some systems can change when the turntable or the speakers are moved around the room to different relative locations (and results have been known to be significantly improved by operating the turntable system in a completely separate room, reducing the acoustic coupling between it and the loudspeakers.) And actually changing the speakers for ones that have a less extended bass response can also clean up the sound coming from the turntable system!

It has often been claimed, and indeed is the majority viewpoint, that the sound quality of the speakers is the most important factor in the quality of reproduction in a hi-fi system. But this attitude is based on the fallacy that the sound quality difference of the other components are of an order of magnitude less important. It is my opinion (as yet as a minority I concede) that the exact opposite is the case. There is little point in having the finest speakers in the world when they are being fed inferior signals, and probably helping to cause these inferior signals by feeding plenty of wide-bandwidth energy into the turntable! I believe that it is perfectly valid to state that the sound quality of the turntable system is the most important single factor in determining the sound quality of the system as a whole, for the simple reason that the amplifier and the speakers can only make the best of the signal they receive from the record deck. (It is true that many people find FM radio an equally satisfying signal source, but I would respectfully suggest that for the majority of people the record deck is comfortably the most important signal source on grounds of accessibility, freedom of choice, quality of musicianship etc.; the cassette machine can not really yet be considered as anything other than a 'bastard' source, as the best recording will inevitably have originated from radio or disc, and will naturally lose a significant amount in the transcript.)

So in choosing a turntable system, it is worth considering that it may have more effect than any other component on the overall sound quality. It is also worth emphasising ergonomic significance, to avoid damage to records and styli (the latter can be most vulnerable if one is given to holding parties or returning late from the local to play a few discs!) And to confound the situation, the more complicated the record deck becomes in order to assist the ergonomics, the more sound quality compromises have to be made (this statement is not always true, but is more a generalisation that nevertheless holds true in a great many cases.)

The Job of the Turntable System

The prime function of the turntable system is to mechanically 'interface' the disc and the cartridge, so that the cartridge is able to extract the maximum amount of the musical information from the disc.

Ideally this is accomplished by ensuring that the cartridge is rigidly fixed with respect to the groove on the record at all times, but there are all sorts of reasons why this is impossible to achieve in practice. If we look first at how a record is cut, the disc is held down securely onto the massive platter of the lathe by vacuum suction, while the cutting head is actively driven along the lathe bed to make the groove spiral. This means that the position of the cutter head is always known precisely, and this leaves the cutter itself free to get on and cut the music into the groove. The whole process takes place as isolated as possible from structural or air-borne vibrations, and although things are far from perfect and there are bound to be some unwanted vibrations present, these will be imposed on the recording, rather than doing their best to throw the system out of control.

When it comes to replaying the mass-produced disc the position is very different. The very process of mass production introduces sizeable errors of eccentricity and in flatness, and the 'pitch' of the groove that is cut is not standardised anyway, being a variable adjusted by the cutting engineer according to the content of the recording and running time required. So there is no way we can clamp the stylus in a lathe and drive it across the disc; the system has to allow the cartridge to follow the unpredictability of warps and the like. The normal approach is to fix the cartridge at the end of tonearm about 9" long fixed to a plinth, and then let this track across a platter which should be spinning *steadily* at the cutting speed of $33\frac{1}{3}$ rpm. Some of the signal modulations in the groove are the same order of size as the wavelength of light (you can see the coloured interference patterns in reflected light), so we are perhaps talking about 'reading' signals cut as small as a millionth of an inch. And to read a signal we need to keep the cartridge rigid with respect to the groove, despite spinning the platter at $33\frac{1}{3}$ rpm and hanging the cartridge on the end of a beam that allows horizontal and vertical motion!

In order to further emphasise the inherent mechanical problems that the system has to try and overcome, it is both instructive and disturbing to examine the different magnitudes involved. This was poignantly portrayed by E. B. Meyer in the Boston Audio Society's magazine *The Speaker,* so I will draw heavily upon his data. To start with we must understand that the 'audio bandwidth' is the range of frequencies the human ear can hear, and extends from 'vibration rates' or frequencies from 20 to 20,000 cycles per second (abbreviated Hz). (There are arguments that frequencies below 20Hz are also important, but this is still a matter for debate and it would only further complicate the issue to deal with them here.) Likewise the human ear can easily detect differences in loudness that encompass 60dB, or a ratio of 1,000,000 :1. Even the simplest music is likely to contain enormous numbers of these frequencies at all these different levels at any one time, and the problem for the record deck (and the hi-fi system as a whole) is to get as much of this back as possible, while avoiding adding too much extra of its own.

To understand the dimensions involved in the record system we will construct an enlarged model in which one micron (one thousandth of a millimeter) is represented by one inch. A midband modulation in the groove at a 'typical' level (1kHz, 5cm/sec) gives a 16 inch peak-to-peak excursion for the stylus, while a 50Hz organ pedal at 10dB higher will require 10ft 6ins and the low level harmonic of a violin (10kHz, -40dB) only 0.068 ins! A typical stylus with 'line contact' profile on a high quality cartridge would produce vertical oval 'footprints' on the groove walls 10ins by 4ins. and would deform the vinyl by about one inch (twenty times the size of the violin harmonic.) The stylus itself is about 30ft high, and is attached to a bent pipe that represents the cantilever of 50ft diameter and 275 ft length, extending from a 2000 ft long cartridge body that is some 80 ft from the record surface! The arm has a diameter of 450 ft and crosses 1300 ft above the record surface from its pivot point nearly four miles away! This approach is somewhat deceptive, and deals only with dimension, not mass or velocity, yet it certainly admirably illustrates the problems of relative magnitude that the turntable system has to deal with. In fact it is quite amazing that record decks work as well as they do, and it is hardly surprising that there are differences between them.

Assessing the System's Performance

As far as the motor unit is concerned, we need to know how accurate the speed is, and how accurate it remains under all use conditions. We need to know to what extent vibrations generated within the turntable itself as a result of inadequacies of bearing and motor engineering or due to undesirable decoupling between platter and arm affect the net output of the turntable system, and also the effects of external vibrations, whether through the air or the shelf, ie to what extent the system behaves as an

When a test record is cut, a tiny amount of wow and flutter creeps into it from the wow and flutter of the cutting machine.

We ought to know.

We make what is probably the world's most accurate test record.

And we found that it wasn't accurate enough to measure the extraordinary low level of wow and flutter on our new series 2000 record decks.

Before we tell how we solved the problem, let us tell you how we caused it.

What's wrong with quartz.

Most advanced record decks use an oscillating quartz crystal to help control the revolutions of the platter.

As quartz oscillates accurately at about 1.3 million vibrations a second it makes a perfect standard to judge the speed of the platter.

That's why we use quartz at Denon.

But, and it's a big BUT, quartz does not make a deck accurate. It only measures accurately the inaccuracies in speed rotation.

To make the deck accurate in the first place, we had to invent a new type of servo-mechanism.

We check the speed 500 times a second.

Most advanced record decks have a system that checks their speed about 100 times a second.

That might seem a lot. But, as their specifications reveal, it allows the level of wow and flutter that we at Denon find unacceptable.

So we developed our completely new magnetic pulse system.

First, each platter is placed on the shaft of a special pulse wheel.

Then a magnetic coating of 1000 pulses is recorded on the inside of the platter rim.

Each individual magnetic pulse is placed to within an accuracy of 1 in 10,000.

Then, when the platter revolves the special magnetic head measures the rate at which the 1,000 pulses are passing.

This data is turned, via integrated circuits, into an electronic speed signal and then compared with the electronic speed signal given off by the quartz signal.

Any deviations lead to an instant electronic instruction to the motor.

This means that any speed errors caused by disc warp or excessive tracking pressure are corrected.

So the wow and flutter of the DP 2500, for example, at 0.015% WRMS, is a specification you get in practice. Not just one we get in our laboratory.

The new tests we developed.

With this specification, it's clear that a conventional wow and flutter testing system would only be measuring the inaccuracies inherent in that system.

Why a test record failed

So we developed a magnetic pulse system similar to that used in the deck itself. This gives a degree of accuracy greater than ever previously reached in record deck testing.

We also, incidentally, had to develop a new type of lacquer disc to measure the signal to noise ratio. The 75 DB level was so low, a conventional test record actually creates more noise than our deck itself.

AC makes less rumble than DC.

We come now to another revolution in our record deck: an AC motor.

The snag with DC motors is that small amounts of audio contamination are caused by the pulse surge of direct current. By definition, these surges are directly linked to platter speed and it shows up as rumble.

Denon have developed a linear flow AC motor that overcomes this problem. And with extra coils and a clean AC voltage system the conventional problems of an AC motor are also overcome.

Only one of 18 Denon Hi-Fi products.

We could continue explaining why our DP 2500 is worth every penny of £318*.

Like the way we've eliminated even the vibrations in a record picked up from the reverberations of the speakers.

But we wouldn't like to end by giving you the idea that we only make outstanding record decks.

Our range includes a cartridge that was used by Hi-Fi for Pleasure as their reference cartridge in a comparison of 11 top cartridges.

It includes our 850 series amplifier that has the best in built head amplifier for moving coil cartridges. (We haven't just added on integrated circuit to boost the signal.)

It includes tone arms, tuners, cartridges, transformers and the revolutionary Phono Crosstalk Canceller that virtually eliminates crosstalk from your hi-fi system.

Send us the coupon and we'll tell you where you can hear our equipment for yourself. Bring your favourite records along by all means, but don't bring a test record.

They're just not good enough.

Please send me more details of Denon's equipment. And where I can hear it. I am most interested in: Record Decks ☐ Amplifiers ☐ Tuners ☐ Cartridges ☐ Cartridge transformers ☐ Tone arms ☐ Head amplifiers ☐

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*Price without arm. Price with arm is £336.

to test our record deck.

unwanted 'microphone' that will promote feedback. Turning to the pickup arm, it is neccessary to ensure that the bearing friction is low enough, that the geometry and alignment is correct, the effective mass (inertia) is appropriate (both these parameters will be dealt with later), and that the arm (ideally) does not decouple at the headshell fixing.

I used the word ideally in the last sentence because in practice of course it is impossible to prevent some sort of movement due to bearing play or resonance in even the most sophisticated apparatus. It is here that the designer must make choices, and the best systems carefully play one weakness off against another to give the most successful compromise between a number of undesirables and give a subjectively satisfactory end result. So even though this report has gone far more deeply into measurements and objective assessments than most investigations in this field, the proof of the pudding must remain in the listening. And, in the last analysis, as I have said before, under the would-be-purchaser's own conditions.

Speed stability

Naturally a turntable must have constant speed if it is going to repeat the action of the cutting lathe for the benefit of the stylus. But this is a far from easy task in practice, because the stylus acts as a frictional drag that is never constant because it is related to the content of the music cut into the groove. There are also a number of other mechanisms in the turntable that can affect speed stability in a variety of ways. Speed variations are usually described by the length of time they last, so that a long term variation (caused perhaps by tolerances or electronics changing as a unit warms up) is known as *drift*, while a shorter term change that causes wavering in the pitch of a note (and is particularly noticeable on piano music) is known as *wow*. If you momentarily disturb the rotation of the platter, you can easily hear the results of introducing a gross amount of wow. Even shorter variations are known by the equally onomatopoeic term *flutter*, and this can sometimes be detected by a 'blurring' effect. But how important are these variations, and are there any other important mechanisms at work?

Absolute speed accuracy and drift stability, providing they are not severe, are unlikely to trouble the great majority of listeners at all. A minority of people (typically one per cent) are blessed — or cursed — with a sensitivity to and awareness of 'perfect pitch'; they will probably find variations between different discs of absolute speed and will have to correct accordingly, and will obviously be upset by a piano that drifts fractionally off-tune over a period of time. Fortunately this sensitivity is spared most people, so the absolute speed and drift parameters are of rather limited importance unless errors are gross.

Wow and flutter is normally quoted as a single 'figure of goodness' that can frequently cover a multitude of sins. We have gone a step further by separating these two components because their perceived effects can be rather different. Wow is probably the less harmful, and is often detectable on certain types of music only; some people find it rather more annoying than others, but because it is by definition subsonic it will interfere primarily with the presentation of the music rather than the music itself (think about it!) Flutter on the other hand refers to speed changes of shorter than one tenth of a second duration (ie frequencies above 10Hz.) And this will include frequencies that extend up into the audio band (ie above 20Hz) which will act along the line of the groove rather than across or up and down. So the cartridge will not respond to them directly, but they will have a 'frequency modulation' effect which will cause a blurring in the pitch of a note or interference with the harmonic structure. Although flutter is perhaps rather harder to detect than wow, there is some evidence that its effects are considerably more fatiguing in the long term.

One great weakness of the traditional methods of specifying wow and flutter is that the measurements are taken while the cartridge is replaying a steady single tone, so that the cartridge load on the turntable is constant, whereas in reality this constantly varying force has a considerable effect itself. In fact during the last *Hi-Fi Choice* on Turntables it was noticed that a number of designs exhibited audible 'dynamic wow' as a result of this variable drag. The potential for loss of the vital transient information on the disc by such a mechanism is serious indeed. Let us examine what happens in the simple case of disc that contains a silent passage followed by a single note played loudly on a piano. When the piano note arrives at the stylus, the drag on the turntable will increase significantly, will try to slow the motion of the disc with respect to the cartridge and the initial transient may be 'smeared' and followed by a 'wow' in recovery if the turntable system cannot cope effectively. And this initial part

of the note is the most important part, as it gives one the clues as to *how* the piano was played rather than merely what note was played at what loudness; this part of the note therefore contains much of the emotional content of the performance which helps to distinguish hi-fi from Muzak.

The only way one can cope with these problems of short term speed variations is to 'swamp' the force with a much larger one. In practice various combinations of three different techniques are used, but before even considering these it is obvious that the disc must be mechanically well-coupled to the platter by the mat, or any attempt to use the turntable to help overcome these effects will be in difficulties before it starts. The first technique that is used to keep speed constant is a servo or feedback mechanism which senses the speed and applies correction if necessary; this techique is quite effective for controlling long term speed inconsistencies such as drift, but naturally takes a finite time to react and cannot be of much assistance in preventing transient drag problems. The servo does not of course act as a force to overcome drag but as a reaction to counteract its effects, and therefore does not protect the 'music' content very effectively; in fact detractors of servo systems have described them rather unkindly as mechanisms that ensure that the speed is never exactly correct! Poorly designed servo systems can also introduce an extra wow or flutter component due to poor speed control.

The second mechanism that is used is the constant running power of the motor system (as distinct from the power added by a servo in response to a speed change). A measure of power is necessary in any case to restore and maintain speed, and naturally the greater this is, the more resistance to stylus drag will be offered. The inherent problems of the high power approach lie in feeding increased vibration into the turntable system as the power is increased due to the inevitable 'pulsing' effects of all motors. A high power motor also increases the torsional load on the main bearing and great care must be taken in design and manufacture to avoid problems.

The third and in many ways ideal way of overcoming transient drag problems is to use a high inertia platter. This effectively stores considerable 'force' in its rotational momentum, and yet avoids any pulsing vibrational problems. The use of a high mass platter requires careful bearing design to avoid wear (particularly in the thrust direction), and does not inherently correct for speed variations, so torque sufficient to overcome the inertia and keep the speed constant is also needed. But with the added advantage that high inertia is inherently stable and can iron out other speed variations effectively as well, the high platter mass would appear to offer some worthwhile advantages over other possible approaches.

Rumble and the like

Rumble is a general low frequency disturbance that is picked up by the cartridge. It can be caused by poor bearing quality but can include hum components from the motor and other general vibrations. Though similar in some ways to flutter, rumble actually causes extra signals in the cartridge as well as affecting existing signals and the results can be equally unpleasant. A problem area that can be adversely affected by the rumble performance of a turntable is the excitation of the low frequency resonance of the cartridge. This will be discussed in a more detail shortly, so for the time being it is enough to point out that it is a bad thing, is to be avoided as much as possible, is one of the reasons why careful matching of cartridge, arm and turntable is desirable, and also why a change in any of these can give unexpected results. This problem of the LF cartridge resonance makes it difficult to measure rumble meaningfully, but provided one is aware of the implications sensible comparative results can be obtained.

Resistance to external disturbances

One area of design that is frequently given only passing thought is the resistance of the turntable system to exterior disturbance. Different approaches are adopted by different designers, but without a doubt the use of a separate subchassis to support platter and arm, the whole unit decoupled from the plinth on springs, can be a very worthwhile approach. Nevertheless this is an area of uncontrollable variables such as the properties of the shelf or supporting furniture, and compromises such as whether the designer aims for vibration or shock resistance. The ideal 'high Q' decoupled system is probably best for vibration isolation and hence absolute performance, but is disliked by many because of the handling difficulties, as it responds to the slightest touch; my own experience of using such a system for several years is that one quickly gets used to the decoupling (this only takes about a week), but I would shudder at the thought of

garbage in! garbage out!

Said about computers, but equally true about Hi-Fi. No matter how expensive or advanced your arm, cartridge, amp and speakers . . . if you feed in a rubbish signal you get a rubbish sound out. Think about it before you spend another penny on your system. Pounds paid for your amp and speakers and pennies for your turntable mean only one thing . . . pounds down the drain. You might as well throw the entire system in the bin!

At Linn Products our objective is musical satisfaction from disc material. Bearing this in mind we have produced the finest disc source around in the LP12.

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grandmother or the baby-sitter attempting to operate it, so its suitablity must depend to some extent on one's domestic circumstances and priorities. The same must apply to shock resistance, which is not strictly a performance feature, but is most certainly an ergonomic feature of some importance.

The turntable does not only receive shock and vibration through the structure on which it sits, but is also very likely be used in the same room as the loudspeakers and will be bombarded by direct air vibrations, which can excite resonances in the structure that result in undesirable coloration. The net effect is that the entire system functions as an inefficient microphone, constantly feeding back the main signals at a lower level and thus reducing the 'dynamic range resolution' of the system (ie the range between soft and loud sounds that can be distinguished simultaneously). We have attempted to make some assessment of the different systems' susceptibility to vibration and feedback of all kinds, and this is described more fully in the *Technical Introduction.* There are as yet no agreed standards for making such assessments, so we have had to develop our own; because this is a new and poorly understood field, interpretation of these results must be made with great caution.

A little practical advice for those who may be suffering from vibration and feedback problems of various kinds may be appropriate here. A drastic but often effective solution is to physically remove the player from the listening room, but moving the unit around the room can also enable one to find a location where there is a significant improvement (typically corners are the worst places.) Improved isolation can sometimes be obtained by making sure the lid is closed, but there are lids and lids, and this again is not entirely predictable. Immunity from shock can often be improved by siting the unit on a wall-mounted shelf or a heavy slab of material like stone, slate or marble, or better still a wall-mounted heavy slab.

A recent trend has been to introduce such heavy materials as part of the construction of the turntable itself, but this is not really the same thing at all. This approach may reduce the susceptibility to a degree of excitation somewhat, but can also store the vibrations that it does receive for rather longer — another trade-off.

The Tonearm

The function of the tonearm is to follow the groove itself so that the stylus can follow the modulations inscribed therein and replicate as far as possible the motion of the cutter. This is normally achieved by pivoting the arm at a point typically 9″ from the stylus and arranging the geometry of the arm to avoid tracking errors as far as possible. Some horizontal tracking error is unavoidable except when using 'straight line' parallel tracking devices like the Revox and B&O 4000 series, because the cutter itself travels along a straight line. It is unnecessary to go into the complicated geometry, but sufficiently low tracking errors can be obtained when the angle of the cartridge is offset by about 25° from the line of the arm. The maximum tracking error of a fixed pivot arm is reduced as the arm is lengthened, but to avoid excessive increase in arm inertia (which will be explained shortly) the 9″ figure makes a good compromise. This does not mean that somewhat shorter or longer arms are not equally viable. It is necessary that the correct offset angle and precise location of the arm with respect to the platter be chosen, and individual reviews comment on the success with which this has been achieved. In fact the relationship is not a purely geometrical one, and the best overall compromise minimises the tracking error towards the centre of the record, where other distortions tend to be higher, in order to achieve the best balance.

An unfortunate adjunct to the use of an offset angle is the introduction of a bias force. The drag between stylus and groove will be along the line of the cartridge, and because this is not in line with the pivot, a force will be generated that pulls the arm towards the centre of the disc. Unfortunately this force has a frictional part which changes according to the program content of the disc (as has been discussed when dealing with turntables), so it is not possible to compensate for bias as accurately as one might like. In practice it is assumed that the highest level signals are the ones which are most difficult for the stylus to track anyway, and are also the ones that generate the greatest bias or sidethrust, so the compensator force is set to cope as well as possible with these high level signals, by means of an opposing outward force supplied by a mechanism built into the arm.

The above descriptions are generalisations that are applied and accepted by the vast majority of arm designers, but the field of disc replay apparatus has always thrown up unorthodox ideas and generated controversy, so there are quite a number of variations. Some designers for example might

prefer to sacrifice some tracking error in order to reduce the bias, as the bias force increases with the offset angle. The real winners in terms of geometry and bias are of course the straight-line trackers which have zero horizontal tracking errors, zero offset angle, and hence zero bias force to worry about.

Staying in the groove.

In order to keep the mass of the cartridge over the groove that the stylus is trying to trace, there is a spring mechanism known as a compliance between the stylus and the cartridge which supports the weight and ensures self-centering horizontally. This spring takes the form of a tensioned elastic hinge or pivot at the inside end of the stylus bar. In practice a spring/mass combination has a specific way of behaving which changes at different frequencies: imagine holding a springy metal rod with a weight at the other end; as you move your arm slowly, the rod and weight tend to move along with the arm and with little flexure in the metal spring, but as you increase the speed at which you move your arm to and fro, the spring starts to flex, the weight overshoots the end of a swing and comes springing back, until at some frequency your arm has to do very little work at all and the mass/spring combination swings wildly from side to side with only a slight wrist movement at the correct frequency. This 'natural frequency' of the combination is known as its 'resonant frequency'. Above this resonant frequency the mass will tend to stay quite still while the spring merely behaves as a spring by flexing. In effect there are three distinct regions: the 'stiffness' region below the resonance, where the spring will hardly flex at all; the resonance region where everything is excited very easily; and the compliance region where the mass will tend to stay still and the spring flex.

Having described the 'classic' mechanical resonance system,. it is necessary to add that no system actually behaves in such an ideal way because some degree of damping will be introduced. In the analogy with rod and weight, its behaviour underwater or in a barrel of tar rather than air would be considerably different. Some damping is present to control the resonance in arm/cartridge systems anyway, and this in turn reduces the decoupling effects of the resonance, so vibrations will be transmitted into the arm above the resonant frequency. So the 'classic' situation does not hold, and in fact the entire situation becomes sufficiently complex to make predictions somewhat uncertain.

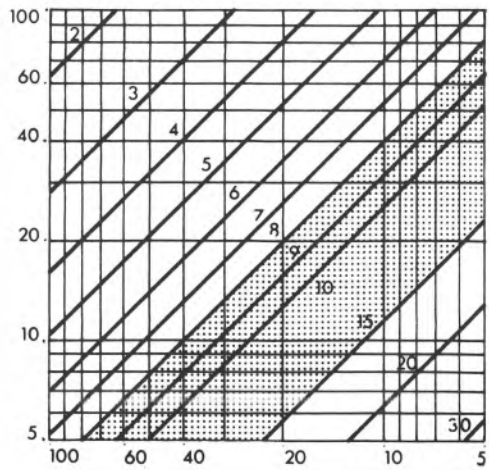
Getting back to the real position of the cartridge, stylus, and groove, we should get little relative movement and hence output below resonance, subtantial output and possible tracking problems at resonance, and 'normal' output corresponding to the groove modulations above resonance. Now we are obviously not too interested in getting signals from the cartridge that correspond to record warps,

MASS/COMPLIANCE/RESONANCE RELATIONSHIPS.

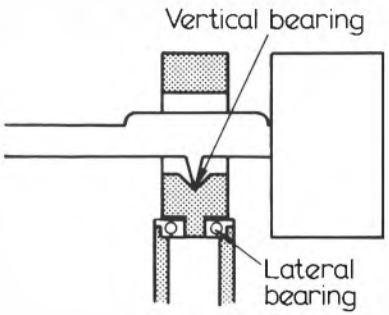
Calculating the main arm/cartridge resonance is relatively simple if one knows the following details; arm effective mass; cartridge mass; cartridge compliance.

Add the arm and cartridge masses together and draw in the corresponding vertical line. Then draw in the horizontal line corresponding to the cartridge compliance. At the point of intersection the resonance can be read from the diagonal frequency lines; the shaded area represents the optimum area within which the lines should intersect.

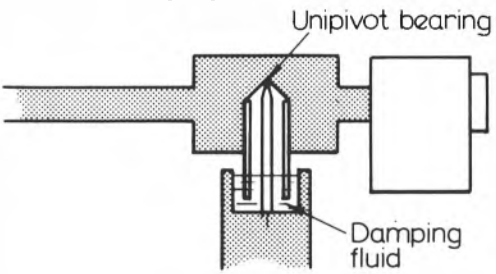
While not infallible, this technique usually gives useful and meaningful results.



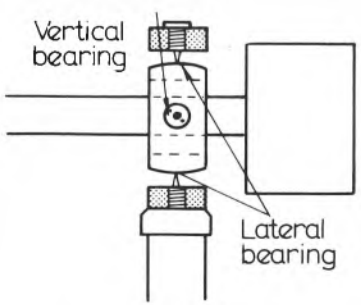
THREE TYPICAL ARM BEARING TYPES



1. Similar to that used by SME, this has knife edge bearings for vertical movement and ball race for horizontal. Many designs use a gimbal type instead of the knife edges. Most designs of this type rely to some extent on the arm weight to hold the bearings tight.



2. A typical unipivot with fluid damping, to assist stability is also 'gravity loaded'. and care must be taken to avoid rocking effects in use.



3. The gimbal type bearing should be independant of gravity or rocking effects, but may require more care in manufacturing adjustments.

and most such pressing faults occur below 8Hz, so it is best for this to correspond to the 'stiffness' region of our system. Audio signals are assumed to start at the lowest audible frequencies of about 20 Hz (and I don't propose to open the floodgates of controversy over this point here), so we need our compliance region to operate above 20Hz. This leaves the resonance in between, and this should be the area where there are fewest signals on the disc (or in the system if it has been designed correctly) and thus minimal excitation of this undersirable but unavoidable phenomenon. So by choosing an appropriate combination of mass and compliance, we have a system where the arm will follow record imperfections like warps, and allow the stylus to follow the groove modulations, which is precisely what is needed.

Various parties have suggested that the resonant frequency of the systems should be deliberately lowered to increase the bandwidth of the signals from the cartridge. There are possibly some gains to be made by adopting this approach, but they are a little nebulous, and it has been shown that if the LF resonance is continually excited then there will be a clearly measurable increase in midband distortions, so it is probably safer to avoid this approach. The interested can try adding extra mass to the headshell via a coin and some 'blu-tack' or modelling clay, but don't forget to reset the tracking weight or the stylus could disappear into the cartridge body! Other arguments for increasing the resonant frequency to nearer 20Hz have also been made, and this may have some benefits on some systems where a reduced LF bandwidth might prevent overload and upset, but by and large the 8-15Hz resonance seems to be the best compromise. The individual reviews will show the range of suitable cartridge parameters to achieve this optimised balance.

Damping

Most cartridges contain damping to help control the LF resonance, and this would seem to be a good thing in practical terms. Some arms contain or provide for pivot damping to assist the cartridge here, and in some circumstances this can improve the sound quality overall; whether this is due to the LF effects is not by any means certain. Damping at LF can help to reduce the magnitude (Q) of the LF resonance, but also increases the range of frequencies that will excite it, so that it will produce a difference, which may but is not necessarily an

improvement. Damping can also have the disadvantage that it will reduce the arm's ability to follow warps to some extent, and this means that some of this load will be taken by the flexing of the stylus in relation to the cartridge which will increase some forms of distortion in the cartridge.

Arm vibrations and resonances

A by-product of the compliance necessary to keep the arm and cartridge above the groove, obtain an optimum LF resonance, and ensure correct groove tracing at all frequencies, is that mechanical energy will be fed into the cartridge and also into the disc vinyl. The existence of this vital effect is frequently ignored by manufacturers, and amongst those who do recognise it there are diverse opinions on the best ways to cope with it! It is nevertheless worth mentioning some of the basic ideas involved.

Cartridges with low compliance and which use relatively higher tracking weights, such as moving coil devices, are potentially likely to feed more energy into the system in both directions than typical moving magnet types. So even if the moving coil cartridge does have instrinsic benefits (which is still a matter for debate), it is likely to make life harder for the arm and punch more energy into the vinyl.

Whatever the cartridge, the arm will receive vibrations as a result of tracing the groove modulations. If we go back to the resonance situation described earlier in connection with 'staying in the groove', we had three situations: stiffness below resonance, where movement is transmitted; resonance, where vibrations are absorbed (and in fact converted into heat as a result of relative movement and friction); and compliance through which vibration will not pass because relative movement will take place. In effect the resonance 'decouples' the frequencies above it from transmission. In the arm/cartridge system there are bound to be numerous resonances, all of which will introduce some degree of relative movement and hence degraded tracing accuracy at certain frequencies and decoupling above; and all the resonances will have a degree of damping that will affect their behaviour. If we were to decouple the cartridge from the arm at a frequency only slightly above its LF resonance with a high Q resonance , the cartridge would only generate signals over a narrow band, so it is fairly obvious that stopping the arm vibrations by resonant decoupling is an inherently undersirable thing to do.

Different approaches include avoiding decoupling for as long as possible down the arm and until as high a frequency as possible, selective absorption either at one point or spread through a material, the use of decoupled counterweights beyond the bearings to absorb vibrations and prevent reflections, the use of high quality bearings to transmit the vibrations through to the turntable (to complete the circle?) The situation is further complicated by the fact that resonant decoupling can introduce spurious extra coloration signals by reflecting vibrations back. The same arguments can be used to examine the excitation energy of the vinyl, which can be reflected, transmitted, or damped, and likewise it is difficult to say which approach is the 'right answer'.

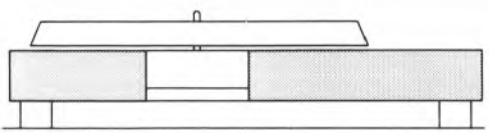
One cannot at this stage make definite assertions about the 'correct' approach to these situations, but evidence does suggest that systems resolving the most musical detail couple the cartridge closely to the arm tube, avoiding resonances as much as possible, and provide the finest bearings to transmit the energy on into the plinth or subchassis, while at the same time being light enough structurally to avoid problems associated with too low an LF resonance. Well-damped systems do perhaps obscure a certain amount of detail, but at the same time avoid introducing colorations. Because of the many imperfections and various trade-offs, once again the prospective purchaser is advised to try and listen for himself.

Arm features

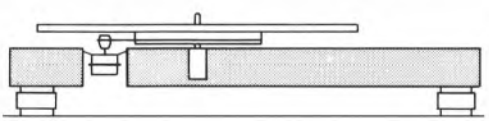
Pickup arms tend to use a limited number of engineering principles, and designers or their advertising agencies can be fiercely partisan about their chosen approach. It is true that some outstanding no-compromise systems can work extremely well for some people, but others may not find them to their taste at all, and a low-cost and heavily compromised system may have the different compromises chosen extremely well for a lot of people and thus become justly popular. There are fairly sound technical reasons why popular features such as automatic arm control or detachable headshells are undesirable, yet they do not constitute a disaster in a system if they are used wisely. Similarly a low cost bearing that uses the weight of the arm to load the bearing will not be as rigid as a high quality gimbal type of bearing, but used wisely can easily produce better results than a poorly chosen or set up 'super-arm'.

So while certain features in a pickup arm may be intrinsically desirable, there are others that are far more a matter of interest to the copy-writer who is trying to sell the device. Only the purchaser can decide the relative importance of such overall factors as sound quality, ease of use, ease of adjustment, stability in use, suitability to different cartridges etc etc, and every arm (and turntable) will have a different balance that will suit different people. The only essentials are appropriate effective mass, adequacy of bearings, correct geometry and alignment adjustment, although one might add a degree of mechanical integrity to ensure that the thing doesn't go out of adjustment or fall to pieces within a few weeks. If automatic facilities are provided, they should at least avoid interfering with the performance of the arm as much as possible, and work accurately without risking damage to the stylus they are designed to help protect.

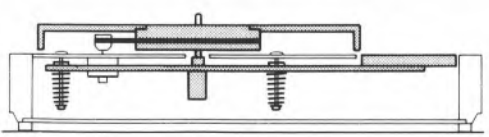
THREE TYPICAL TURNTABLE DESIGNS



1. A direct drive motor integral with the platter bearing is usually mounted on a solid plinth with any decoupling in the feet.



2. A solid plinth/belt drive type is often used in cheaper systems.



3. A decoupled sub-chassis/belt drive system offers good environmental and motor isolation. The entire suspended section is shaded.

Summary

In this introduction, I have deliberately tried to avoid dwelling on the inherent advantages/disadvantages of certain design approaches or special features as much as possible, because I believe these are usually of only marginal relevance to the actual performance of the system. Too often the system which is bristling with the latest highly desirable technology throws the majority of it away by making some particularly silly compromise somewhere, in the interests of saving manufacturing costs, at the behest of the marketing people, or even through just plain ignorance and misunderstanding. Consequently I have not even discussed the so-called controversy on the relative virtues of belt or direct drive, as I believe it to be the chimera of the sensationalist (or ignorant) writer. The tools used are invariably less important than the way in which they are used, and there are both good and bad examples of both belt and direct drive turntables.

Instead I have tried to look at the mechanical problems involved in getting back the information that the cutter has put onto the disc, and attempted to give the reader a framework for visualising some of the mechanisms involved. The intention is not to turn every reader into an armchair turntable critic, but to give some idea of the problems involved in order to illustrate how likely it is that turntable systems not only handle differently but also sound quite different as well, a suggestion that would have been regarded as preposterous in many quarters not long ago. The overall intention has been less to lay down set rules that invariably prove to have exceptions than to provoke thought about the different aspects of the system, because there is no getting round the fact that the most elaborate and expensively engineered systems do not necessarily work better than the apparently mundane that has been designed with a bit of flair. It is not an exaggeration to say that the 'art' shows itself all too frequently to be in a pretty sorry state, yet the spirit of enquiry that currently abounds seems to be advancing turntable system design at steady, if unspectacular rate at the moment, even though there is still enormous unrealised potential. And it is only by fostering a spirit of criticism and curiosity within the individual consumer that 'market forces' will start to work in his favour.

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If you're thinking of buying hi-fi, you'll find the same piece of advice cropping up again and again in advertisements and brochures:

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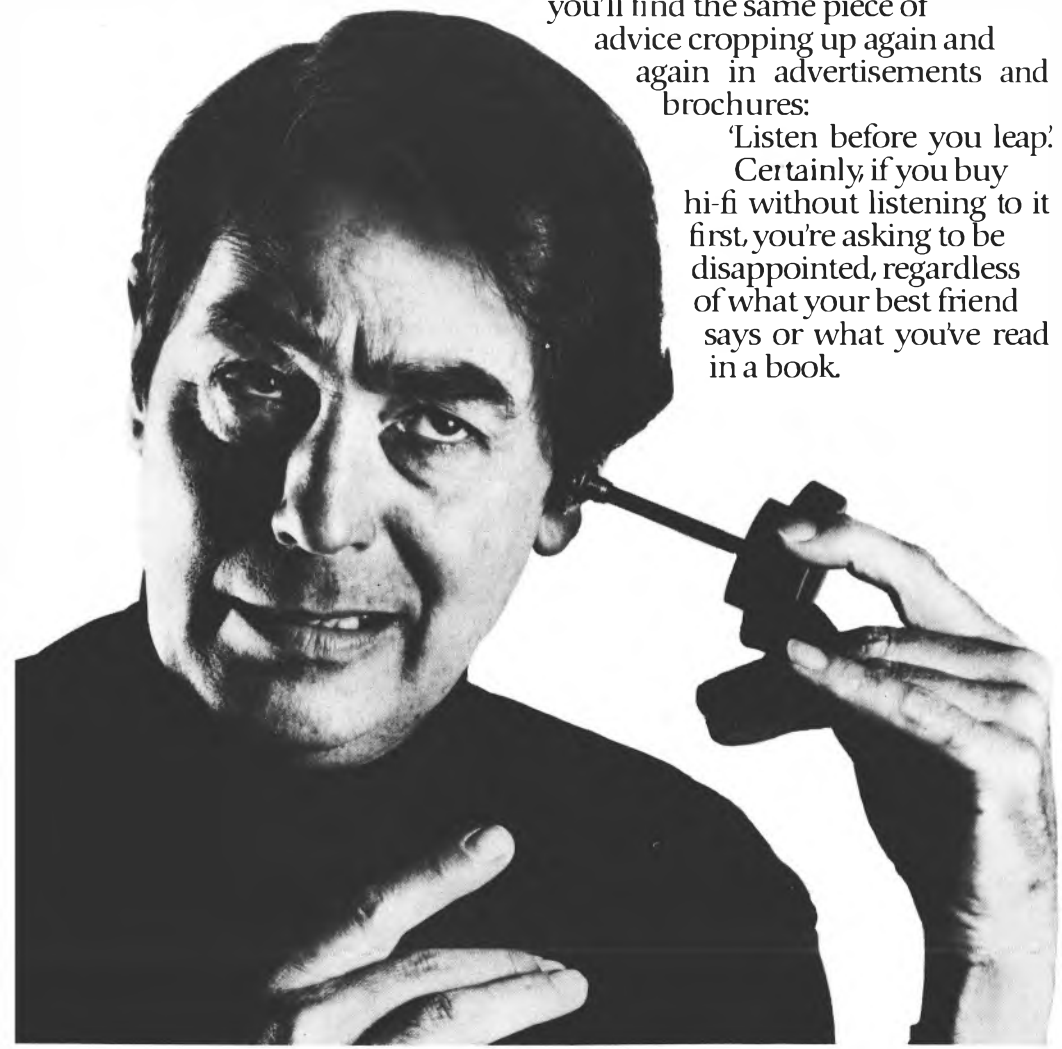

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Whatever turntable you choose there is no doubt that the arm and cartridge combination is the most critical of the record playing system. Because of this we have spent many hours trying the hundreds of arm and cartridge permutations – measuring and listening to find the correct combinations. As a result of this we are able to match cartridges to your arm, or arms to your cartridge to ensure complete compatibility. We can also advise on the correct loadings to obtain the optimum matching between cartridge and amplifier.
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18 months has passed since the preparation of the first *'Choice'* on turntables and cartridges; that issue contained sixty decks and arms, together with some forty pickup cartridges. This second edition has grown to cover well over 100 models of arm and turntable. While this expansion has made for improved product coverage in one direction, it has also meant that cartridges could not be included; a consecutive issue is currently being prepared to cover some sixty cartridge models, and this has given us the opportunity to examine some 40 headphone models at the same time.

The last issue of 'Turntables was technically ambitious in seeking to present those factors of turntable performance that particularly affect sound quality in more qualitative terms than had previously been attempted. In addition to conventional data — rumble, flutter and the like — other aspects of performance were also investigated: dynamic wow, for example, which is generated by some low torque servo-motors which possess speed recovery overshoot after a momentary loud passage has been tracked by the stylus. Other important factors taken into consideration were vibration and feedback susceptibility, plus acoustic breakthrough and tone arm resonances, the latter in both the subsonic as well as the audible range. All these aspects are again covered in this edition, and in some cases measurement advances have helped to refine and amplify the information obtained.

Arm Resonances

In the first issue the technique used to assess arm resonances was probably the least successful, as it relied upon the indirect method of examining the location of breakthrough in the crosstalk versus frequency characteristic of a high quality cartridge. This breakthrough is produced by arm resonances — a loss of rigidity which momentarily dislocates the left/right geometry of the tracking cartridge. In measurement terms however the high noise level precludes the generation of clear data. A dramatic improvement has been effected in this new issue by using a new ultra low mass (0.4g) B&K accelerometer/vibration transducer (model 8307). This tiny device may be fixed almost anywhere on the arm structure, to give a clean output of resonances in the band 20Hz-20kHz, without significantly altering the mechanical characteristics of the arm under evaluation.

A medium compliance cartridge was employed for this test, namely an Ultimo *20A* moving-coil (20cu at 10Hz), which weighs c.10g and comes fitted with a die cast body to allow firm fixing. This tracked the *'L'* band of B&K *QR2009*, 20Hz to 20kHz (pen recorder settings: paper 3 mm/s, pen 315 mm/s; *1615* pre-amp; *2603* mic-amp; 50 dB rms scaling on *2305* recorder). The energy transmitted into the arm via the mechanical impedance of the cantilever hinge was detected by the accelerometer in the vertical excitation plane, at a fixed length ratio of $^1/_3$ from the pivots or arm bearings. The curves illustrated for each arm represent raw data; in other words no correction has been made for the four main factors which together determine the base line function. These are as follows:

1) The variation of velocity with frequency cut on the disc (6dB/octave rising from 20Hz-1kHz, then constant velocity, 1kHz - 20kHz).
2) The non-linear function of magnitude of the cartridge's mechanical impedance (fig 1).
3) The accelerative response of the vibration transducer (6dB/octave rising output with frequency)
4) The mass control characteristic of the arm's mechanical impedance as seen by the cantilever.

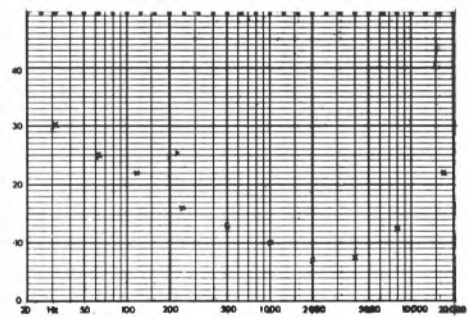


Fig 1: Mechanical Impedance Ultimo *20A* (1.8g, OdB = 33 Mech Ω).

It is necessary to integrate all these facts before the magnitude of the anomalies present on the graphs can be judged, in terms of the resonance characteristic of the arm under test. Before interpretation can proceed, however, it is important to realise that some of the plotted resonances are intrinsic to the Ultimo cartridge itself, representing as they do structural resonances in internal components. To try and assess the latter, the cartridge was freely

suspended on a flexible loop and the vibration in the vertical plane on the cartridge body was plotted (see fig 2). However, this graph cannot be compared

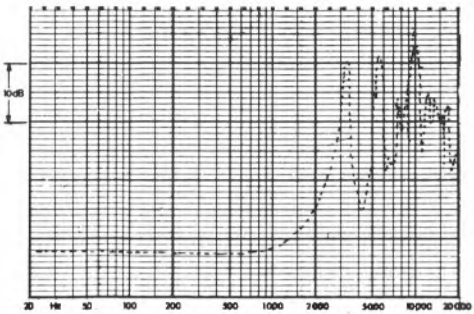


Fig 2: Resonances in test cartridge, free suspended.

directly with the arm resonance curve, since the cartridge mass is not coupled to the arm, and the measuring point is greatly different. However, an interesting comparison can be made with the vibration curve of the same cartridge body when attached to a test arm (fig 3). Measurement was

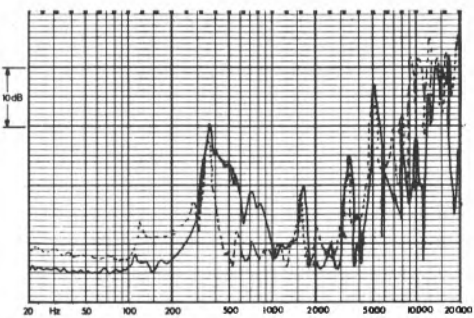


Fig 3: ADC *LMF1* (vert. sensing), dotted curve on headshell, solid curve 1/3 from pivot.

made in two locations, firstly on the headshell/arm body and secondly at the ⅓-from-pivot position adopted for the remainder of this investigation.

A series of sample responses taken on the Ultimo test cartridge suspended on various flexible mounts indicated that no intrinsic cartridge resonances occurred before 1.5kHz. In the vertical plane simple resonances were present at 3.3kHz, 5.5kHz and 10kHz, while in the lateral plane 2kHz and 5.5kHz were dominant, with notches rather than peaks at 14kHz and 17kHz. When fixed to a pickup arm, further resonances appeared, whose magnitude and distribution were dependant on the type of pickup arm used. These were introduced into the otherwise 'clean' region of the cartridge output; for example, a perfect arm of infinite rigidity should theoretically exhibit some mildly distorted form of the cartridge's own irregularity above 2kHz.

It is thus the modification introduced by the arm which gives a clue to its own dynamic behaviour, and thus hopefully its sound quality. Take the illustrated case of the ADC *LMF1*. By comparing the graphs of the 'free' cartridge with that attached to an arm, the outputs above 2kHz tally closely until the 10kHz point is reached, above which the comparative eveness of the cartridge response is distorted by a sequence of 20dB peak-to-trough resonances. However, by moving from the headshell to the ⅓-from-pivot measuring location the agreement is pretty good up to 7kHz, but becomes clearly modified above this frequency.

From these and other graphs was devised an approximation to the energy input curve to the arm under test, and this has been superimposed on each arm resonance graph to aid comparison. While with a single cartridge (in this case the Ultimo) the curves are highly repeatable, it must be remembered that this energy input signature is unique to the cartridge model, and different results will prevail with other models. For example, fig 4 shows the resonance curves of the Mission *774* arm using both the Ultimo and the Supex *900E Super*, the differing characteristics of the two cartridges giving rise to different excitation patterns.

(Note: when assessing the arm resonance graphs the small fine 'spikes' on the traces are not resonances — these are due to random noises or 'clicks' and should therefore be ignored.)

Subjective data taken from the 100 or so arms tested strongly supports the view that to give the best results in terms of coloration, precision of stereo image, plus depth and detail rendition, the first priority must be rigidity. For the cartridge to track in a defined vertical relationship to the record surface it must be clamped rigidly over as wide a frequency range as possible. Once the frequency is reached where the arm structure, be it a tube, shell or socket, begins to flex, twist or vibrate, then the geometrical relationship of the cartridge to the two opposing groove walls is disturbed, and the retrieval of the information impressed therein is consequently impaired.

This high rigidity criterion suggests that the location of the first resonance or loss-of-rigidity

point be deferred to as high a frequency as possible — a requirement not unfamiliar to the designers of loud speaker diaphragms. In fact the anology can be taken a step further, the headshell/arm structure equating to the cabinet of a loudspeaker and the cartridge to the speaker drive unit. In either case, delayed resonances will colour the sound and impair transmission of fine musical detail.

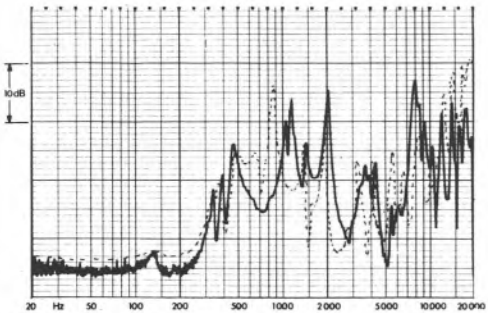


Fig 4: Comparison of Supex *900 E Super* (solid), Ultimo *20A* (dotted) (Mission *774, TD160C).*

Another way of viewing the consequences of significant arm flexure derives from intermodulation theory. When vibrational frequencies due to flexure appear in the music passages, the arm resonances act to amplitude modulate the other frequencies present, thus producing side bands or intermodulation products in the form of increased distortion.

Returning to the interpretation of the resonance graphs. If the published curves are examined, it can be seen that the first flexure may occur as low as 80Hz, or as high as 900Hz (dominant modes considered) and these are more than 3 octaves apart. Most detachable headshell models begin to flex noticeably around 250-300Hz — this first mode often identifiable in mechanical terms as a lack of rigidity in the plug and socket fitting. Such flexure complicates the interpretation of the remaining sections of the graph, as it is certain that this junction will fail to uniformly transmit energy down the arm tube to the accelerometer position. In such cases, judgment of spectral inbalance needs to be undertaken with great caution (While the ideal accelerometer position is undeniably on the headshell or cartridge body itself, tracking problems result from the high stiffness of the accelerometer cable).

From the listening tests sufficient data has also emerged to link several other aspects of arm sound quality with the measured response graphs. For example, break up as low as 80Hz tended to impair bass definition and imaging, while 200-500Hz resonances often resulted in a thickening and muddled effect in the midband, with a 'loud' 'forward' quality that reduced the impression of depth. Uncontrolled breakups higher up the band were often linked with a coarsening and hardening of the sound quality, and above 5kHz irregularities were associated with slurring of vocal sibilants and a fizzy effect on treble sounds. In several instances this was sufficiently pronounced to give an impression of mistracking or even of a worn record, but further investigation proved that the arm and not the disc was at fault in each case (fig 5 shows an example of quite severe upper frequency resonances).

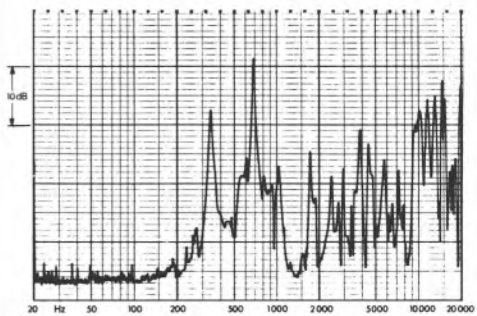


Fig 5: shows significant HF resonance modes (DSC Jelco).

In addition, mild changes in tonal balances from one arm to another can also be allied to clear response differences. A fine example of this is provided by the SME *III* and the Mission *774* as both are rigid head/tube designs with the junction near to the pivot. However, by comparison with the Mission the SME sounds a trifle rich and muted in the upper treble range. Examination of the energy in the 10-20kHz octave shows that of the SME to be damped down by some 10-20dB relative to the Mission. (This is not to imply that the cartridge output will be reduced by this amount, as the arm resonances are second order effects responsible for perhaps only 0.2-0.4dB changes in the prime cartridge frequency response.)

Subsonic Arm Resonance

So far we have only touched on the subject of arm

resonances above 20Hz — those occurring below this frequency have yet to be discussed. In conjunction with the compliance or resilience of the cantilever hinge, the cartridge mass plus effective mass of the pickup arm as related to the stylus position results in a mechanically resonant system. Ideally the latter should have a minimal effect on performance, and with moderate subsonic (from cartridge and/or arm) damping and a resonant frequency in the 10-15Hz range this is in fact the case. Unfortunately very few arm/cartridge combinations even approximate to this theoretical objective. For example, with ideal values of low frequency cartridge compliance eg. 10, plus a 5g effective mass and 5g arm, a desirable resonance of around 13Hz results. Examining values for current models. we find detachable head/arm masses at typically 15-20g, cartridges 15-10g and compliances in the 10-50 region. Typical values would give a total effective mass at 25g, compliance at 20 and the resulting resonance lifting an average of 11dB above the reference level, at about 6Hz. This will produce continuous oscillation during record play, inducing both vertical and lateral 'scrub' flutter, an imprecision of tracing geometry, and severe stylus down-force variations, all of which will combine to impair the tracing margin. With mild external vibration or shock, this near unstable condition also promotes groove-hopping, and furthermore it can degrade feedback margins by a factor of 10dB or so.

Using a B & K*2010* record 5-20Hz sweep, rigid arms were found to produce well defined arm cartridge responses (fig 6) but nonetheless some did reveal oddities, particularly the unipivot types. For example, the Hadcock produced a double humped resonance with a strong suckout following at a higher frequency, (14Hz). This was due to the lateral resonance exciting rocking in the vertical plane, and in this case the specified damping did not greatly ameliorate the irregularity, which is likely to the felt in terms of a mild detail loss due to the vertical tracking angle instability, plus a loss of bass definition. Generally speaking, the other unipivots appeared to suffer rather less from this problem (notably the new Michell *Focus* arm, which has sufficient self-righting stability and damping to control the double resonance.) This double resonance can also be produced by such as the Dynavector, an arm which possesses two effective masses — one in the lateral and another in the vertical plane. Alternatively, a cartridge with two compliance values such as the Decca also exhibits this effect. A further contributing factor was traced to the harmonic of the subchassis resonance (see Breuer resonance with and without Linn *LP12* subchassis clamped fig 10).

While still on this subject of subsonic resonances, it is worth noting that at the present time it is almost impossible to state what defines an accurate bass response in a disc reproducing hi-fi system. At the recording data stage, bass is strongly modified by the quality of the orchestral platform as well as the nearby walls and hall acoustic. Added to this are microphone rolloff; the multiplicity of balancing transformers in the studio chain mixer and recorder etc; rolloff due to recorder electronics and tapeheads, and finally, equalisation and rolloff at the disc cutting stage. At the consumer end add the arm/cartridge bass resonance and preamp roll-

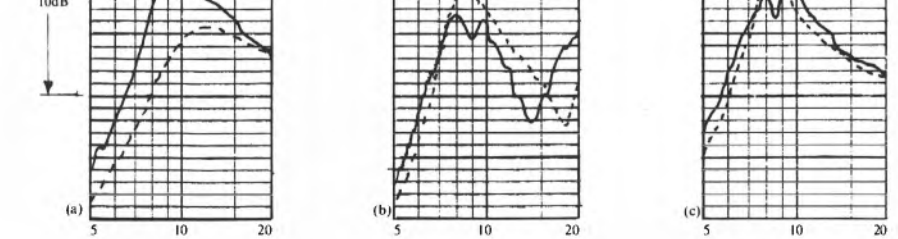


Fig 6: Examples of LF resonance; 9.5g, 20 cu. cart. (a) SME III, solid undamped, dotted damped. (b) Hadcock, solid undamped, dotted damped. (c) Linn/Breuer, solid subchassis free, dotted subchassis clamped

off plus the inevitable rolloff at the loudspeakers, and the latter's interactive response in the listening room. Cumulatively, this means that the final –3dB bass cutoff as perceived by the listener can be anywhere from 30 to 100Hz, with considerable phase shift resulting from as many as 12 cascaded filter poles. In some ways, it is surprising that we can enjoy disc bass at all!

Motor Unit/Arm Matching and Coloration

Obviously arm sound quality is further complicated by the addition of the turntable. Ideally this should not contribute any sound of its own, but in practice it often adds further varying degrees of mild coloration. These derive from a number of sources which can be summarised as lid induced resonances; energy storage in the disc due to inadequate record support; resonances in the plinth and/or on its support system; and finally if the latter is inadequate, floor borne vibration. These may prove either beneficial, as in the case of the Michell *Focus* system where the end result is quite well-balanced musically, or alternatively they can prove detrimental; for example, the Monitor Audio *ET500* motor and Micro *MA505* arm were found to make an unfortunate combination in terms of the resulting sound quality, and yet the motor alone partners most other arms well, while the *MA505* was itself satisfactory when used in its own Micro *DDX1000* turntable.

Thus when one attempts to describe the sound of a turntable unit, one has to take into account a seemingly never ending combination of circumstances — floor-borne vibration; direct acoustic transmission; disc support; the arm and its audible and subsonic resonances; whether the lid is up or down (in some models the feedback margin can change by 10dB); what room position and what kind of shelf the deck is mounted on; and finally, such factors as the tightness of the cartridge fixing screws (see graph of finger tight and screwdriver tight metal screws, fig 7.)

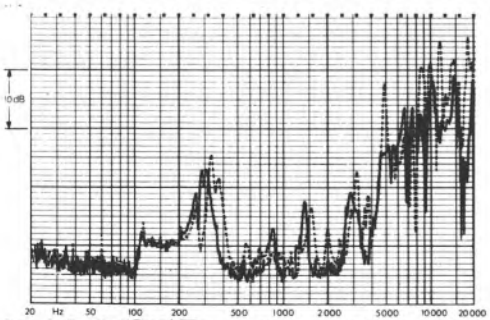


Fig 7: ADC*LMF1*, dotted cartridge screws tight, solid screws finger tight.

Rumble

All these factors do not include the contribution of other mechanical defects in the turntable system which might not be directly audible but which might nonetheless disturb listening satisfaction. It has been suggested that the high transverse forces developed by some direct drive motors on the main bearing can generate a form of rumble which can be detected as flutter sidebands in the lateral plane*. Fortunately, for this issue a new rumble measuring method was adopted, utilising an energy coupler developed by Thorens which has pushed the 'Din B' measurement from a –73dB limit to around –80dB. It is in precisely this range that one can begin to discriminate between direct drive motors in terms of rumble, and it can be easily illustrated by spectral analysis that many direct drive motors do generate more rumble than comparable belt drive counterparts (see fig 8 graphs for Trio *KD750* and Thorens *TD126 III*).

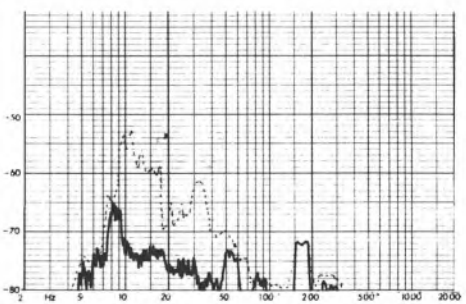


Fig 8: Comparison of rumble spectra; solid Thorens *TD126III*, dotted Trio KD 750. (50,160 Hz regions include hum).

On theoretical grounds it can be argued that a sufficiently low rumble level for direct inaudibility

* A difficult but sophisticated measurement of flutter has been developed for research purposes by B & O, which readily resolves such sidebands. An optical sensor is used, with accurate computation of irregularities in periodicity.

may still not guarantee complete freedom from other rumble induced effects. Whether directly audible or not, any unwanted or spurious displacement due to platter main bearing inadequacy or out of balance motor torque effects will interfere with the accuracy of groove/stylus tracing. After all, Din B rumble is only an arbitrary weighted curve approximating to the directly audible sound of rumble noise. With the help of the 'coupler' we have discovered that while a –72dB Din B figure was in some instances insufficient to guarantee inaudibility, with others measurements as poor as –66dB gave an inaudible background at typical listening levels. This points to a failure of the weighting curve to cope with all types of rumble spectra.

In fact, we found it possible to trace sources of rumble noise for some of the turntables in the report. For example, several direct drive models possessed main bearings with an intrinsic rumble in the –78dB Din B region (power off, motor free-wheeled). Reconnection of the supply resulted in degraded figures, not due to hum, but generated by the torque pulses in the motor. This interference was also observed with at least one belt drive design, the source being readily traced to poor isolation of motor vibration from the arm base.

Unweighted Din A readings were also taken, but inevitably these results were dominated by the unwanted 'weighting' introduced by the particular subsonic resonance curve of the test cartridge, while the quality of vibration isolation could also contribute.

Acoustic Breakthrough

The acoustic breakthrough tests were further improved in this issue by the use of equalisation, which gave a flat energy pink noise sound field from 30Hz to 2kHz at the test location, thus producing more relevant curves. As before the graph represents $^1/_3$ octave analysed noise of the RIAA equalised cartridge output resting in a static groove (paper speed 1mm/s, pen 25-80mm/s, 50dB rms pot, Ultimo *20A* cartridge).

Wow and Flutter

While still to the DIN standard, the measurements for wow and flutter in this edition differ somewhat from those previously published. The same Matsushita master acetate was used as before, but this time in conjunction with a new generation wow and flutter instrument (model *WM1)* with an automatic reading facility (B & O instrumentation division.) DIN specify peak readings which are difficult to estimate from the usually wildly fluctuating meter pointer, while the picture is further complicated by occasional random noise excursions; consequently with a conventional meter one tends to under-read. However this new instrument has the ability to reject random effects and accurately records the peak periodic wow and flutter over either three selected intervals, or σ functions. We used 'σ2', (5% of the test period).

By comparison with previous results this method yielded 20-30% higher readings with commensurately greater accuracy and consistency. Linear peak readings were also taken for wow below 6Hz, as well as for flutter above this frequency (with a poorly damped arm/cartridge subsonic resonance these measurements can be in error and accordingly a Shure *V15IV* with damperwas mainly employed for the flutter tests, in place of the Ultimo) The finest examples recorded 0.04% DIN peak-weighted (σ2), and this level is probably close to the residual flutter on the test disc itself. Therefore models reading 0.05% or below are simply quoted as measuring less than 0.05%.*

While still on this subject it is particularly interesting to note that some 0.1% unweighted peak wow can be produced by an off-centre displacement of the record of as little as 1mm which can be the result of poor record manufacture, an oversized or inaccurately placed centre hole (the standard specifies 7.24-7.33mm diameter) or even an undersized turntable spindle. For an off-centre record rotating at $33^1/_3$ rpm, the wow frequency is 0.5Hz approximately, a rather slow rate.

The ear is most sensitive to wow in the 4-7Hz range; frequencies above this are not perceived in the form of wavering pitch, and even when excessive are only really audible as 'roughening' type of distortion increase. In part this explains why it is desirable to shift any turntable system subsonic resonances away from this region, be it suspension or arm/cartridge in origin. Since the two latter resonances should not coincide, we are left with the suggestion that the subchassis resonance should be below 3Hz and that of the arm/cartridge above 8Hz. The maximum incidence of record warp

* Denon claim very low wow and flutter measurements using a magnetic shaft encoder (a derivative of their magnetic pulse speed control method encoded on the platter rim.)

amplitudes also falls within this critical 3-8Hz region, and further reinforces the suggestion.

Arm Geometry and Cartridge Alignment

Another important area concerns arm geometry and cartridge alignment. There are two extremes, one a system of mediocre quality where comparatively large errors in cartridge alignment may pass unnoticed, and the other an up-to-date high performance system, where poor adjustment will significantly degrade the potential end result. The automobile analogy is an elegant one; a family runabout with a low compression engine is fairly tolerant of poor engine tune, but a higher performance model is utterly dependant on accurately set timing, valve openings and mixtures etc.

A few degrees of cartridge misalignment will degrade the channel separation of a high class cartridge by a factor of some 15dB, but on the other hand it will produce relatively little impairment of the already moderate separation characteristic of a less expensive pickup. At present the importance of accurate arm alignment is highly underated. Virtually all Japanese arms and turntables are currently supplied with an alignment procedure called 'overhang adjustment', which is accomplished by altering the amount the stylus tip overhangs the record spindle when the cartridge body is aligned immediately above it. But this is next to useless when quality cartridges are involved. While a 1° error can be easily seen and corrected with a protractor, a small 1mm overhang error (less than 4/100 of an inch) can produce a similar degree of misalignment. One solution would be to use one of those protractor cards that are supplied with a number of universal pickup arms, as these have an array of parallel lines against which the cartridge side face can be aligned when the stylus point is in a specified position. However the majority of protractor cards (SME and its counterparts) have a stylus point at a 6cm radius from the spindle, working on the basis that the optimum tracing distortion trade-off will thus be obtained, if using a traditional spherical stylus and a mix of 45 rpm singles and 33⅓ LPs. In practice, this is not the best solution for the mean music radii of today's 33⅓ LPs (45s discounted), particularly if used with the now almost universal elliptical and line/hyperbolic styli supplied with hi-fi cartridges.

With a correct offset angle (for which it is often necessary to rotate the cartridge laterally in the headshell, since most headshell offsets are not optimal), and with an accurate overhang for the actual arm length (the pivot to stylus dimension), a condition of minimum tracing error may be achieved. Two points of zero error are used, sensibly positioned between the maximum and minimum playing radii, with the inner zero at a radius of 6.6cm and the outer at 12.1cm. Such precision also suggests that as the bias be equally carefully set, so that the stylus is kept as far as possible at its geometrically aligned position (large bias errors permit the out of balance forces to laterally deflect the cantilever, thus adding to tracking error.)

Aside from matters of mass/compliance compatibility, damping, tracking weight, and bias adjustments, two other alignments are also crucial. One is that the effective axis of the generator system within the cartridge is accurately aligned perpendicular to the record surface; hopefully this is ensured when the cartridge body itself is truly vertical when viewed from the front. Small degrees of tilt of the order of 1° may again degrade separation and Vertical alignment is particularly important with Shibata tips where a small tilt will cause the long contact walls to miss the intended groove sections, resulting in mistracking.

Finally the horizontal axis of the cartridge, that is the angle as seen by the cantilever back to the arm pivot from the stylus record contact point, must agree with the disc cutting standard. Nominally this measures 20° but in practice it is closer to 18°, and if this is not maintained, the stylus side contact line will rake across the cut groove axis at an angle, distorting the playback. Unfortunately it is not enough to simply ensure that the top surface of the cartridge is parallel to the record, as some cartridge manufacturers are not wholly consistent and many pickups when set visually parallel have cantilever/generator axis 'rake angles' as great as 40°.

Correction of this sort of error will require one of two solutions: either a lowering of the arm pivot by as much as 2.5cm (but with many cartridges this will cause fouling of the body on the record surface or complicate arm operation); or alternatively (the preferred solution) would involve rigid angled spacers at the headshell position, but these are not readily available. The only relevant angle when setting the 'rake' is that made by the cantilever with respect to the disc plane, and allowance needs to be made for higher compliance cartridge styli with their significant change in rake angle with applied tracking downforce.

Where a cartridge manufacturer has chosen to adopt say an incorrect 35° vertical tracking angle and has set the longer tracing edge of the stylus accordingly, no proper correction can be made via arm tilt, because if rake is correct the stylus groove wall geometry will be wrong, and vice-versa.

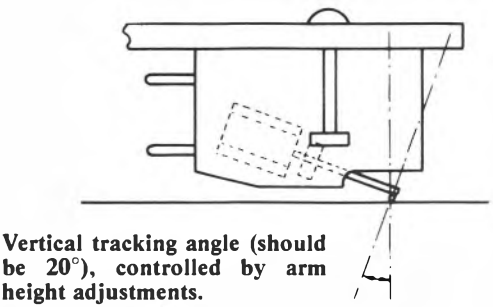
Leaving aside the doldrums of optimal alignment, it is disheartening to report that not only did the majority of arms examined make no provision for vertical alignment, but also many have their headshells fixed in a permanent 1-2° canted attitude. Likewise, very few of them made provision for height adjustment to optimise cantilever vertical tracking angle, and even the basic lateral correction for tracing angle often relied on an imprecise overhang measurement, which is often theoretically in error for the arm dimensions. It must be admitted that these shortcomings are not wholly of the manufacturers' making, but reflect the inaccuracy of the disc playing system, which is so tolerant of niceties of alignment that despite a compounded multiplicity of errors the cartridge will nonetheless continue to play records, and many users remain oblivious of the musical information they are missing!

Listening test conditions

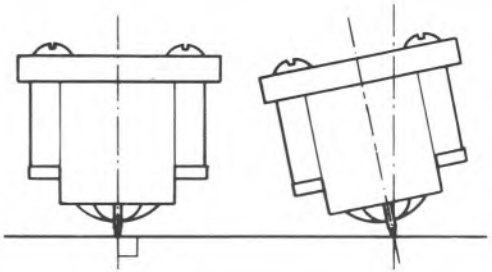
These were conducted in the author's living room, which closely aligns to the IEC recommendations for such testing (96h x 139w x 184l; Rt 0.3 seconds +/−20% over the prescribed band.) The test turntables were placed on a substantial cabinet constructed of ¾ins blockboard, the latter resting on a timber suspended floor. The cabinet was located at the opposite end of the room to the loudspeakers, with the test turntable positioned 1.5m from the corner but adjacent to a local wall. The decks were tested using the supplied cartridge (if any), the main references being a matched pair of Supex *900E Super,* with alternatives including the Ortofon *F15E,* and Shure *V15 III.* Ancillary equipment comprised KEF *105* and Spendor *BC1* loudspeakers; Naim *NAP250* and *NAC32* power and pre-amplifiers; Quad *405* power amplifier and a Technics *SU9070* preamplifier.

Records used in testing mainly comprised the following: Matsushita master acetate discs; Sheffield Direct Cut 'Dave Grusin Rediscovered' and Thelma Houston: I've Got the Music; specially selected copies of 'Joan Armatrading' (as some copies sound different from others); Enigma Records 'Peter & The Wolf', a crossed pair recording; and finally 'Bunk Dogger'.

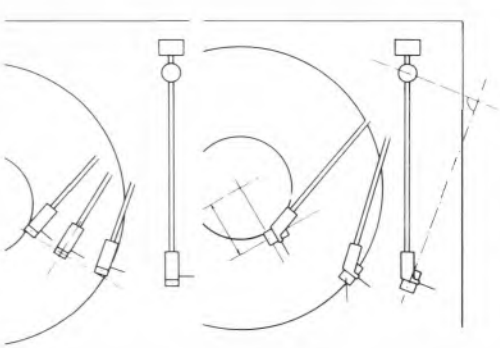
CARTRIDGE ALIGNMENT



Vertical tracking angle (should be 20°), controlled by arm height adjustments.



'Tilt' angle (seen from cartridge front)



LATERAL TRACKING ERROR

Note how the arm with 'angled' headshell offers better geometric alignment with the groove than the straight fixed-pivot arm. The dotted lines show how the drag between stylus and groove is translated into a force pushing the arm towards the disc centre, and bias compensation is used to counteract this.

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Trio	Hitachi	I.M.F.
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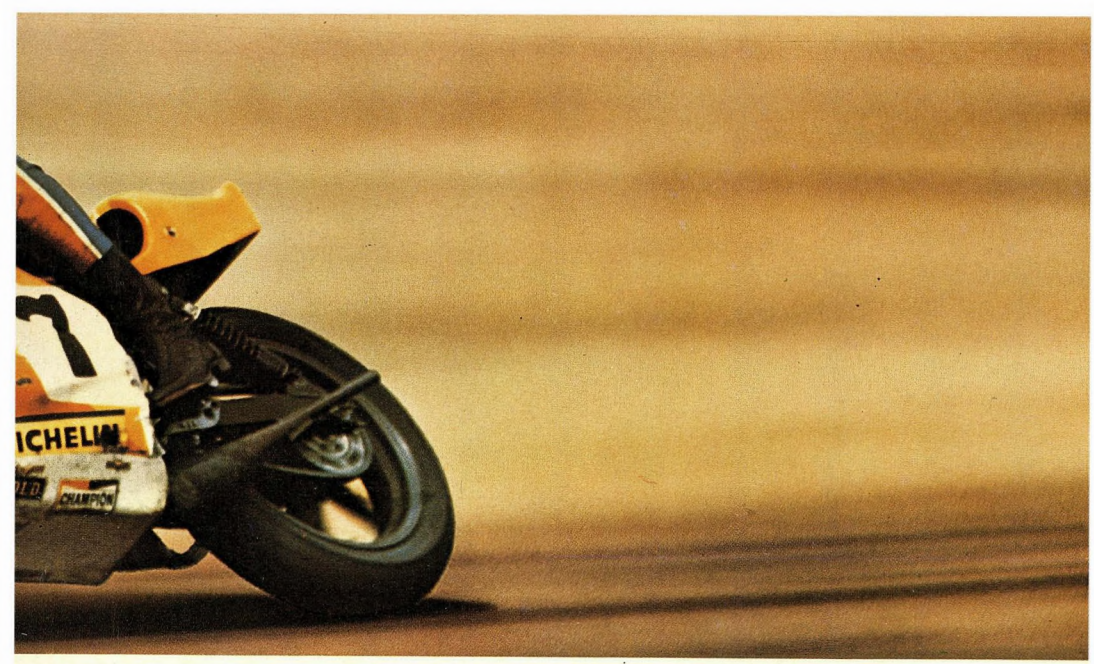

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RECOMMENDED

Acoustic Research AR77XB

Acoustic Research, Teledyne Acoustic Research, High Street, Houghton Regis, Bedfordshire LU5 5QJ. 0582 603151

Features, facilities, setting up and use

This latest version of the basic AR deck is simple in the extreme, the only controls being a slide switch for motor 'on', plus the arm cue. Two speeds are offered, but changeover involves a rather tedious series of steps, namely the removal of mat and outer platter, careful guiding by hand of the talc-dusted belt onto the appropriate section of the motor pulley, and then, reassembly. The arm is also a straightforward design, employing a rather flimsy headshell, with special socket collar fixing, plain sleeve bearings and approximate bias compensation, provided by the lead torque alone.

Unfortunately the first sample supplied for review was highly unsatisfactory; speed change proved impossible, high arm friction and a noisy motor were both apparent, while the lid stay action, rumble, wow, assembly and finish were all to a poor standard. Accordingly a second unit was supplied — factory sealed and of later manufacture — and this performed much better, producing the results subsequently recorded. In fact, it was good enough to gain a recommendation, albeit with some reservations.

This model's engineering strength is undoubtedly its well-executed floating sub-chassis system, which endows high vibration and feedback immunity, however even with the second sample the quality of the lide hinge and arm gave rise to some qualms. In the AR tradition, a five year warranty is included.

Lab performance

Fairly good wow and flutter and very good rumble levels were recorded, and while start up was slow at 5.5 seconds, this should not prove any problem for most users. Other vital factors such as feedback margins, vibration resistance and acoustic breakthrough were all very good.

Arm resonances were in good control over most of the band, but the first bending mode was rather low at 150Hz — this probably at the headshell. Standoff bushes hold the cartridge clear of the shell, and infilling this gap with a suitable amount of plasticine or related compound could well effect an improvement. Friction levels were reasonable with some 100mg or so of bias, this approximating to adequate correction over a suggested 1.5-2.5g downforce range. If care is taken while setting up, the resulting geometry is quite good, and as the arm mass is light, it is suitable for medium to high compliance cartridges. Hum levels were fine, except when using moving-coil models, which are not to be recommended.

Sound quality

No wow or rumble was audible in normal use, and the general sound quality was rated as above average. The frequency balance was quite neutral with the bass register even and extended, while coloration proved mild, with some veiling of depth. Aggressive or 'loud' effects were absent, this confirming the good damping shown on the arm resonance graph, and stereo precision was also to a good standard.

Conclusions

At £80.00 odd inclusive of cartridge, and as-

RECOMMENDED

suming that the construction quality and performance of the second rather than the first sample is maintained, the AR 77XB can be recommended as good value for money. However, a version with a better arm or even no arm at all would be very welcome.

GENERAL DATA Integrated Player

Motor Section

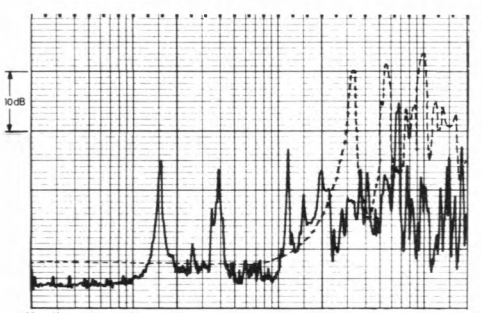
Type	manual belt drive
Platter mass/damping	1.6kg/good
Finish and engineering	fair
Type of mains/connecting leads	2 core/phonos (earth connected
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.09%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.1%/0.15%
Speed accuracy/drift/variation under load	+0.05%/ synchronous/–0.2%
Start up time to audible stabilisation	5.5secs
Rumble (av DIN B wtd L/R)	73/74dB

Arm Section

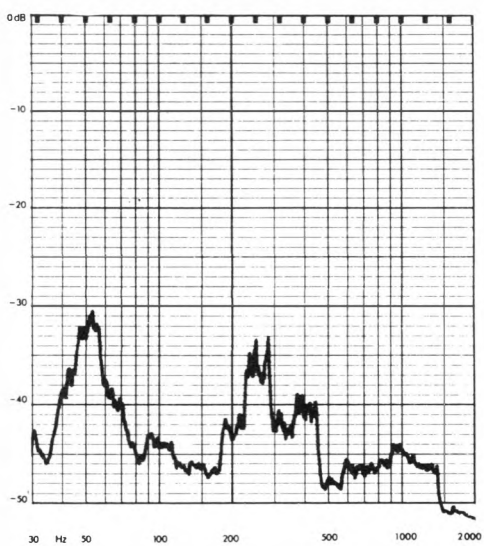
Approximate effective moving mass (excl cart. inc screws)	8.0g
Type of headshell	special detachable
Headshell mass (inc screws)	6.0g
Geometric accuracy	good
Facilities for adjustment	overhang: tilt: height (with spacers)
Finish and engineering	fair
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	100mg(bias)/45mg
Bias comp: type/force rim/centre	uncalibrated lead torsion
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/4.0secs
Downforce calibration error 1g/2g	-0.075g/-0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42.6(w) x 33(d) x 14.4(h)/6.7cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	poor/very good
Vibration or shock sensitivity	very good
Ease of use	adequate
Estimated typical purchase price	£80

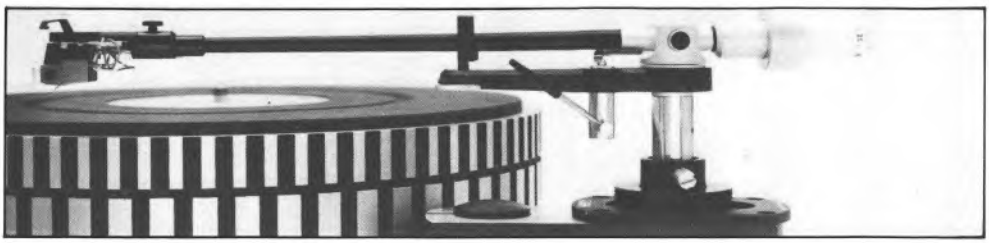


Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

ADC LMF2



Features, facilities, setting up and use

Physically, these two arms are quite similar, the only difference being the provision of a fixed cartridge platform on the *LMF1* as opposed to the unique detachable platform of the *LMF2*, the latter employing a knurled screw to firmly clamp the plug and socket section. While a normal hole fixing is standard, the optional *ASB1* accessory comprises a sliding base with SME-spaced mounting centre; the ensemble was very easy to set up for downforce and overhang. No provision was made for vertical tilt adjustment, but fortunately the platform alignment of both arms was good.

Carbon fibre has been skilfully employed for the tapered arm tubes, which proved highly rigid despite their low mass design; both finish and engineering were also to a high standard, with well adjusted precision bearings. However, a fairly large rear clearance was required to accommodate these arms, since the downforce knob extended some 7.5cm behind the pivots. This knob is only scaled to 1.6g, though it is of course possible to set any downforce by using auxiliary stylus scales. Bearing this in mind it is perhaps fortunate that the bias was somewhat excessive, which will assist the arms' use at higher than expected tracking weights.

ADC LMF1

ADC, BSR Ltd., Powke Lane, Cradley Heath, Warley, West Midlands, B64 5QH.
0384 65191

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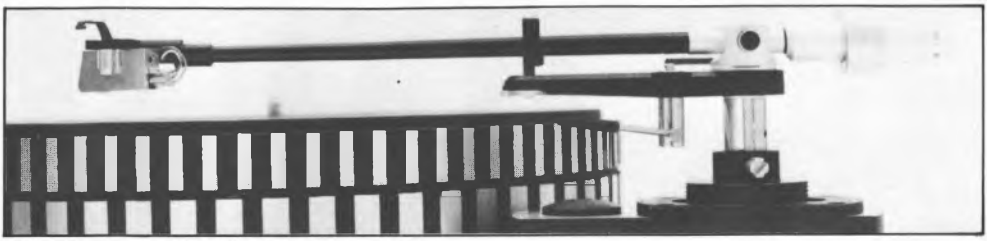


Lab performance

Friction was excellent in both planes with the bias in excess by approximately 30%, this allowing a correction of up to 2g downforce. Relative to the dialled settings, a commensurate 30% reduction is thus recommended when setting up.

Conversely, downforce on these samples was about 10% under, although this is still quite reasonable. Cue operation was fine, and while the effective mass for both models was very low thus making them eminently suitable for high compliance cartridges, low to medium models can also be used, with the addition of extra mass. Arm resonances were above average, particularly in the case of the fixed version, where the first mode appeared at 350Hz with good energy control above this point.

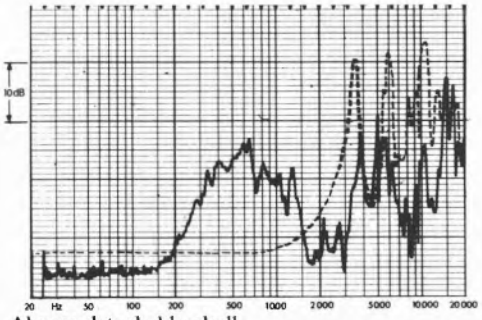
Sound quality

Both models gave a good account of themselves, but of the two the *LMF1* was noticeably better, so much so that it gains a recommendation. It exhibited a firm, extended, low frequency range, complemented by a neutral mid-band plus precise stereo imaging. The higher frequencies were a trifle subdued, imparting a slightly rich and warm quality that became apparent when comparing the arm with other models such as the Grace or the Mission.

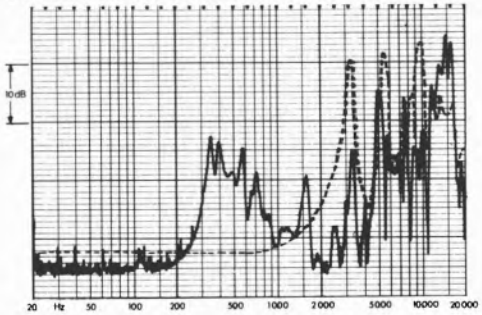
Conclusions

The *LMF1* is undoubtedly a high performance arm at the price and is recommended. A conventional conterweight system (should not be too difficult to modify) would reduce the rear clearance required, allowing use with many turntables. The *LMF2* is less attractive but still does fairly well – the detachable head facility clearly somewhat penalises performance.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	4g(5.5g)
Type of headshell	Fixed (special detach.)
Headshell mass (inc screws)	N/A/(4g)
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	< 10mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/280mg/250mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/6secs
Downforce calibration error 1g/2g	-0.1g/-0.125g
Amount of damping	none
Arm resonances	good
Subjective sound quality	very good/above average
Motor recommended	TD160, note large rear clearance
Estimated typical purchase price	£65



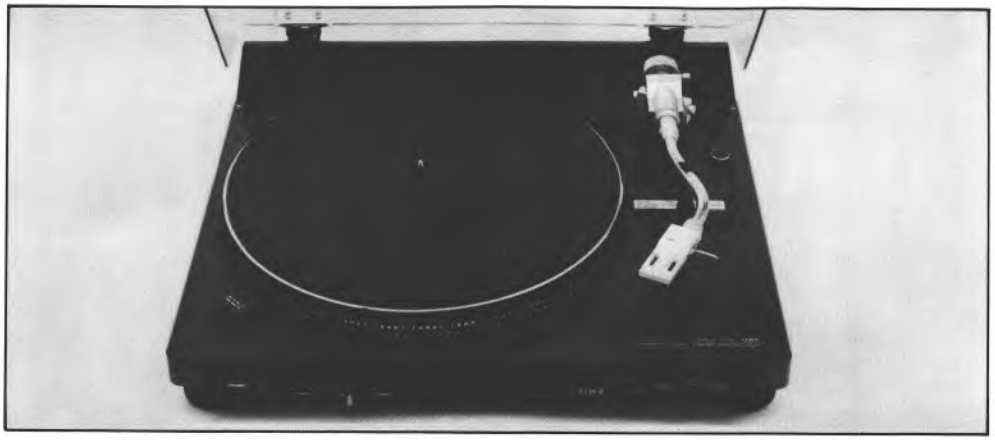
Above: detachable shell



Arm resonances (compared to cartridge resonances, dotted). Above: non-detachable

Aiwa 2200

Aiwa, Aiwa Sales & Service (UK) Ltd., 30/32 Concord Road,
Westwood Park Trading Estate, Western Avenue, Acton, London W3 0T8 01-993 1673



Features, facilities, setting up and use

A remarkably compact, direct drive auto-return player, the *AP2200* needed only 40cm of shelf depth with negigible rear clearance for the lid. All controls were accessible on the plinth front, and although a modest 2g downforce spherical tipped Aiwa moving magnet cartridge comes ready fitted, the headshell will accept many other alternatives; the shell was however rather heavy at 11.5g, including fixing screws. Both finish and engineering were to a good standard and the deck proved easy to set up and operate, with the notable exception of the clumsy alignment procedure required when exercising the option of fitting a substitute cartridge.

Lab performance

The motor section gave very good rumble figures but was less favourable in terms of wow and flutter, particularly when the significant slowing under load is considered in conjunction with the servo-speed control overshoot on off-load recovery. With several models this combination of factors generated audible wow on programme. Despite virtually no foot or suspension decoupling, the shock or vibration resistance was remarkably fine. Acoustic feedback was classed as very good, but the measured acoustic breakthrough was less commendable particularly at the higher frequencies, although still no worse than average.

The arm resonance graph showed very little energy in the upper range, suggesting a loss of transmission to the measuring accelerometer. This was confirmed by the first break at a relatively low 120Hz. While the headshell was damped by rubber pads, it was nevertheless not very rigid. Arm friction was generally low, although the 'lateral' figure represents a worst-case end-of-side result. Bias and downforce calibration were both very good, and all other facilities (cue etc) worked well. Only overhang adjustment was provided for the cartridge, so some care needs to be taken to ensure that a compatible replacement/alternative is selected that fulfils the height requirements.

Sound quality

Hum levels were good with moving-coil cartridges, and excellent with normal models, while no rumble was apparent except for the merest trace of transformer hum. However, a touch of wow was detactable on critical dynamic passages, at a 2g downforce. Overall the sound quality was considered to be average, which is a good result for the price quoted. Compared with our top-rated systems, the arm showed some emphasis of upper treble distortion — almost a fizzy effect — although this was not severe. Bass quality was fairly good, with upper emphasis and some loss of the extreme registers, and while stereo imaging was satisfactory locational information was a trifle vague, and a loss of depth was also apparent. The mid balance was judged to be a trifle on the rich side, resulting in a mildly 'dulled' effect.

Conclusions

Attractive in many respects and offered at a reasonable price, this Aiwa sets a good standard. With the slight wow effects eliminated and a more rigid arm/headshell, it could have done well.

GENERAL DATA Integrated Player

Motor Section

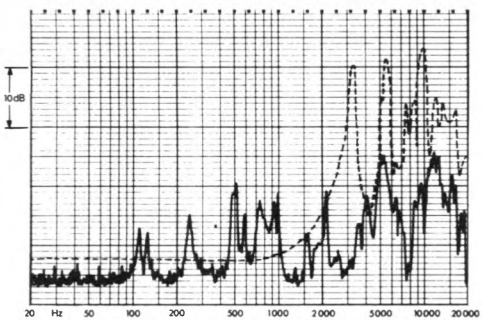
Type	auto stop direct drive
Platter mass/damping	1.5kg/adequate
Finish and engineering	good
Type of mains/connecting leads	2 core/Earth + phonos
Speed options/variable?	33⅓: 45 rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.09%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.12%/0.12%
Speed accuracy/drift/variation under load	adjustable/-0.2%/-0.4%
Start up time to audible stabilisation	2.5secs
Rumble (av DIN B wtd L/R)	70/74dB

Arm Section

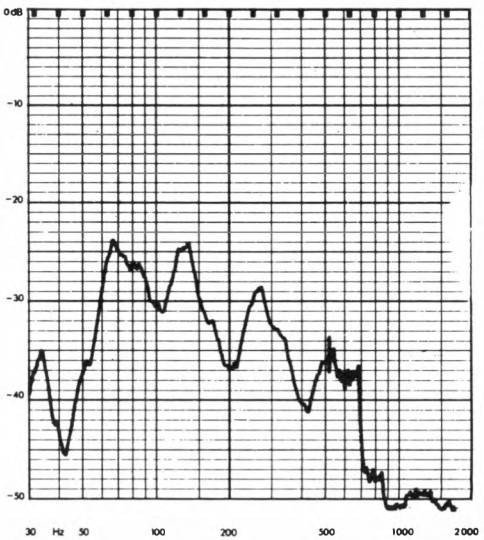
Approximate effective moving mass (excl cart. inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	11.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	100mg/< 10mg
Bias comp: type/force rim/centre (1.5 ell set)	spring/140mg/210mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/2.5secs
Downforce calibration error 1g/2g	0.0g/-0.05g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42.4(w) x 39.5(d) x 12.5(h)cm/0.9cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/very good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£115



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Aiwa 2500

Aiwa, Aiwa Sales & Service (UK) Ltd., 30/32 Concord Road,
Westwood Park Trading Estate, Western Avenue, Acton, London W3 0T8 01-993 1673

Features facilities, setting up and use

Otherwise visually unrelated, the *2500* carrys its operating controls on the plinth front, as does its more compact brother, the *AP2200.* Both decks were provided with a cable, which when used in conjunction with an Aiwa cassette deck ensures the latter will automatically start recording as soon as the stylus is lowered into the groove. The *AP2500* is an auto-return direct drive model, with a clear internal strobe viewed through a small front window; however, it is unfortunate that unless a highish shelf is used, one needs to crouch to see the strobe properly. Otherwise, the finish and engineering were very good.

As with the *AP2200,* the only geometrical adjustment provided for a cartridge was overhang or lateral alignment, so a model should be chosen with a dealer's help, in order to ensure compatibility. All controls worked well, the deck proving easy to use.

Lab performance

Wow and flutter results were superior to those recorded by the small model, and the motor proved high enough in torque to exclude dynamic wow effects. However, the linear wow figure was on the high side considering the price of the deck. Start up was reasonable at 2.5 seconds, and speed drift fine. With a moving-coil cartridge hum induction was only 'satisfactory', and thus high output moving-coil or alternatively less susceptible normal cartridges are recommended. Rumble measured very well. Acoustic breakthrough was about average and feedback on the test location very good, but vibration and shock resistance were only adequate due to the poor isolation imparted by the adjustable feet. As with almost all turntables a rigid structural wall shelf is recommended to give the best performance.

As with the *AP2200* the rubber headshell damping apparently provided absorption of resonances at higher frequencies, but that a rather more rigid headshell is fitted to this model is clearly apparent from the higher first breakup, in this case around 300Hz, while the greater than average headshell mass (c.12g) also helped to control resonant energy.

General alignment accuracy, bias, friction and downforce were all very good. At a 15g effective mass, the arm is clearly more suited to lower compliance cartridges, (8 to 15cu).

Sound quality

Still in the average sound quality grouping, the *AP2500* did not in fact sound very different from its smaller brother. Wow was inaudible as was rumble, and a mildly dull balance gave an impression of some masking of stereo image depth and precision, while the sound balance was slightly forward and thickened. Bass quality was fair, exhibiting the all-to-common mild emphasis in the upper regions, with a corresponding loss in low bass power and clarity.

Conclusions

Overall this is a competently aligned and manufactured turntable of good technical performance which offers an average sound quality, the latter corresponding to its average price grouping.

GENERAL DATA Integrated Player

Motor Section

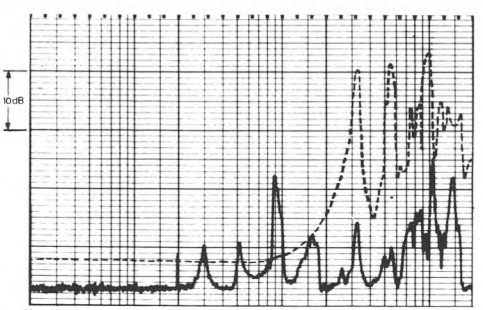
Type	auto stop, direct drive
Platter mass/damping	1.75kg/very good
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.07%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.15%/0.09%
Speed accuracy/drift/variation under load	adjustable/-0.1%/ 0.05%
Start up time to audible stabilisation	2.5secs
Rumble(av DIN B wtd L/R)	0.09%

Arm Section

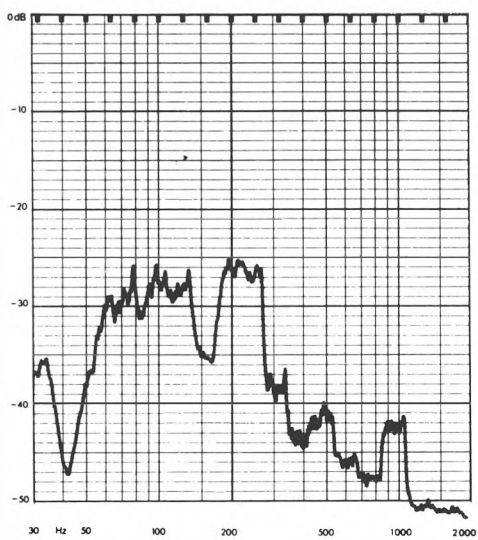
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	12.0g
Geometric accuracy	very good
Facilities for adjustment	overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	15mg/20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/175mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/3.0secs/3.5secs
Downforce calibration error 1g/2g	-0.075g/-0.1g
Amount of damping	little

System as a whole

Size/rear clearance for lid	48(w) x 40.4(d) x 15.2(h)cm/5.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/very good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£170



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Akai AP100

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

Features, facilities, setting up and use

The first edition included the *AP001* (now discontinued), with its successor reviewed here demonstrating a number of improvements, namely variable bias compensation, full auto-return, and a better finish. The same belt drive system used for the *AP001* and powered by a large synchronous induction motor is again employed here, and as before, this proved to be insufficiently isolated from the plinth mechanically. Thus while the general standard of construction is good, no real steps have been taken to reduce feedback and vibration effects, and in addition the dust cover is formed in a noticeably 'live' grade of plastic, probably polystyrene. Arm adjustments for height and overhang were provided, but the procedure described for the latter was not only awkward to effect, but more seriously resulted in a 3° error. Instead, the purchaser is recommended to use a protractor. All the controls in fact worked well otherwise, with the exception of the auto-return, which was rather jerky in action.

Lab performance

Close to correct speed, the drive showed fine torque characteristics, with an under 1 second start up, plus good wow and flutter. However, motor vibration breakthrough degraded the rumble figure. The generally light and resonant structure was reflected in the poor results for shock and vibration resistance together with the just adequate feedback margins and the only 'average' level of acoustic breakthrough.

The arm resonance pattern was quite typical, with the usual headshell/socket mode appearing at 210Hz, followed by fairly strong dissected resonances at the higher frequencies. Lateral friction was fairly good at 80mg, rising to 160 at end-of-side, due to the trip mechanism. Vertical friction was also very low with little play, while bias and downforce were both acceptably calibrated — the former about 40% high and the latter about 10% low. Cue descent was somewhat slow at 4.5 seconds.

Arm effective mass proved to be on the heavy side at 15g, thus indicating suitability for low compliance cartridges. As with the vast majority of decks in this report, no provision for damping was included.

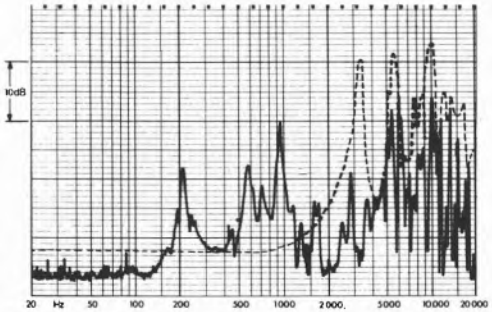
Sound quality

The overall sound quality was only judged to be adequate. Motor noise was audible in the reproduction at medium to high listening levels, and the musical balance showed some modification; namely reduced lower bass, emphasised upper bass, and a thin quality allied to a forward effect, thus reducing depth and masking stereo locational information. Hum levels were too high for a sensitive moving-coil cartridge to be used, and hence conventional types are recommended.

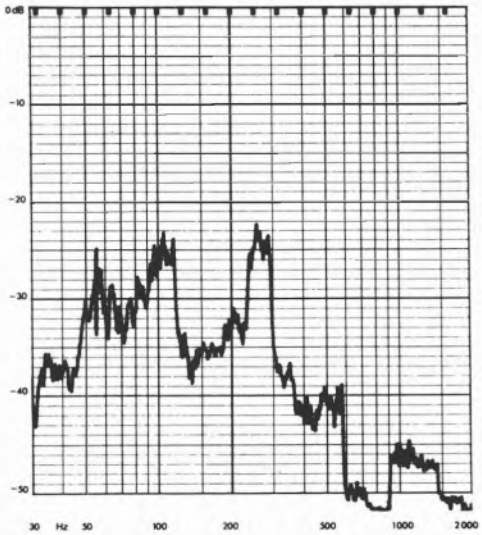
Conclusions

While this auto-return player is undoubtedly inexpensive, its performance as judged by both measurement and subjective audition was rather weak, and hence no recommendation can be made.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto return, belt drive
Platter mass/damping	1.0kg/good
Finish and engineering	good
Type of mains/connecting leads	3 core, IEC plug/phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.1%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.2%/0.1%
Speed accuracy/drift/variation under load	+0.2%/synchronous/-0.3%
Start up time to audible stabilisation	0.75secs
Rumble (av DIN B wtd L/R)	53/61dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly/setting up	fairly good
Friction lateral/vertical (typical)	160mg/ 10mg
Bias comp: type/force rim/centre (1.5g ell set)	—/180mg/210mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/4.5secs
Downforce calibration error 1g/2g	—0.1g/—0.15g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	44.1(w) x 35.4(d) x 14.5(h)cm/4.2cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	poor/adequate
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£70



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Introducing Memorex MRX3 the brand new tape that's shattered me it gives higher highs and lower lows so more than ever no one knows is it MRX3, or is it meeeeeeeeeeeeeeee

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You get brighter highs and richer lows: higher output at saturation, specifically a 3.0 dB improvement over MRX2 Oxide at high frequency maximum output level and a 3.0 dB boost at low frequencies.

You get less distortion: 4.0 dB less distortion than MRX2 Oxide.

And you get a wide dynamic range for crystal clear recording: the most important indication of tape quality. Boosted MOL and low noise level give you an excellent signal to noise ratio and a 2.5 dB improvement in dynamic range over MRX2 Oxide.

New MRX3 Oxide.

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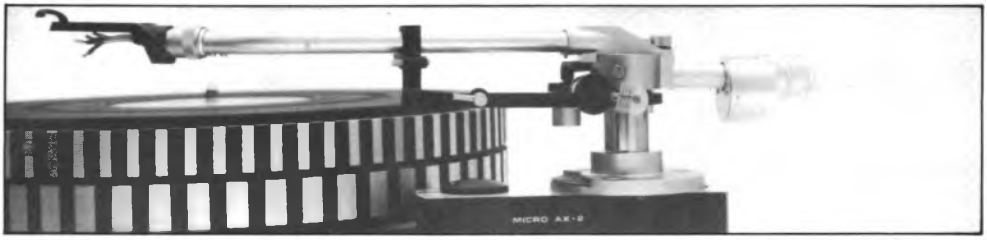
Audio Technica AT1010

Audio Technica, Shriro (UK) Ltd., Shriro House, The Ridgeway, Iver, Bucks. SL0 9JL.0753 652222/7



Features, facilities, setting up and use

A complex and costly new arm from Audio Technica, the AT1010 is fitted with almost every gadget of which one can conceive. Unfortunately the instructions were not too clear on some points; for example the 'fo damper' (a variable tension elastomer block between counterweight and arm), and the 'gyro-balance' (a variation on the lateral balance outrigger theme, where the position of the balance mass is variable in both the horizontal and vertical planes.) The instructions suggest adjustment by trial and error once set up and playing, using music discs.

This design brings the pivots down to the stylus plane for improved tracking stability, and employs precision ball race bearings plus a thread and weight pivoted lever for bias correction. Great care has been taken with the headshell/socket fit, providing an unusually solid connection. The cast magnesium shell was also very strong, although for no clear reason it was fitted with thick silver litz wires. Overall, very good engineering quality plus excellent finish were in evidence.

Lab performance

Downforce calibration was about 10% low, and biasing nearly 3 times the required value, although the correct ratio of rim to centre was maintained. Friction in both planes was fine, but cue ascent was a little slow — 1 second or less is preferable, and some lateral drift was also observed. Subsonic resonance curves were run using several settings of the 'fo damper', but as these resulted in less than 0.5dB change in the 10dB resonance peak, it indicated that the damper was ineffective.

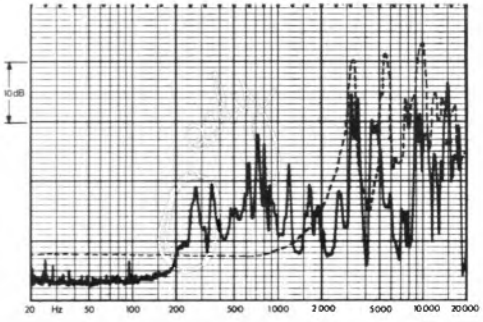
The arm resonance curve exhibited an above average result, with the even energy transmission to 20kHz showing good rigidity, plus only a moderate incidence of severe high crest resonances, and a suppression of the usual socket bending modes. The 15g effective mass indicates a compatible cartridge compliance on the low side, eg 8-15cu.

Sound quality/Conclusions

Tight headshell fixing is crucial in maintaining a detailed stereo focus, and with this arm, careless headshell attachment emphasised the mild depth veiling apparent upon audition. Bass quality was however above average, the upper mid being a trifle hardened and projected, with a touch of high treble emphasis or 'fizz' noted on sibilants and other similar sounds.

While this arm gained an above average sound quality rating, and in doing so represents a worthwhile improvement over previous Audio Technica models, its high price precludes a recommendation in this report.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	11g
Geometric accuracy	very good
Facilities for adjustment	height, tilt, overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Ease of use	very good
Friction lateral/vertical (typical)	20mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	weighted lever/ 300mg/380mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/2secs/3.5secs
Downforce calibration error 1g/2g	-0.075/-0.2
Amount of damping	negligible
Arm resonances	above average
Subjective sound quality	above average
Motor recommended	various
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).

Audiotronic ATT100M

Audiotronic, Audiotronic House, The Hyde,
Hendon NW9 6JJ. 01-200 0444

Features facilities, setting up and use

An inexpensive, manual belt drive player made in Japan to Audiotronic's requirements, the *ATT100M* exhibits numerous similarities to the Eagle *7500,* another Audiotronic-linked product. In fact as it happens both decks were independantly specified by the purchasing offices concerned. An *ATT100S* semi-auto model is also available at about £8 extra.

A large synchronous induction motor is employed, which was found to be faulty on the first sample, thus producing very poor rumble measurements due to motor breakthrough. A replacement deck proved much improved, but for some reason (probably an interpretation of the electrical safety standard), the chassis/signal earth was taken to the mains earth, thus producing a hum loop when the unit is used with conventional amplifier wiring.

Finish and engineering were both reasonably good, despite the absence of significant plinth isolation. The deck was quite simple to set up and use, but this procedure required the purchaser to ignore the cartridge alignment instructions as provided by the manufacturer and use a protractor, since following the specified (difficult-to-measure) 10mm stylus/centre spindle overhang imparted a 2° lateral alignment error!

Lab performance

A poor 45dB DIN B figure was recorded for rumble on the first sample, improving to 63dB with the second. Speed characteristics were good, with fast start up, fair absolute accuracy and good torque, plus very satisfactory wow and flutter.

However, acoustic breakthrough was only adequate, with the peak value at 80Hz some 10dB poorer than average. This result was also reflected by the poor results for acoustic feedback and shock vibration resistance.

Of average character at lower frequencies, the arm resonance curve showed a notable isolated emphasis at 10KHz, this peaking high. On the other hand, the remaining features were all to a good standard, including friction levels, bearing play, bias, downforce calibration, and cue operation. Effective mass was in the medium bracket with the usual absence of damping.

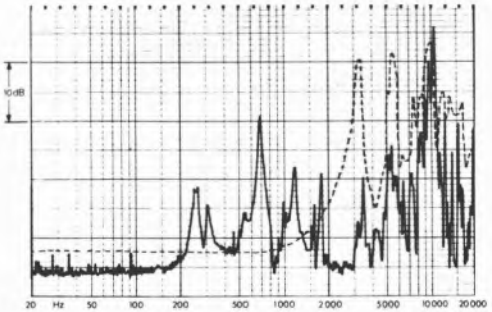
Sound quality

Even with sample two, the subjective rumble level was dominated by motor vibration due to poor isolation of the motor from the plinth. Although this was not disastrous, it was clearly audible at decent listening levels, and partly as a result the overall sound quality was judged as significantly below average. The low frequency spectrum showed bass loss, with a boomy upper region, and stereo imaging was muddled with veiled ambience, exaggerated brass sounds and a forward, hard tendency. The poor feedback margin was also evident in the general 'liveness' of the deck when it was operated.

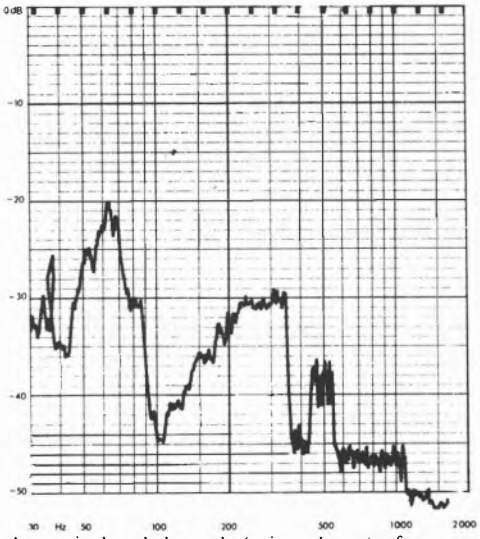
Conclusion

While the standard was not unreasonable considering the price, nonetheless it fell below that attained by other similarly priced models which have gained recommendation in this report.

GENERAL DATA	Integrated Player
Motor Section	
Type	manual, belt drive
Platter mass/damping	0.8kg/very good
Finish and engineering	fairly good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.08%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.12%/0.10%
Speed accuracy/drift/variation under load	+0.5%/ synchronous/-0.1%
Start up time to audible stabilisation	0.6secs
Rumble (av DIN B wtd L/R)	62/63dB (retest)
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	9g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	50mg/20mg
Bias comp: type/force rim/centre (1.5 ell set)	thread & weight/ 75mg/140mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.0secs/3.5secs
Downforce calibration error 1g/2g	+0.05g/+0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	42.9(w) x 36(d) x 14.3(h)/4.0cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	poor
Hum level/Acoustic feedback	poor/poor
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£50



Arm resonances (compared to cartridge resonances, dotted).

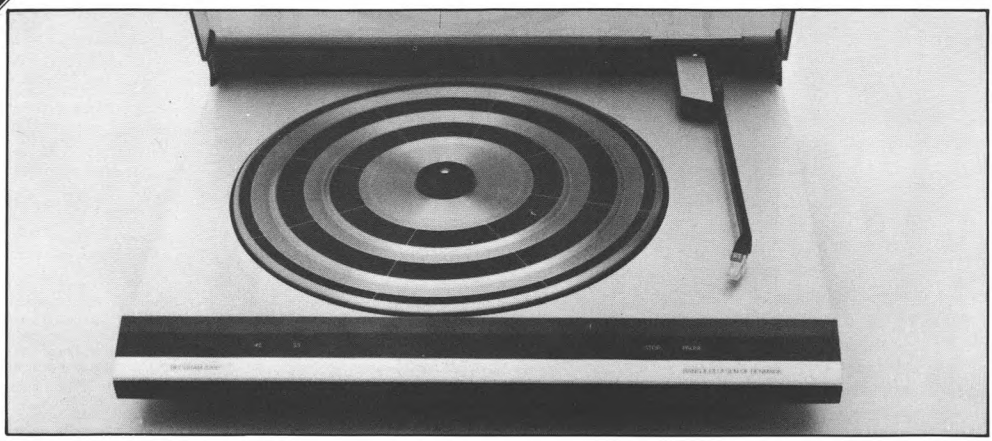


Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Bang & Olufsen 2200

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



Features, facilities, setting up and use

There is inevitably some confusion concerning the B & O range of turntables, which are basically all variations on a theme. Internally they derive from one design, but externally the facilities offered can vary, for example, as regards the type of cartridge fitted, the styling or control arrangement.

The *2200* is based on a well-designed floating sub-chassis; it is belt driven and uses a very low mass magnesium die-cast pickup arm. This is used with an integral B&O cartridge, a feature that is in fact common to the older *1102* and *1902* decks recommended in the last edition of *Choice,* and the soon-to-be-released *1500.* It thus follows that all the models in the range exhibit certain basic similarities of performance. The *2200* reviewed here is a fully automatic unit with accessible (with lid down) front-mounted controls and a disc weight detector system. The latter automatically engages 45rpm for singles, with an override included for 45rpm LPs. A new design of *MMC20E* cartridge tracking at 1.5g comes ready fitted in the arm, making for trouble-free assembly, and the unit also proved easy to operate, with an extremely rapid starting cycle. The review sample was in fact an early version with highish lateral arm friction, but B&O anticipate that the fine values measured for the *1900* in the last edition of *Choice* will also become the *2200* production norm.

Both subjective and arm resonance data was recorded as a system, that is with the supplied cartridge, and hence these results are not wholly comparable with the other models, where the standard test cartridge was employed.

Lab performance

The motor section gave very good results for both wow and rumble, and demonstrated fine speed accuracy, stability and torque. Vibration resistance was excellent but the feedback margins were less favourable, and while the acoustic breakthrough curve was fine below 300Hz, it worsened rapidly from 400 to 600Hz, both effects attributable to the light platter and the poorly damped record contact area. However, this problem can be ameliorated by a worthwhile 6dB if the lid is closed when playing a record.

It must be remembered that the arm resonance curve is not directly comparable with the other review models, since the excitation was generated by B&O's own cartridge. Nevertheless, relevant information was provided up to 2kHz; eg: the first mild break at 300Hz with fair energy control thereafter. Biasing was found to be set too high, at double the required value, and B&O should improve this alignment in future production. However the other facilities were all fine, with the geometrical alignment of the fitted cartridge measuring well. At 4g or less, effective mass was very low, and matched perfectly the supplied cartridge, thus providing a stable 12Hz subsonic resonance.

Sound quality

A touch of rumble could be heard, indicating a 'good' rather than a 'very good' rating, but both the wow and hum levels were fine. The bass

RECOMMENDED

register proved both firm and extended, although the midrange was a trifle veiled with some depth loss, and a mild coarseness plus added brilliance was also apparent.

Conclusions

As reported in the previous issue concerning the related *1902,* a significant proportion of the B&O's strength lies in the skilled subchassis suspension and integrated arm/cartridge design. This combination serves to lift the sound quality of the system to into the 'good' category, although this is to some degree based on a preliminary assessment of the cartridge quality, whose properties will be more fully examined in the forthcoming edition of *Cartridges & Headphones.* This aside, while the rating is an achievement considering the price level it also assumes that the minor sample faults discovered, namely incorrect friction and bias settings, will be rectified in subsequent production.

GENERAL DATA Integrated Player

Motor Section

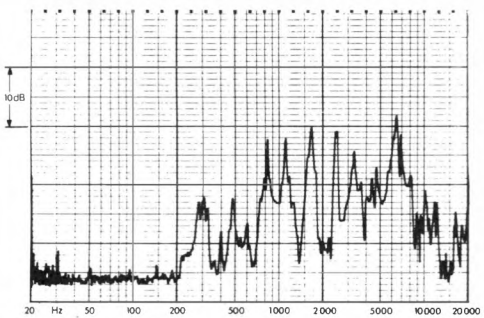
Type	automatic belt drive
Platter mass/damping	0.8kg/adequate
Finish and engineering	good
Type of mains/connecting leads	two core/DIN
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.06%/0.1%
Speed accuracy/drift/variation under load	–0.1%/<0.05%/–0.02%
Start up time to audible stabilisation	2.7secs
Rumble (av DIN B wtd L/R)	73/70dB

Arm Section

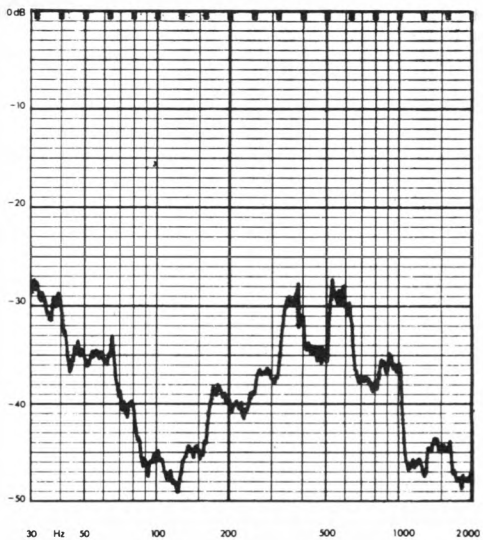
Approximate effective moving mass (excl cart, inc screws)	4g est.
Type of headshell	N/A fitted cartridge
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	downforce
Finish and engineering	good
Ease of assembly/setting up	excellent
Friction lateral/vertical (typical)	≏ 100-150mg/50mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/250mg/310mg
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/1sec
Downforce calibration error 1g/2g	–0.05g/–0.075g
Amount of damping	little (friction)

System as a whole

Size/rear clearance for lid	44(w) x 36.7(d) x 8.5(h)cm/none required
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	good/fairly good
Vibration or shock sensitivity	
Ease of use	
Estimated typical purchase price	



Arm resonances



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Connoisseur BD2A

Connoisseur, A. R. Sugden & Co. (Engineers) Ltd., Connoisseur Works, Atlas Mill Road, Brighouse HD6 1ES. 0484 712142

Features, facilities, setting up and use

This review was conducted on the *BD2A* which comes as a complete auto-lift player; the unit can be purchased without the 'lift' facility and the motor and arm sections are also available as separate items (*BD1* and *SA U2* respectively). The latter was also assessed independantly, as well as forming an integral part of the *BD2A* player.

This new deck is a revised version of the model recommended in the previous edition, considerable changes having been made to the plinth and feet/suspension system. To recap, a small flexibly suspended synchronous motor drives the undersize 250mm platter via a tough rubber cord. Thin steel bars make up the suspension springing, which was poorly centred in our sample, and required adjustment in order to obtain the best results. In addition, neither the lid support nor the hinges were particularly effective, and tended to come unscrewed, while insufficient clearance was provided for both the start and stop speed change controls with a 300mm LP record *in situ* Although the important parts are undoubtedly well engineered, it was felt that the general appearance could be improved upon — overall, the arm was rather better finished than the deck. The arm is fitted with an unusual gravity bias lever whose residual connection precludes proper lateral friction measurements, the canted gimbal also limiting the range of height adjustments possible, since a non-parallel tube tilts the headshell. The simple bearings were well adjusted, and stylus scales plus extra counterweights are supplied as standard.

Lab performance

Fine wow and flutter levels were recorded with ample torque, quick start up, and good accuracy. Rumble was also fine, with the subjectively quiet assessment reflecting the 66dB right channel rather than the poorer figure measured for the left. Slight motor vibration was evident, due to inadequate decoupling, and acoustic breakthrough was quite good, except in the 200-300 Hz range which was traced to lid resonance. Feedback margins were nonetheless satisfactory, and improved with the lid down, while shock immunity was excellent (much better than last time.)

Bias values were rather on high side (+100%) but reduced towards the centre; (the reverse is, however, preferrable.) However, friction, downforce, and cue operation were fine, with good geometric accuracy at the recommended arm attitude.

Examining the arm resonance graph, only minor effects were visible at 130 and 170Hz, with the first dominant mode at 240Hz well controlled, probably due to the non resonant properties of the plastic headshell. Resonances appeared well controlled at higher frequencies and the maintained energy to 15kHz suggests that the socket fixing is quite firm.

Sound quality

The BD2A was not as highly rated as its predecessor, and only received an 'adequate' rating, which is nonetheless reasonable for the price. When compared with more highly favoured

systems in the report, 'loud and muddled' effects were noticeable, with a cold almost brittle balance, and the conclusion to be drawn is that the subjective performance appears to have suffered at the expense of the revised shock resistant plinth and lid assembly.

SAU2 (Recommended)

Independantly, the *SAU2* arm fared better when partnered by a somewhat more advanced player such as the Thorens *TD160,* the sound quality improving to an 'above average' rating, thus making it very good value at the price. A loss of stereo image precision and depth, plus a slightly nasal midrange quality and upper range coarsening but fairly good bass register basically describes the sound.

Conclusions

Connoisseur promise both better finish and tighter quality control on future production, which should undoubtedly improve the deck's potential. The SAU2 can be recommended as offering a fair performance at a very reasonable price. The *BDI* motor unit, available assembled or in kit form, can also be recommended as offering good value for money if mounted securely in a very heavy plinth system (eg concrete).

GENERAL DATA Integrated Player, components available separately

Motor Section

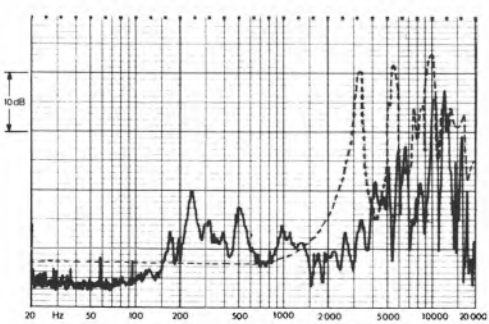
Type	auto stop belt drive
Platter mass/damping	1.35kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓, 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.11%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.13%/0.08%
Speed accuracy/drift/variation under load	synchronous/-0.1%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	62/66dB

Arm Section

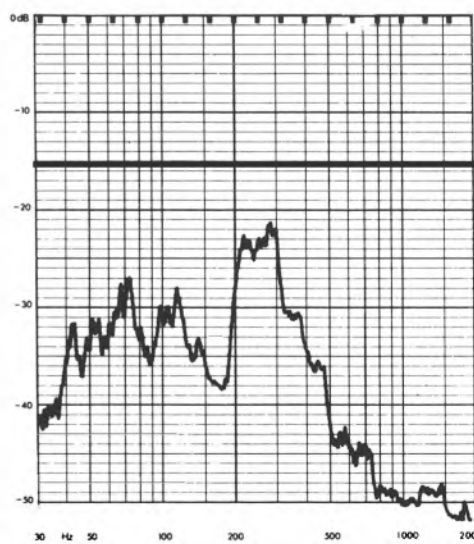
Approximate effective moving mass (excl cart, inc screws)	8g
Type of headshell	special detachable
Headshell mass (inc screws)	8.5g
Geometric accuracy	good
Facilities for acjustment	height, overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	50(bias interferes)mg/25mg
Bias comp: type/force rim/centre (1.5 ell set)	weighted lever/ 275mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/1.5secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	little

System as a whole

Size/rear clearance for lid	45.6(w) x 13(d) x 15.7(h)cm/6.1cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	very good/good
Vibration or shock sensitivity	excellent
Ease of use	very good
Estimated typical purchase price	£55



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Connoisseur BD101

Connoisseur, A. R. Sugden & Co. (Engineers) Ltd., Connoisseur Works, Atlas Mill Road, Brighouse HD6 1ES. 0484 712142

Features, facilities, setting up and use

Supplied for review with an integral *SAU4* arm, the latter is also available as a separate item and it is also planned to sell the *BD101* as a motor unit, or alternaltively fitted with the less expensive *SAU2*. Built on an enlarged plinth with a steel bar spring feet suspension similar to that of the *BD2A*, the *BD101* is also a belt driven model, powered by a synchronous motor. The inner die-cast platter section carries the round section belt on a retaining groove, with light spun-alloy forming the outer shell. Two motor pulley diameters provide 33 1/3 and 45 rpm, the belt alignment optimised for the former size. In practice the speed change proved sufficiently confusing for us to misuse it, resulting in its collapse, and as with the *BD2A*, the lid stay tended to come unscrewed.

The pin lugs in the headshell were both too stiff and too large to fit several models of cartridge, and strangely enough of the 4 lugs fitted only one was silver plated while the other 3 were merely tinned. Furthermore, two structural components of the headshell were loose on one sample that we tried.

A hum breakthrough problem clearly existed due to proximity effects, particularly towards end-of-side, these resulting from the front left-hand mounted motor. Connoisseur are investigating this problem and although the motor was also found to tick audibly, its lab performance was not impaired as a result.

Aside from some confusion about the bias settings and an unduly complex lateral alignment gauge, the *SAU4* arm proved easy to set up, considering its damped unipivot design.

Lab performance

With hum excluded, good rumble figures were recorded. Wow levels were very satisfactory with good speed accuracy, but the slowing under load was rather high at 0.6% and could well be audible. Acoustic breakthrough showed poorer than average levels at 30-80Hz, but feedback was classed as good and vibration resistance as excellent.

SAU4 arm

Friction values were more difficult to measure on this model, as it was supplied ready damped, but nonetheless an excellent 15mg was recorded. Biasing and downforce calibration were equally good, though in practice the bias thread running over a fixed guide inevitably added to the lateral friction. While no drift occurred during cue, the rise time was quite excessive. Despite using the more rigid of the two metal headshells supplied, the arm resonance curve showed breakup as low as 150Hz. However resonances were reasonably well controlled at higher frequencies, except above 12kHz, where energy transmission to the accelerometer was abruptly terminated.

Sound quality

BD101 (for SAU4 see BD103 report)

Rated as average on overall sound quality, it was characterised as possessing some low bass loss with a correspondingly emphasised and softened upper bass register, together with impaired transient clarity. Vocal balance was quite natural, upper ranges a trifle coarse but not unduly so, and

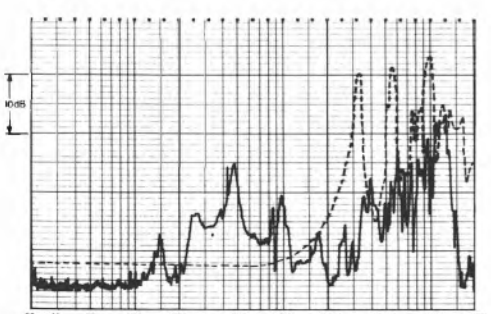
image depth and precision were both good for the price. Slight pitch wavering could be deard on loud passages, using a 2g downforce moving-coil cartridge.

Conclusion

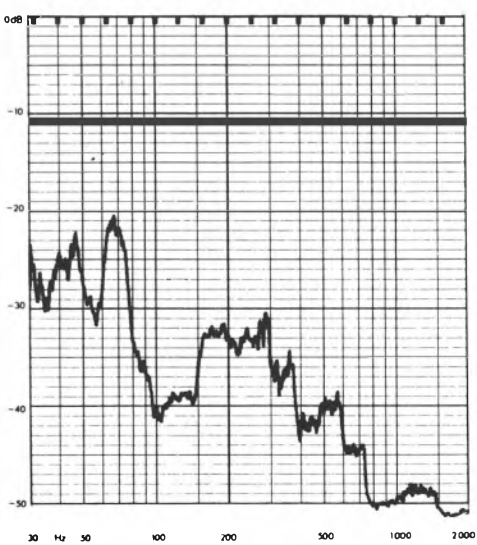
This combination falls short of a recommendation due to its hum level, plus poor quality control and finish. However as the price is still fairly competitive, it is up to Sugden to keep their promises and improve their production standards.

GENERAL DATA Integrated Player: components available separately

Motor Section	
Type	manual, belt drive
Platter mass/damping	1.65kg/good
Finish and engineering	below average
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓, 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.095%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.16%/ 0.07%
Speed accuracy/drift/variation under load	synchronous/–0.6%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	69/74dB
Arm Section	
Approximate effective moving mass (excl cart. inc screws)	9g
Type of headshell	special detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for adjustment	tilt, overhang, height
Finish and engineering	fair
Ease of assembly/setting up	fairly good
Friction lateral/vertical (typical)	15mg/15mg
Bias comp. type/force rim/centre (1.75 ell set)	thread and weight/ 140mg/160mg
Cueing. drift/8mm ascent/8mm descent	negligible/6.5secs/3.5secs
Downforce calibration error 1g/2g	0.9g/0.9g
Amount of damping	moderate
System as a whole	
Size/rear clearance for lid	45.6(w) x 38.9(d) x 15.6(h)cm/6.1cm
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	adequate/good
Vibration or shock sensitivity	excellent
Ease of use	fair
Estimated typical purchase price	£73



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Connoisseur BD103

Connoisseur, A. R. Sugden & Co. (Engineers) Ltd., Connoisseur Works, Atlas Mill Road, Brighouse HD6 1ES. 0484 712142

Features, facilities, setting up and use

Strongly related to the *BD101* and sharing the same plinth, platter and suspension arrangement, the *BD103* adds several facilities, including an auto-lift system operating at end-of-side; unfortunately the switch arrangement for this facility was faulty on our sample. The deck is also available as a motor unit and comes supplied with an enlarged plinth of more substantial construction which will accept virtually any pickup arm.

A reflection type stroboscope was built into the BD103, with dots crudely printed on the platter underside and viewed by a restricted angle mirror; three speeds are offered, plus fine speed control. Upon examination the spring feet were found to be maladjusted and required careful bending and alignment to achieve a satisfactory 'float' to the plinth. The deck uses a DC motor with a remote cable-connected power supply, the latter of poor finish. It was unfortunate that all three Connoisseur models were plagued by problems of quality and finish, all of which the company hope to have solved by the time this edition is published.

Lab performance

While the DIN peak wow and flutter reading was excellent, some wow was evident from the 0.15% linear reading, and the drive was low on power, with a serious 0.75% slowing under a modest 3g downforce 'dustbug' load. Rumble was very good with no hum problems which is undoubtedly due to the separate power supply. With excellent vibration resistance and good feedback immunity, the acoustic breakthrough curve matched that for the *BD101*, and excluding the arm, was rated as 'fair'.

See *BD101* review for lab performance of *SAU4* arm.

Sound quality

BD103 assembly

The complete turntable assembly gave very similar results to the *BD101* but with reduced hum and consequently a 'very good' rumble rating. However, the speed stability was unsatisfactory; the extra drag imparted by high transient record modulation levels produced some mild but audible pitch changes.

SAU4 arm

Fitted to a reference turntable the *SAU4* rated a 'good' classification — above that for the *SAU2*, and in a similar category to the *SME II ND.FD200*, and the ADC *LMF2*. The bass register was fairly extended with good definition, although the mid character tended to richness with moderate image vagueness and depth masking. A slight emphasis was apparent in the upper midrange plus a trace of slurring on sibilants and other similar treble sounds. Extreme treble energy seemed muted.

Conclusions

Low motor torque and sample quality defects make recommendation for the *BD103* marginal, but potentially it is capable of a good performance at the price. The *SAU4* arm worked surprisingly well, and while it is not as finely finished as its

RECOMMENDED

Japanese competitors, it has in its favour moderate effective mass, some subsonic damping, and a generally good sound quality.

GENERAL DATA Integrated Player, components available seperately

Motor Section

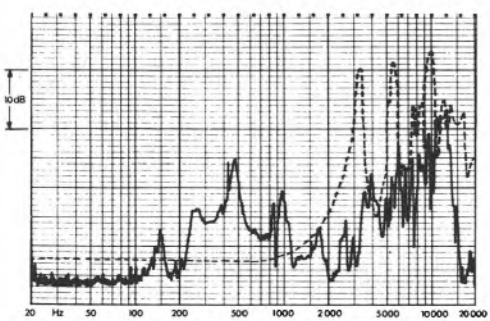
Type	auto stop, belt drive
Platter mass/damping	1.65kg/good
Finish and engineering	only fair
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓: 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.1%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.15%/ 0.07%
Speed accuracy/drift/variation under load	adjustable/-0.3%/-0.75%
Start up time to audible stabilisation	2.5secs
Rumble (av DIN B wtd L/R)	73/75dB

Arm Section

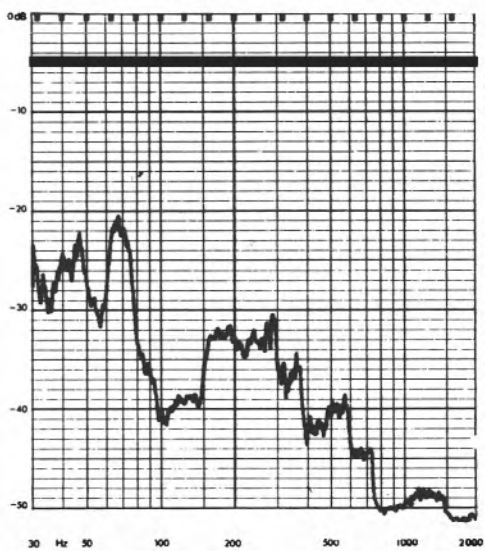
Approximate effective moving mass (excl cart, inc screws)	9g
Type of headshell	special detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for acjustment	tilt,overhang, height
Finish and engineering	fair
Ease of assembly/setting up	fairly good
Friction lateral/vertical (typical)	15mg/15mg
Bias comp: type/force rim /centre (1.75g ell set)	thread & weight/ 140mg/160mg
Cueing: drift/8mm ascent/8mm descent	negligible/6.5secs/3.5secs
Downforce calibration error 1g/2g	0.9g/0.9g
Amount of damping	moderate

System as a whole

Size/rear clearance for lid	45.6(w) x 38.9(d) x 15.6(h)cm/6.1cm
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good
Vibration or shock sensitivity	excellent
Ease of use	poor
Estimated typical purchase price	£92



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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

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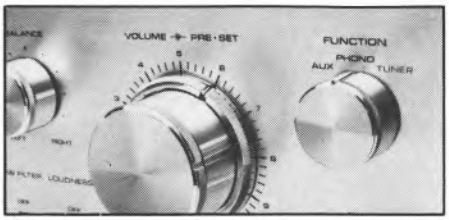

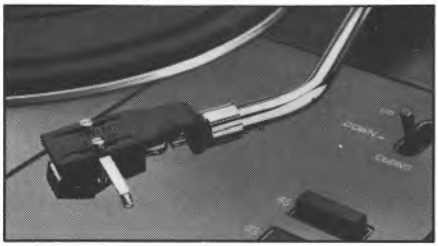

TP 1100-2 Direct Drive 2 speed stereo turntable. Direct driven platter is operated by a brushless DC Motor. Recessed stroboscope, cueing and anti-skate devices.

RECOMMENDED HI-FI CHOICE TURNTABLE

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

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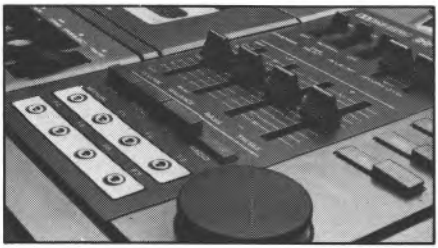
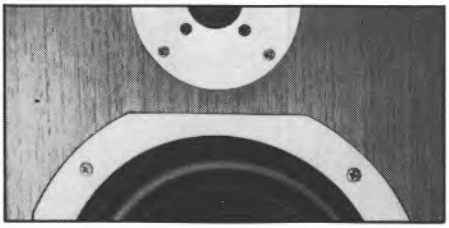


G2811KL Music Centre. Features belt driven 2-speed turntable, magnetic cartridge and diamond stylus. LW, MW, SW and FM wavebands can be sensor touch pre-selected.

RECOMMENDED HI-FI CHOICE MUSIC CENTRE



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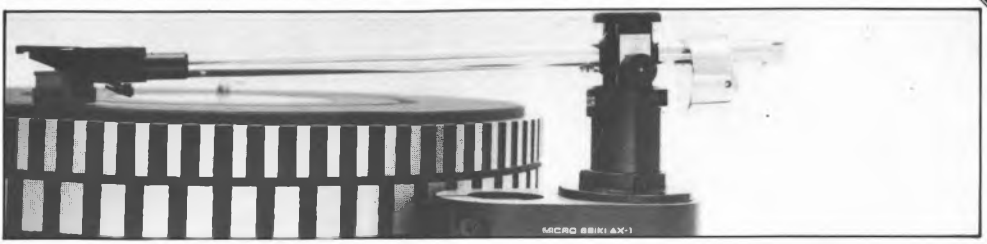


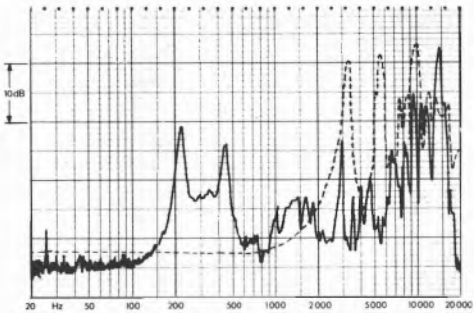
Compared with the standard set by most of the models in this survey, the finish and engineering of this fairly expensive arm were definitely below par. Extensive use has been made of a black plastic which marks easily and visibly distorts under normal adjustment; for example, the arm pillar fixing ring when under tension from the locking grubscrews. While high rigidity is usually to be preferred at the pivot, the Decca offered a damped magnetically-suspended plunger arrangement under the unipivot mount, with significant play in both horizontal and vertical planes. In addition the downforce and lateral balance adjusters were none too secure, and in use could rattle. The special plastic headshell comes from Connoisseur, using their unique socket arrangement, and carries a spirit bubble to aid levelling. An effective magnetic bias compensator was incorporated, but unfortunately could not be adjusted to the lowest settings when used with low profile turntable platters such as the Michell *Focus*.

Lead-out wire torque compromised the friction measurements, but despite this problem the values were acceptably low, and the magnetic bias system ensured that no further friction was added. Downforce calibration was just over 10% low and biasing 60% high, but fortunately in the correct ratio. Full geometrical adjustment were possible to a good standard of accuracy, but the arm resonance graph showed a fairly serious pair of resonances at 220 and 440Hz, with an energy loss beyond 15kHz. However, these two regions apart, the behaviour was quite good, with only moderate amplitude peak-to-trough resonances. Despite damping, the subsonic resonance had a double mode with the fundamental suppressed and only detectable on the crosstalk response (indicative of a unipivot rocking mode.)

Due to the upper subsonic resonance, the output was 3dB high at 20Hz with the test cartridge, as compared with the 1-2dB typical of the other arms. This perceived during the listening tests as a 'heavy' quality to the frequency balance. However, an overall good sound quality rating was attained, the sound appearing quite rich and pleasant, although slightly muddled in the bass and with a touch of mid forwardness giving a 'loudness' effect. Some loss of stereo focus was also noted.

This arm was found to work well with the Decca 'Gold' cartridge, the almost clinical sharpness of the latter balancing the arm's 'rich' qualities and resulting in a very good combination. Irrespective of this, however, its sound quality rating would in any case have merited some recommendation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	12.0g
Type of headshell	special detachable/(Conoisseur)
Headshell mass (inc screws)	9.5g
Geometric accuracy	good
Facilities for adjustment	height, tilt, overhang, damping
Finish and engineering	fairly good
Ease of assembly/setting up	fairly good
Ease of use	fair
Friction lateral/vertical (typical)	60mg (bias)/45mg
Bias comp: type/force rim/centre (1.5g ell set)	magnetic/200mg/300mg
Cueing: drift/8mm ascent/8mm descent	no cue fitted
Downforce calibration error 1g/2g	-0.125%/-0.25%
Amount of damping	moderate
Arm resonances	average
Subjective sound quality	good
Motor recommended	N/A
Estimated typical purchase price	£73



Arm resonances (compared to cartridge resonances, dotted).

Denon DP2500

Denon, Eumig (UK) Ltd., 14 Priestley Way,
London NW2 7TN. 01-450 8070

Features, facilities, setting up and use

Based on the latest Denon *DP2000* quartz lock direct drive motor unit, the *DP2500* represents the complete unit, while a further version is also available with plinth but without arm, designated the *DP2550*. Both the motor and the arm on the *'2500* were superbly engineered and finished, the motor being an outstanding example of a linear torque ac drive, using magnetic pulse error detection with excellent servo characteristics, an internally generated flicker free strobe, plus electromagnetic braking for speed change and stop. The first sample, which was an ex-dem unit possessed a faulty main bearing and incorrect 45rpm speed; the second model suppled was fine, and gave the majority of the results recorded below. In common with many other decks, the anti vibration isolation feet were not particularly effective, the typical plinth resonance was unfortunately on the wrong side of the arm/cartridge resonance at 12Hz. The arm incorporated Denon's own vibration absorber, consisting of a rubber damped flexible tube joint between the arm section tube and pivot section (see also *DA307, DA309*), and the platter was well damped by a sensible mat with good record contact. It should be noted that the manufacturer's *A* suffix does not denote any extra facilities, but is merely a means of differentiating between plastic veneer finishes; light ash where the *A* suffix applies, and walnut where it does not.

Lab performance

Both rumble and wow and flutter results were beyond reproach, while torque was also excellent and no overshoot was present. Quartz lock ensured near perfect speed accuracy. Very good hum levels were noted although vibration resistance was only adequate, but the heavy construction and good quality lid gave a 'good' feedback margin, agreeing with the fairly good curve for acoustic breakthrough, the latter showing some weakness in the 50-80Hz range.

Despite the tube decoupling no subsonic damping was detectable on the arm, while the light magnesium headshell helped to keep the effective mass at an estimated 9.5g. Arm resonances were non too promising, with the graph showing a damped mode at 20Hz, a severe one at 600Hz, and fairly serious additional resonances thereafter. A rapid energy fall also occurred above 10kHz, (note that for this graph the cramped scale places the 20kHz point at 10kHz.) Geometry, biasing, downforce and friction were all judged as very good, and cue operation fine.

Subjective quality

As might be expected from the lab results, neither wow nor rumble effects were audible. Overall the sound quality was rated as 'average' which is rather disappointing considering the high price level. A degree of upper bass emphasis was noted, probably related to the high level in the breakthrough graph, together with an attendant suppression of low bass. The midband was mildly coloured with a veiling of depth and detail, though at higher frequencies the balance moved to the bright side. Stereo imaging was vague, which we

feel is attributable to the flexible joints provided for the arm pillar and tube. It is likely that the motor section alone, partnered by a suitable arm and mounted on a structural wall shelf, would perform rather better subjectively.

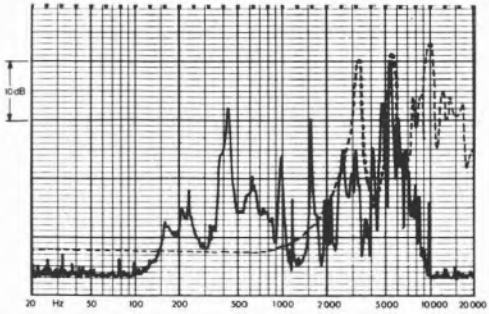
Conclusions

Considering the price bracket no recommendation can be made; while this is an excellently engineered product, insufficient attention has been paid to questions of vibration feedback and arm coloration. Used optimally however the motor unit (*DP2550*) merits recommendation.

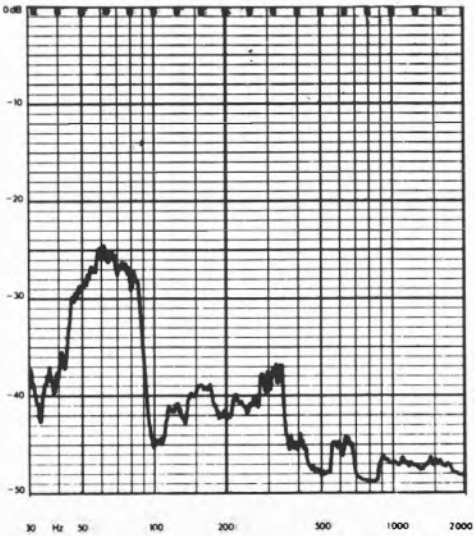
GENERAL DATA Integrated Player, components available separately

Motor Section	
Type	manual, quartz direct drive
Platter mass/damping	1.55kg/very good
Finish and engineering	excellent
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.06%/ 0.07%
Speed accuracy/drift/variation under load	quartz/quartz/0%
Start up time to audible stabilisation	1.3secs
Rumble (av DIN B wtd L/R)	75/76dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	9.5g
Type of headshell	universal detachable
Headshell mass (inc screws)	7g
Geometric accuracy	very good
Facilities for adjustment	height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	40mg/ 10mg
Bias comp: type/force rim/centre (1.5 ell set)	spring/190mg/150mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/3.5secs
Downforce calibration error 1g/2g	-0.05g/-0.15g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	48.6(w) x 40.3(d) x 17.6(h)cm/4cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	very good/good
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£300

Due to 45 rpm sample error frequency scale is compressed, 20kHz → 10kHz and *pro rata*.



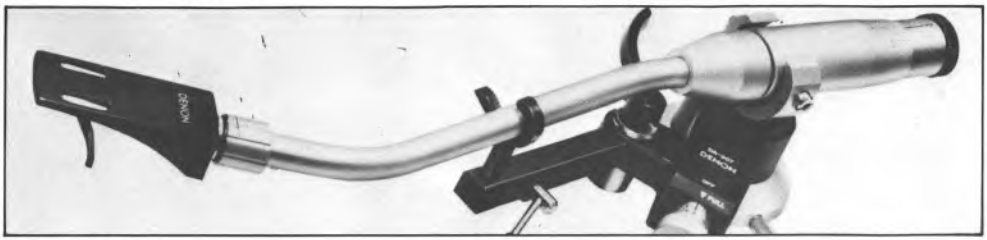
Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Denon DA307

Denon, Eumig (UK) Ltd., 14 Priestley Way,
London NW2 7TN. 01-450 8070



Features, facilities, setting up and use

The *DA307* represents a refinement of the *DA309*, and by comparison possesses an effective mass reduced by a factor of 1/3, in part achieved by the use of a lighter version of the magnesium headshell. The 'soft' joint at the arm tube pivot mount junction is even more flexible than that of the other two Denons reviewed; in this instance it is pre-stressed to take up the visible sag which occurs when the arm is set up. As with the *307*, considerable height clearance is required to accommodate the arm, which employs magnetic biasing — an ideal frictionless method. Finish and engineering were both to the customary and exemplary Denon standard.

Lab performance

Lateral and vertical friction levels were unmeasurable at less than 10mg, or 100th of a typical tracking force. Downforce calibration was 7.5% low — a not excessive value, but the bias figures were higher than for the other two Denon arms, and when set to '1.5g' gave approximately 1.5 times the required correction. In general, suggested starting values for an elliptical stylus at this downforce are 150mg at the record edge, increasing to 200mg (or 0.2g) at the centre.

Cue ascent was slow at 3 seconds, which unnecessarily prolonged the time required for the stylus to clear the groove (and hence cease damaging the recorded modulation.) The arm resonance curve illustrates a more rigid headshell coupling than the for *309*, with the first significant break deferred to 360Hz, and a more evenly maintained high frequency spectrum, albeit exhibiting resonances of greater severity. Above 1.5kHz the curve was dissected by large peak-to-trough irregularities, with a dominant mode clearly apparent around 720Hz.

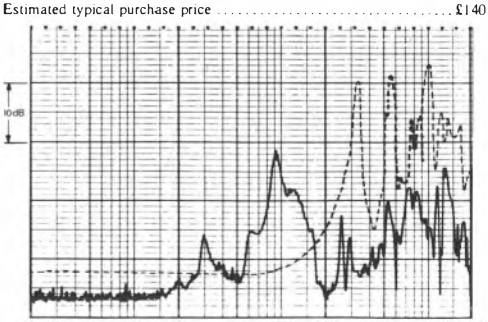
Sound quality

The *DA307* was rated as 'average', a similar ranking to its relatives, although it was felt to be marginally superior to the *309*. Low frequency definition was better, the balance a little more open and neutral, however stereo image precision and depth were comparable and of a veiled, somewhat vague nature. These may seem unduly severe criticisms, but they must be viewed in the light of the superior performance attained by other similarly priced pickup arms.

Conclusions

Of medium mass, suitable for cartridge compliances in the 15-25cu range, the '307 is certainly not a bad arm; it just doesn't sound good enough at its price to be recommended.

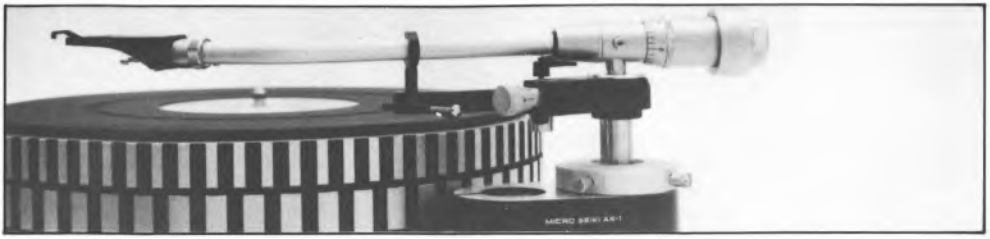
GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	10g
Type of headshell	Universal detachable
Headshell mass (inc screws)	7g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	<10mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	magnetic/ 250mg/280mg
Cueing: drift/8mm ascent/8mm descent	negligible/3secs/2secs
Downforce calibration error 1g/2g	-0.075g/-0.15g
Amount of damping	none
Arm resonances	average
Subjective sound quality	above average
Motor recommended	Denon
Estimated typical purchase price	£140



Arm resonances (compared to cartridge resonances, dotted).

Denon DA309

Denon, Eumig (UK) Ltd., 14 Priestley Way,
London NW2 7TN. 01-450 8070



Features, facilities, setting up and use

Similar in many respects to the arm fitted to the DP2500 player, the magnesium cast headshell of this model carries rubber absorption pads on the internal surfaces. Overall, the arm possessed a clean, well-engineered feel, with many operating features attractively presented; for example, the magnetic bias compensator, arm lock, cue and downforce adjustment. However, the headshell socket fit was none too secure, and a further loss of rigidity resulted from the Denon's own decoupled arm tube as well as the vertical bearings, which were suspended in rubber sleeves. As with several other arms in the report, a sliding counterweight was provided, with a constrained rotating section to accommodate a wide range of cartridges. One major drawback was the considerable total plinth height the arm required, as to my knowledge, not many motor units will accept the 15cm needed between the highest arm point and the base/plug/cable. (This excludes any further clearance necessitated by cartridge height adjustment.)

Lab performance

At 13g effective mass, this arm falls into the medium category, suited to 10-20cu cartridges. No significant damping was attributable to the specified decouplings at subsonic frequencies, and while a slight headshell tilt was present, the other geometrical adjustments were all fine. Accurately biased with zero bias friction, the excellent bearings contributed negligible friction in both planes, while downforce error was satisfactory at around -7%, as was the cue operation (although the latter could have been a trifle faster.) The arm resonance graph showed a well damped break at 300Hz followed by a prominent region centred on 900Hz, with total energy well down above this frequency band.

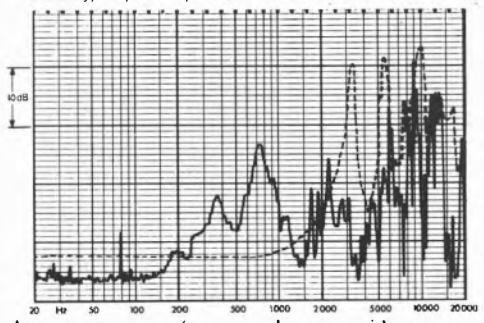
Sound quality

The sound quality was rated as 'average', a disappointing result for such an expensive specialist arm. Midrange information possessed a mildly hard and thick quality, while bass sounds were softened and lacked precision, with imaging vaguer than usual. Depth impression on cross-miked recordings was reduced.

Conclusions

Denon would appear to have optimised the isolation properties of this tonearm to reduce feedback effects, at the expense of rigidity and ultimate sound quality. The engineering is well up to the standard for the price, but the subjective findings preclude any recommendation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	13g
Type of headshell	Universal detachable
Headshell mass (inc screws)	9.5g
Geometric accuracy	fairly good
Facilities for adjustment	height, overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	<15mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	magnetic/145mg/160mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.5secs/4secs
Downforce calibration error 1g/2g	-0.05g/-0.15g
Amount of damping	none
Arm resonances	average
Subjective sound quality	average
Motor recommended	note considerable height
Estimated typical purchase price	£120



Arm resonances (compared to cartridge resonances, dotted).

RECOMMENDED

Dual 504

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

Features, facilities, setting up and use

Moderately priced Dual players have become increasingly sophisticated over the years, and the £100 odd *CS504,* fitted with a Dual *DMS240E* cartridge, proved to be no exception. It carried a good quality pickup arm, variable speed control, and a machine cut strobe, although the latter relied on incident illumination as no lamp was fitted. At end-of-side the arm returned to its rest position, and the unit shut down. Belt driven, Dual's ingenious multi-lobe expanding pulley is used for fine speed control fitted to a large synchronous motor. The belt 'ticks' slightly on the pulley segments (this observation was noted in connection with the *CS510* in the previous issue of *Choice.)* Dual also market a fully automatic version of the *CS504,* designated the *CS521,* and with the exception of this facility, the manufacturer assures us that all other features, both objective and subjective, should be identical to those of the *504.*

A pressed-steel chassis is used, with the traditional foam damped inverted coil springs giving a resonant frequency at about 8Hz; this was rather unfortunate, as the high compliance cartridge supplied in the *504* resonated with the arm below this frequency, at about 7Hz. Subsonic damping via a decoupled counterweight was claimed, but using both the supplied as well as the test cartridge, our graphs showed it to be ineffective.

Lab performance

Absolute speed accuracy by strobe was very good at 33 1/3, but using this same setting resulted in a +1% error at 45rpm, thus necessitating readjustment. Wow and flutter was virtually in the 'excellent' class, and the drive possessed fine torque with a rapid start up. Rumble was quite good, undoubtedly limited by motor vibration breakthrough, while feedback margins were very good, especially with the lid down. Measured acoustic breakthrough was somewhat better than usual, while vibration resistance was classed as 'good'.

The arm resonance curve was not too promising, showing only modest resonance damping, with the first breakup occurring at 250Hz. An equally severe harmonic appeared at 500Hz, with the whole mid frequency area up to 2kHz quite dissected. At higher frequencies however the arm settled down, with a more uniform energy distribution up to the test limit of 20kHz; (15kHz indicated on the graph due to increasing scale compression.) Mechanically and geometrically the arm was found to be well adjusted, exhibiting low friction, sensible biasing, while both cue operation and downforce calibration were fine.

Sound quality

Only a touch of motor noise was audible, with no bearing rumble components. Overall sound quality (using the test cartridge) was classed as 'above average', with a slightly coarsened or grainy midrange and some depth veiling. The treble was a trifle muted but did not show any sibilant 'splash' or exaggeration, while bass definition was quite good, despite some low bass loss. Stereo image precision was to a good standard.

RECOMMENDED

Conclusions

Of moderate effective arm mass, and with a generally good performance on all counts, the *CS504* does well at its typical purchase price, always remembering that this also includes a cartridge. A similar recommendation would apply to the related *CS521*, if auto facilities are required.

GENERAL DATA Integrated Player

Motor Section

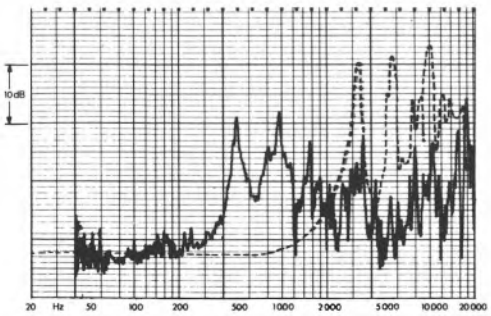
Type	auto stop belt drive
Platter mass/damping	1.2kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/DIN
Speed options/variable?	33⅓, 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/0.075%
Speed accuracy/drift/variation under load	adjustable/synchronous/-0.2%
Start up time to audible stabilisation	1.8secs
Rumble (av DIN B wtd L/R)	64/65dB

Arm Section

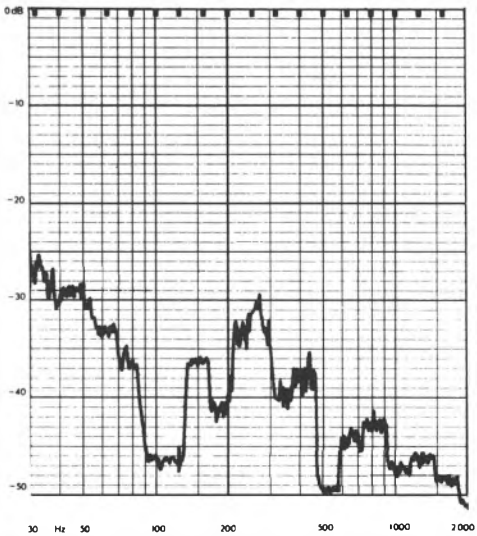
Approximate effective moving mass (excl cart, inc screws)	10g
Type of headshell	special detachable slider
Headshell mass (inc screws)	N/A
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	15mg/15mg
Bias comp: type/force rim/centre (1.5 ell set)	spring/210mg/220mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.0secs/2.0secs
Downforce calibration error 1g/2g	+0.05g/-0.075g
Amount of damping	negligible

System as a whole

Size/rear clearance for lid	42.4(w) x 36.8(d) x 14.6(h)cm/4.7cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	satisfactory/very good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

A single play turntable for those who demand quality to the last detail

Dual **For the finest in sound**

DUAL CS 504 (*illustrated*)

A belt drive semi-automatic turntable that comes complete with cartridge. Available in walnut or black finish.

For Dual, quality begins with excellent engineering. This is reflected in an outstanding performance and dependable operation. Not just in the drive system performance but, in the tone arm functioning and tracking ability as well. So with the Dual CS 504, just as with every Dual, you can be sure you are getting only the best in performance, operation and reliability.

The CS 504 is just one of a number of belt drive and direct drive turntables in the Dual line and to complete the range, Dual can offer cassette decks, amplifiers, tuners and racking systems.

Further detailed information can be obtained from one of our Dual dealers listed on the opposite page or by contacting

Hayden Laboratories Ltd.

Hayden House, Churchfield Road, Chalfont St. Peter, Bucks SL9 9EW. Telephone: Gerrards Cross (STD 02813) 88447

HAYDEN

Dual dealers

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BARROW IN FURNESS
Searle Audio Service
229 Rawlinson Street

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Rylan & Huntley
15 Old Bond Street

BEDFORD
Tavistock Hi Fi
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Dual

For the finest in sound

Dual 621

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

Features, facilities, setting up and use

Dual have recently introduced this relatively inexpensive direct drive automatic deck, designated the *CS621,* as part of a range which includes a cheaper auto return version, the *CS604.* In common with the other Duals in the report, a cartridge comes ready aligned and fitted (in this case a *DMS240E,* probably deriving from the latest Ortofon series.) The *CS621* sports a further refinement of the sprung flexible counterweight system, claimed to counteract chassis vibration and subsonic arm resonance effects. As with most Dual arms, downforce is applied via a tensioned coiled spring, thus preserving the arm's dynamic balance, with the same principle also used for biasing. A die-cast alloy platter is incorporated with rim strobe markings, these illuminated by a mains-frequency neon lamp. The usual steel chassis is suspended in coil springs with the lid fixed separately to the plinth, and a single variable speed control was provided, effective for both 33 1/3 and 45rpm. Overall, engineering and finish are both to a very high standard.

Lab performance

As with the *CS504,* wow and flutter was almost in the 'excellent' class, and although some speed overshoot occurred when the test loading was removed, the high torque of the motor ensured that program wow was well suppressed. While stability was good, a slight 0.4% error existed between the two speeds, but this can of course be corrected using the fine speed control. On the basis of the measured figures, rumble was very good (see subjective assessment), with acoustic breakthrough better than average. Although fine with normal cartridges, the DIN lead output gave only satisfactory hum levels using a moving-coil model, but both feedback and shock rating were very good.

Arm resonances were classed as below average — a small break at 150Hz was evident, and was quickly followed by a severe one at 270Hz. Another severe breakup occurred at 1.6kHz, with erratic behaviour beyond; eg the sharp dip above 15kHz. On the other hand, the mechanical factors were pretty good, including bias compensation, downforce calibration, friction, cue operation and geometry. No subsonic damping effect could be measured. Effective mass was recorded as c.12g, which is rather heavy considering the quite high compliance cartridge fitted as standard; the typical subsonic resonance was 7Hz, coincident with the chassis mode.

Sound quality

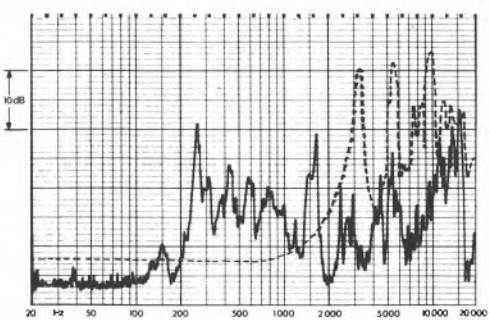
Only a touch of rumble was audible at high listening levels confirming the 'very good' objective rating. Overall, the quality was judged as 'average' which is appropriate for the price. Some stereo depth loss was noted together with subdued lower bass and a softened, emphasised upper bass. The midband exhibited some prominence with a 'loud' quality, a mildly coarsened effect and a degree of stereo vagueness.

Conclusions

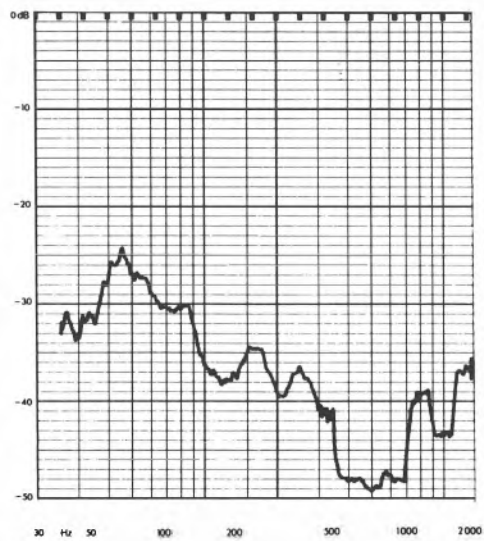
Overall the *CS621* is quite a good turntable at a

reasonable price, particularly considering its ready fitted cartridge and auto facilities.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic direct drive
Platter mass/damping	1.3kg/adequate
Finish and engineering	very good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.07/ 0.06
Speed accuracy/drift/variation under load	adjustable/ 0.05%/ 0.05%
Start up time to audible stabilisation	2.8secs
Rumble (av DIN B wtd L/R)	72/73dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	12g
Type of headshell	special detachable slider
Headshell mass (inc screws)	N/A
Geometric accuracy	good
Facilities for adjustment	overhang only
Finish and engineering	very good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	35mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/210mg/180mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.5secs/2.5secs
Downforce calibration error 1g/2g	0g/-0.15g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	42.4(w) x 36.8(d) x 14.7(h)/4.8cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/very good
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£171



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Dual 721

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

Features, facilities, setting up and use

This automatic deck represents Dual's top-of-the-range direct drive model, and together with its related but simpler auto-return brother the *CS704,* is fitted with a special version of the Shure *V15 111* cartridge (which alone retails at around the £50 mark.) Coil springs supported the pressed steel top deck/chassis, and a flexible counterweight was fitted; on our sample a minor fault concerned the bias compensator, as the spring had become displaced and was offering positive rather than negative side force, however this was easily corrected. The general standard of engineering and finish was undoubtedly good, although the supplied cartridge had been set up to give a 1° lateral error; fortunately the alignment procedure Dual describe is relatively simple, and the arm also has adjustable height. The record mat was of the reduced contact area type, with only three concentric rings to support the disc.

Lab performance

Surprisingly, the wow and flutter result was slightly poorer than the *621,* and while the servo system held the speed quite constant for long term variations, a slow wow overshoot was present on load recovery, and transient torque was not as high. Measured rumble levels were also marginally poorer than for the *621,* and it is interesting to note that a similar Dual motor is fitted to the Revox *B790,* where under different drive circuitry, a superior performance is obtained. Acoustic breakthrough was classed as a little better than average, but the feedback margin was just 'good', and in our test location improved by some 8dB with the lid raised. Excellent shock resistance was noted, and despite the DIN leads, the hum level was quite good using the Supex 900 moving-coil cartridge. The supplied cartridge was of course more resistant to hum, and gave an excellent low result.

Fairly low friction was recorded together with quite accurate downforce calibration, somewhat high bias compensation and satisfactory cue operation. However, lateral friction was undoubtedly greater than the specified 15mg. The arm resonance graph was not too promising with numerous peaky resonances, these beginning with a moderate break at 160Hz and then followed by severe ones at 270, 500, 930 and 1700Hz. Physical examination showed the weakest point to be the section of plastic headshell where it joins the arm at the offset angle. A 15g effective mass was estimated, which places the arm almost in the 'heavy' class, and suggests a low to medium compliance cartridge should be used rather than the high compliance one fitted as standard.

Sound quality

This model was rated as above average, the low frequency register showing an improvement when compared with the *621,* and the midrange being more neutral with less coarseness. Stereo precision was fairly good, although some edgy effects were noticeable higher up the frequency range. A trace of wow and rumble was also audible, the former on loud passages and the latter on quiet ones.

Conclusions

Albeit offering a reasonably good sound quality and objective performance, at its fairly high price level the 721 unfortunately does not merit a recommendation.

GENERAL DATA — Integrated Player

Motor Section

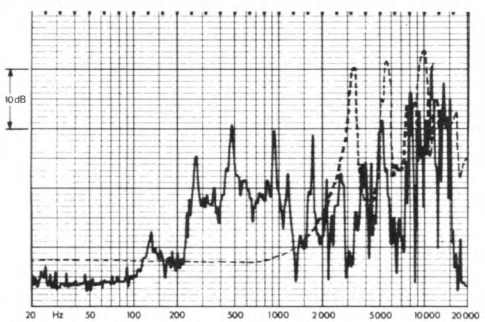
Type	automatic direct drive
Platter mass/damping	1.5kg/poor
Finish and engineering	good
Type of mains/connecting leads	3 core/DIN
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.07%/ 0.06%
Speed accuracy/drift/variation under load	adjustable/+0.15%/-0.06%
Start up time to audible stabilisation	4.0secs
Rumble (av DIN B wtd L/R)	68/71dB

Arm Section

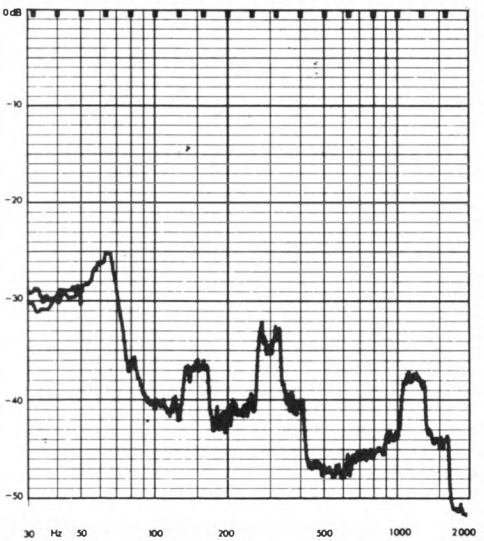
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	special detachable slider
Headshell mass (inc screws)	N/A
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	40mg/ 10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/230mg/210mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/2.5secs/2.0secs
Downforce calibration error 1g/2g	+0.05g/-0.05g
Amount of damping	negligible

System as a whole

Size/rear clearance for lid	42.4(w) x 36.7(d) x 14.5(h)cm/4.9cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	excellent
Ease of use	very good
Estimated typical purchase price	£250

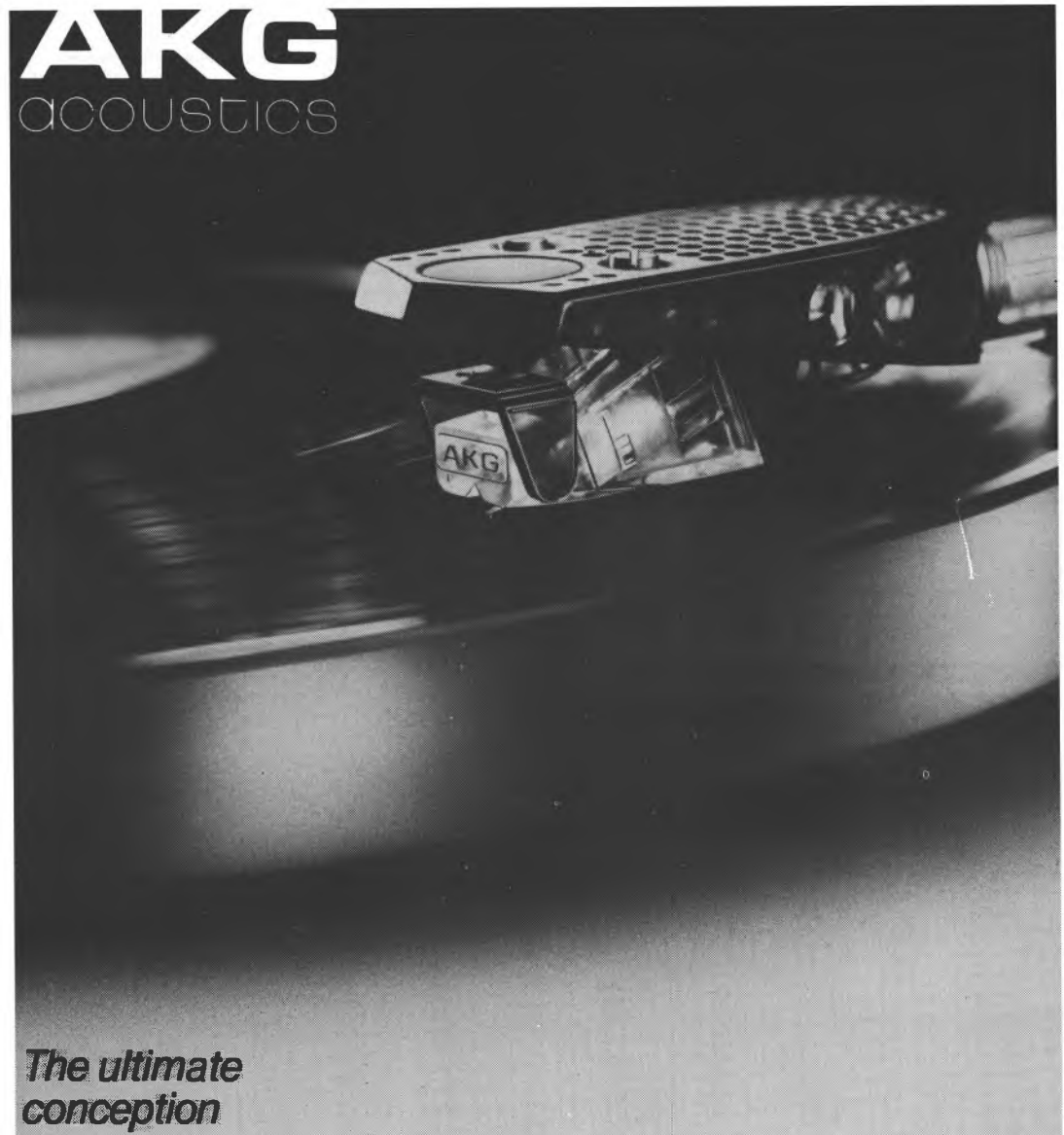


Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

AKG
acoustics



The ultimate conception

The AKG stereo cartridge range incorporate a unique and brilliantly designed single pivot point suspension system which ensures that every instrument and performer will be produced not only with the highest possible fidelity and sound definition, but also with an almost uncanny aural sense of "depth" and directional detail. Features: Unique AKG designed TS (transversal suspension) stylus system. Universal symmetry in respect to transversal movements. Superb transient response. Ultra high tracking ability. Very low effective moving mass. Every model P 8E and P 8ES is individually numbered and supplied with a calibrated frequency respons crosstalk curve. Made with the same meticulous care as the world famous AKG studio microphones.

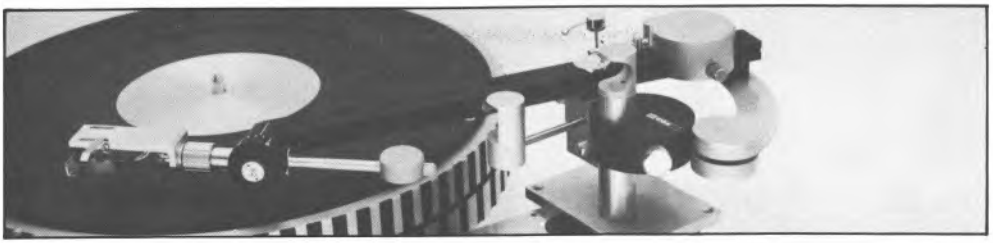
The model P 8ES is the premier cartridge in th completely new range of five models.

AKG

AKG Acoustics Ltd. 191 The Vale, London W3 7QS, Telephone 01-749 2042 (5 lines), Telex 28938 (akgmic g)

Dynavector DV505

Dynavector, Condor Electronics Ltd., 100 Coombe Lane,
London SW20 0AY. 01-946 0033



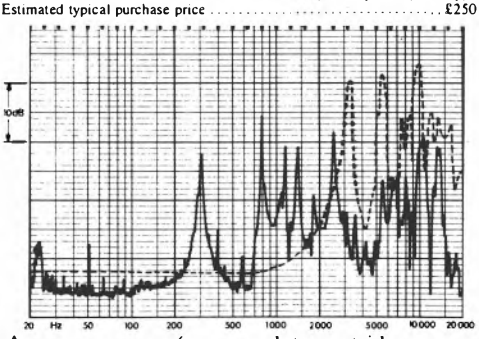
This extraordinary arm was so heavily engineered that it was found to weigh c.1.8kg; as such it can be placed directly on a solid plinth type turntable without any further need for fixing! The manufacturer's instructions were none too clear considering the arm's complexity; a number of features unique to this model were claimed, including the elimination of the subsonic arm cartridge resonance. Unfortunately this was not found to be the case, as the resonant subweight inside the main arm and the electromagnetic eddy-current dampers only acted in the lateral plane; in the vertical plane the arm was in fact undamped. A very high lateral effective mass was attained by the main arm section carrying the sub-arm (is this really desirable?), while the latter was rather lower in mass at an estimated 17g. The heavy loading on the main arm tube inevitably resulted in high lateral friction, greater than the claimed 50mg; in addition, the simple thread and weight bias compensator served to increase friction in the lateral plane, as the guide wire was of small diameter with no pulley. Downforce was supplied by a spring which was strongly angle dependant, making measurement difficult.

Lateral friction was rather poor at 150mg, with the biasing not only incorrect in value and imparting extra friction, but also being higher at the rim than the centre! The shortness of the sub-arm means that warp wow will be greater than for ordinary arm tubes, but in fact this is unlikely to prove significant in subjective terms. An arm resonance graph was taken, with the accelerometer at the 1/3 from pivot position on the sub-arm, but due to this model's unique design, the curve is not fully compatible with the others in this report. High peak-to-trough ratios are visible on a number of resonances, with an unusually low mode at 24Hz, while the first sub-arm break appeared at 300Hz with an uneven energy distribution holding at higher frequencies. Lateral effective mass was so high as to place the subsonic resonance below 4Hz using the test cartridge.

We were disappointed by the overall sound quality of this arm, more particularly when its high price is taken into account. The following characterisations may seem severe, but again they must be put in the context of the superior performance attained by other lower priced tonearms, critisims made included brittleness, midrange hardening and emphasis with a 'loud' effect, plus apparent coloration in the ambient sound field. The stereo positioning was vague and the central image widened, but in contrast the low frequency performance was quite good.

Rated as only 'average' on sound quality, this performance taken in conjunction with certain measured characteristics, preclude recommendation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	complex
Type of headshell	Universal detachable
Headshell mass (inc screws)	12.5g
Geometric accuracy	Very good
Facilities for adjustment	damping, mass, height, overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Ease of use	good
Friction lateral/vertical (typical)	150mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	t & w 220mg/120mg
Cueing: drift/8mm ascent/8mm descent	No cue fitted
Downforce calibration error 1g/2g	Depends on adjustment:
Amount of damping	little
Arm resonances	average
Subjective sound quality	average
Motor recommended	probably solid plinth type
Estimated typical purchase price	£250



Arm resonances (compared to cartridge resonances, dotted).

Eagle 7500

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

Features, facilities, setting up and use

The *D7500* is a neat auto return player which in all other respects bears a remarkable resemblance to the manual Audiotronic *ATT100M,* both models marketed by the same parent organisation. Of simple construction, with an unsprung fabricated plinth standing on rubber feet, the light platter was powered via a synchronous induction motor, and in contrast to the *AT100M,* a proper signal earth lead was present with the phono connectors. The lid, while well-finished, was also of rather resonant construction, and its direct attachment to the plinth unfortunately ensured that its stored energy was effectively coupled through to the arm pillar, and thence to the cartridge. The soundly engineered tonearm accepted the usual universal headshell, in this case a perforated light alloy model weighing 9g inclusive of fixing screws. No subsonic resonance damping was provided — not really surprising at this price level. The suggested method of cartridge alignment was by overhang measurement, which not only proved awkward but also resulted in a 2° error; an accessory protractor should be used instead.

Lab performance

Running an acceptable 0.6% fast, the torque was high, imparting an excellent loading stability and a rapid 0.6sec start up. Wow and flutter was satisfactory, but the rumble DIN B weighted figure was barely adequate, and reflected the high level of motor vibration. Acoustic breakthrough was poorer than average, as was vibration immunity, feedback and hum induction.

The arm resonances were notably severe and were definitely indicative of serious vibrational modes. Lateral friction was only fair at 100mg, although countered by good readings for downforce bias compensation and satisfactory cue operation. Unusually for such a low cost player, a height adjustment was also included.

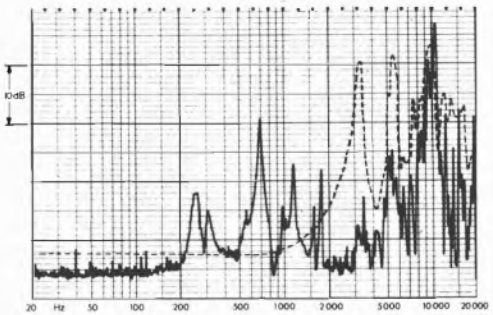
Sound quality

In view of their many similarities, it is perhaps not surprising to find that the sound quality of the Eagle was described as being fairly similar to that of the related *AT100M,* the *D7500* receiving a 'poor' rating which does not compare well with the achievements of other players at this price level. Rumble was clearly audible in the reproduction and should be improved or preferably eliminated.

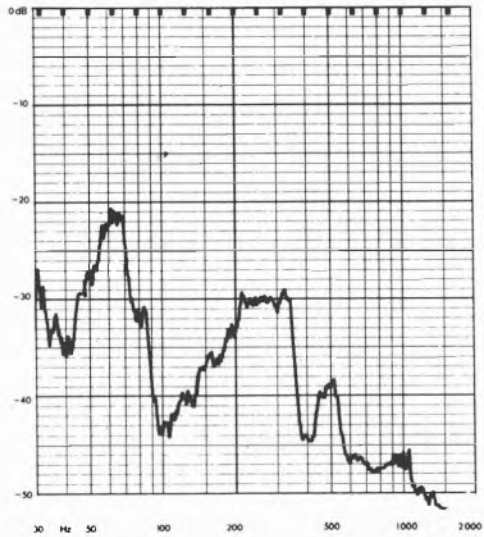
Conclusions

In its present form, the *D7500* does not merit a recommendation.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto return belt drive
Platter mass/damping	0.75kg/very good
Finish and engineering	fairly good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.11%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.12%/0.11%
Speed accuracy/drift/variation under load	+0.60%/synchronous/–0.05%
Start up time to audible stabilisation	0.6secs
Rumble (av DIN B wtd L/R)	50/52dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	9g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	average
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	100mg/ <10mg
Bias comp: type/force rim/centre (1.5g ell set)	thread & weight/ 160mg/175mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/1.5secs
Downforce calibration error 1g/2g	+0.025g/0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	42.9(w) x 36.0(d) x 14.3(h)cm/4.0cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	poor
Hum level/Acoustic feedback	poor/poor
Vibration or shock sensitivity	poor
Ease of use	very good
Estimated typical purchase price	£75



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Elac PC 831

Elac, Paul Spring Electronics, 6 Oast House Way, Cray Valley Rd, Orpington, Kent
Orpington 31341

Features, facilities, setting up and use

The Elac is unique to this group in that it has the ability to accept a stack of records and play them in sequence — in other words, it is an auto-changer. However we did not make use of this facility as it tends to slightly damage records, but if a 'dual purpose' role is envisaged eg for parties etc, then this facility could be very useful. Some considerable power is required to drive an auto-changer mechanism, and in consequence idler-wheel drive was fitted, but an ingenious belt drive was also present working in parallel, and this takes over once the platter has come up to speed and the load demand has reduced.

The steel platter was ferro-magnetic and cannot really be used with moving-coil cartridges, even if this choice is unlikely considering the price of the deck. An Elac cartridge was supplied with the unit, ready fitted and aligned. The deck was fully automatic, incorporating all the usual facilities plus a strobocope and variable speed control. Engineering and finish were both to a fairly good standard, although no real isolation system was present — the steel chassis was simply bolted down.

Lab performance

Wow and flutter were satisfactory, but the 1.5% slowing under load was severe and is likely to produce audible pitch changes on loud music passages. Start up was rapid at 0.5 secs with the idler engaged, this despite the fairly heavy platter. Measured rumble was also satisfactory on Din B at 62-64dB, but the unweighted figures were only just adequate. Acoustic breakthrough was poor, with serious peaks at 300Hz, only 17dB below the reference record modulation level. However, vibration sensitivity was good and feedback resistance surprisingly fine.

The arm resonance curve showed a pretty average characteristic with a significant first break at 250Hz and a fair number of added resonances thereafter. Geometrical accuracy was unsatisfactory, with the fitted cartridge some 2-3° out of lateral alignment. Friction and downforce figures were more reasonable, but again the bias compensation was in the wrong ratio, and about double the required amount. The arm's effective mass was quite moderate at 10g and would suit medium compliance cartridges.

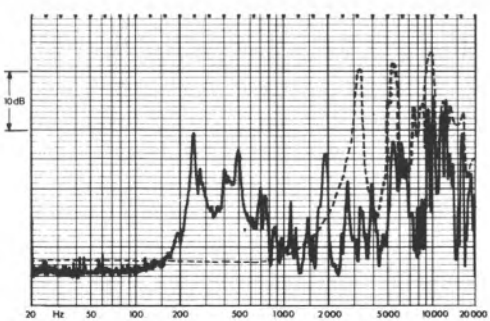
Sound quality

The overall rating for sound quality was just 'acceptable'. Rumble was audible at decent listening levels, together with slow wow pitch changes on records with heavy dynamics. It was also difficult to obtain satisfactory hum levels. The sound character was described as somewhat boomy and 'loud' with a fairly coloured forward midband, and a masking of stereo information. It was not however unpleasant, and would be found satisfactory by many users in uncritical situations.

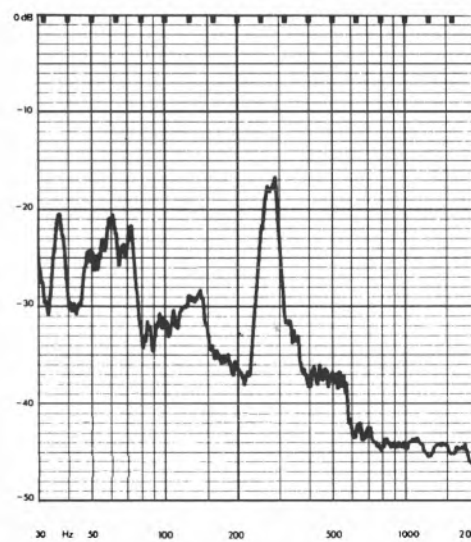
Conclusions

Having said that, its price is perhaps a trifle high for what is basically a reasonable auto-changer complete with fitted cartridge. By hi-fi standards the wow, rumble and sound quality rating preclude any recommendation.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic record changer
Platter mass/damping	1.4kg/adequate (10.8 in dia)
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/DIN
Speed options/variable?	33⅓, 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.12%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.23/0.12
Speed accuracy/drift/variation under load	adjustable/+0.5%/-1.5%
Start up time to audible stabilisation	0.5secs
Rumble (av DIN B wtd L/R)	62/64dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	10g
Type of headshell	special slider
Headshell mass (inc screws)	N/A
Geometric accuracy	acceptable
Facilities for adjustment	overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	<15mg/35mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/280mg/280mg
Cueing: drift/8mm ascent/8mm descent	negligible/2secs/0.75secs
Downforce calibration error 1g/2g	-0.025g/+0.2g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	43.4(w) x 34.8(d) x 17(h)cm/1.5cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	acceptable
Hum level/Acoustic feedback	adequate/very good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£72



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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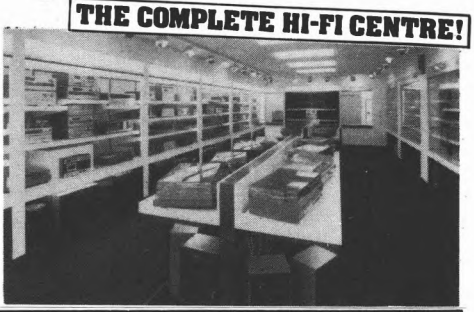

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Fidelity Research, Wilmex Ltd., Compton House, New Malden, Surrey KT3 4DE. 01-940 2545

Features Facilities setting up and use

The *FR54* is a good example of the heavy approach to arm design, as one solution to arm coloration is to increase the strength and mass of the structure, and thus control midband resonances. The large 11g (including screws) FR headshell represents a step in this direction, but unfortunately this method is not without its problems as it also results in a low subsonic arm/cartridge resonance. While finish and engineering were both to a good standard, with no detectable bearing play, strangely enough only one bias setting was provided nominally referred to a 2g downforce on an elliptical stylus; no pulley was provided for the bias weight thread so inevitably further friction was introduced. No damping was incorporated, and the measured overhang cartridge alignment method proved both primitive and none to clear for a novice to master. A second bias weight was also supplied, which suited a 5g downforce!

Lab performance

Geometrical accuracy was high despite the lack of headshell tilt adjustment, and effective mass was estimated at 16g thus placing the arm in the heavy class and best suited to low 8-15cu compliance cartridges. Friction was generally good, the high lateral figure mainly due to lead torque towards end-of-side. The bias compensation was highly accurate for the specified 2g setting, while downforce calibration and cue operation were both fine.

Arm resonances showed an early but controlled break at 280Hz, and were then pretty clear to 900Hz, the latter clearly a significant mode. Above 1kHz fair control was evident, with a relatively even distribution up to the 20kHz limit.

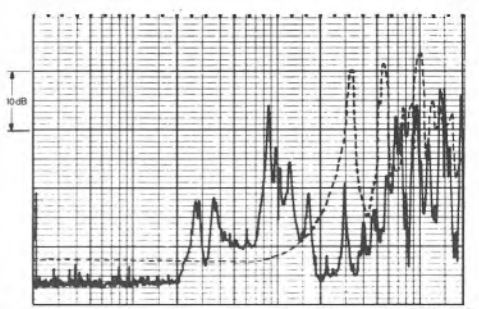
Sound quality

Rated 'above average' the sound appeared to be slightly bright with a degree of sibilant splash, although bass quality was quite good and loss of stereo depth was not excessive. The upper mid-range showed a mild emphasis with a touch of an almost metallic effect, while stereo image positioning was marginally imprecise by comparison with certain other arms in the report; for example, the Mission.

Conclusions

This arm will suit some of the low compliance moving coil cartridges, but cannot be recommended for conventional medium to high compliance non-moving-coil models. In fact, I suspect that the effective mass is a trifle high even for the manufacturer's own *FR1 II*.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	16g
Type of headshell	Universal detachable
Headshell mass (inc screws)	11g
Geometric accuracy	very good
Facilities for adjustment	height, overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	50mg/10mg
Bias comp: type/force rim/centre (fixed at 2g)	thread and weight 200/260
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/2.0secs
Downforce calibration error 1g/2g	-0.05g/-0.15g
Amount of damping	none
Arm resonances	average
Subjective sound quality	above average
Motor recommended	TD160 etc
Estimated typical purchase price	£90



Arm resonances (compared to cartridge resonances, dotted).

RECOMMENDED

Garrard GT25P

Garrard, Garrard Engineering Ltd., Newcastle Street, Swindon, Wilts SN1 2LH. 0793 35381

Features facilities, setting up and use

Two decks are effectively covered by this report, namely the GT25P auto return version and the GT20P, identical in all respects save for its manual operation. Both are belt driven, employing a neat four-pole Japanese synchronous induction motor and the same plastic centre drive and chrome plastic spindle as was used for the *GT35P*. Unfortunately on both the latter and the *'25P* the spindle was undersized and out of tolerance, the official standard being 7.24-7.33mm in diameter.*

An interesting internal mechanical feature was the use of a flexible plastic toothed belt to supply power from the spindle to the automatic return section, this belt being constantly driven even with the turntable in the normal 'play' mode. All three Garrard decks have universal output leads which may be ingeniously reversed, thus offering DIN or phono connections. The rubber feet on the *25P* were not adjustable, and offered minimal mechanical isolation.

Lab performance

Wow and flutter was quite good, but the motor ran a significant 0.6% slow and slowed a further 0.6% under a moderate 3g dustbug loading. Theoretically audible wow is possible with a 2g or higher downforce cartridge. Rumble was satisfactory at 64/65dB, this bettering the specification, while acoustic feedback was only just satisfactory, vibration resistance poor, and the breakthrough curve showed a poorer than average characteristic.

The family resemblance between the resonance graphs for the three Garrard arms in the report is plain to see, and at least the numerical results for all three models indicate good consistency in manufacture. Friction was moderate but biasing double the optimum value but showing the correct ratio, while downforce was pretty accurate and cue rates were good but with varying degree of lateral drift. In common with the other two decks reviewed, no provision has been made for cartridge alignment or tilt.

Sound quality

Rated as 'average' the sound quality was reasonable for the price. Subjective wow and rumble levels were considered fairly good, and the musical character was reasonably balanced, although a trifle 'deadened', with a loss of stereo depth and clarity. A degree of upper bass emphasis was also apparent plus mild mid coloration.

Conclusions

As recommended for the *GT35P*, the use of a solid shelf some distance from the loudspeakers helps considerably with this type of deck. If used in such a location and based on the supposition that Garrard carry out their intended improvements*, then quite good value is offered, and the deck can thus be recommended.

*Garrard were informed of the test problems and by the time of publication they reckon to have corrected the spindle diameter error and to have tightened up the headshell socket as well as improved quality control on socket geometrical alignment.

Garrard GT25P

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

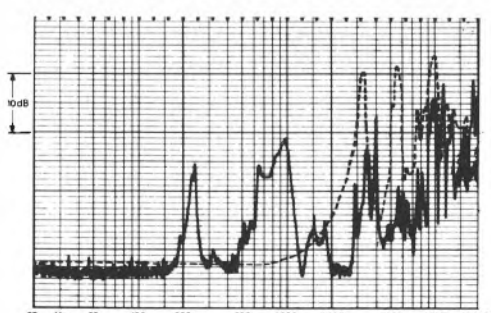
Type	auto return, belt drive
Platter mass/damping	1.4kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	two core/earth + DIN and phono
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.08%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.15%/0.1%
Speed accuracy/drift/variation under load	-0.6%/synchronous/-0.6%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	64/65dB

Arm Section

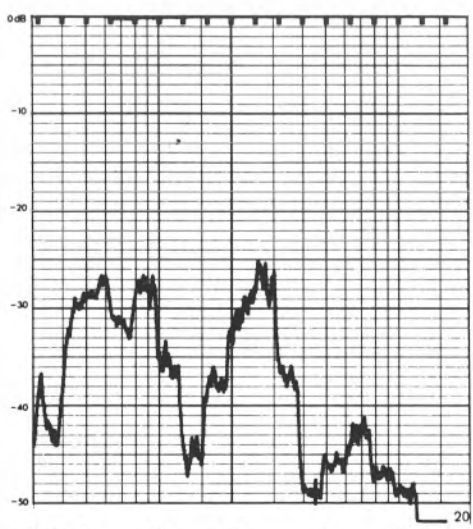
Approximate effective moving mass (excl cart, inc screws)	11g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	fairly good
Facilities for adjustment	overhang
Finish and engineering	fairly good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	30mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/280mg
Cueing: drift/8mm ascent/8mm descent	poor/0.5secs/1.5secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	45(w) x 36.5(d) x 15.8(h)/6cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/satisfactory
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£70



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Garrard GT35P

Garrard, Garrard Engineering Ltd., Newcastle Street, Swindon, Wilts SN1 2LH. 0793 35381

Features, facilities, setting up and use

A belt drive turntable employing a dc servo motor, the *GT35P* carried the basic new Garrard arm with a universal headshell fitting. This is described as an automatic player, but in fact this facility consisted of an auto return cycle at end-of-side, rather than the more usual auto return and stop. Fine speed control was provided in conjunction with a rim cut stroboscope platter of Japanese origin. The inner plastic platter section which carried the belt was fitted with a chromed plastic centre spindle but unfortunately this was significantly undersized (as was also the case with the *GT25P*), thus preventing true measurement of the deck's wow and flutter potential. Another problem concerned the headshell/arm fit which not only was rather sloppy (see *DD130*), but also exhibited a permanent 'list' or tilt; however, Garrard were certainly not alone as regards the latter fault, as the examination of several other models revealed.

Generally the engineering quality was quite high, but the amount of play in the arm bearings was rather worrying, even accounting for the spring loading, while no attempt had been made to provide feedback or vibration isolation.

Lab performance

Wow and flutter was on the high side, partly due to the under sized record spindle. Drift and load variation were satisfactory, but torque was none too high for a belt driven model with a moderate platter mass. Rumble was fairly good at 66/68dB Din B weighted, and just bettered the spec, while acoustic breakthrough was undoubtedly poor over virtually the entire range, 40Hz-150Hz. The corresponding feedback margin in the test location was barely adequate and vibration and a shock immunity were also quite poor.

The arm resonances were classed as about average — similar to those for the *DD130* — but here the rather looser headshell socket shifted the first break down to 230Hz. Arm friction results were fine, as was the downforce calibration, but biasing was up to twice that required. Some cue drift was observed but the rise and fall times were nicely judged.

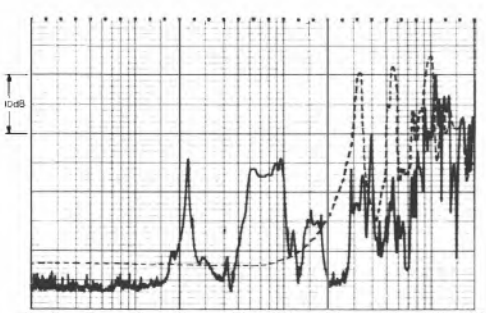
Sound quality

Strangely, the overall impression given by this system was a degree better than for the DD130, and as such it qualified for an 'average' rating, which is quite good considering the price. Rumble was almost inaudible, wow not severe (see *GT25P*), and by comparison with the *DD130* bass definition seemed a little improved.

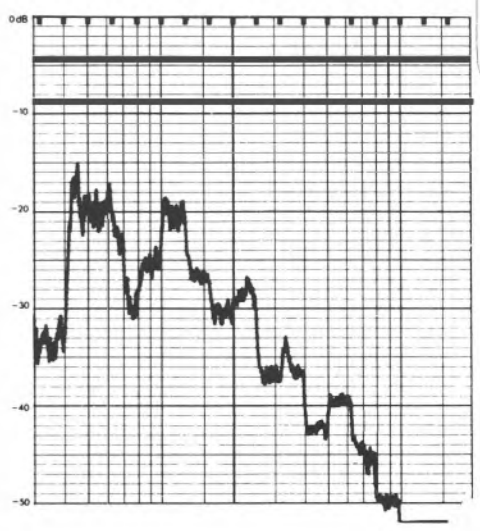
Conclusions

Assuming that Garrard correct the problems encountered, namely inadequate spindle size, loose headshell and canted sockets, this model could be recommended, albeit still with some reservations. The latter simply relate to feedback effects and mean that the model will work best well away from your loudspeakers, and should preferably be located on a rigid shelf mounted on a structural wall.

GENERAL DATA	Integrated Player
Motor Section	
Type	beltdrive
Platter mass/damping	1.6kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/DIN/phono universal + earth
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.12%
Wow/flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.25(see text)/0.11
Speed accuracy/drift/variation under load	variable/+0.25%/-0.4%
Start up time to audible stabilisation	2.8secs
Rumble (av DIN B wtd L/R)	66/68dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	11g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	fairly good
Facilities for adjustment	overhang
Finish and engineering	fair(see text)
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	15mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/160mg/300mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.5secs/1.5secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	44.9(w) x 36.4(d) x 15(h)/5.5cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/adequate
Vibration or shock sensitivity	adequate
Ease of use	fairly good
Estimated typical purchase price	£80



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Garrard DD 130

Garrard, Garrard Engineering Ltd., Newcastle Street, Swindon, Wilts SN1 2LH. 0793 35381

Features, facilities, setting up and use

The successor to the *DD75* reviewed in the first edition the DD130 is only similar in so far as it shares manual-only operation; otherwise, it has been completely redesigned in terms of arm, headshell, plinth and styling. The Japanese direct drive motor was of the open frame variety, and the higher torque plus good overshoot characteristics thus imparted ensured that the dynamic wow problem encountered with the earlier model was eradicated (the *DD75* used an inexpensive Matsushita motor).

The universal headshell, spray-painted grey, was in fact a rigid magnesium die casting, and was fitted with a Shure *M75ED* cartridge which we found to be poorly aligned — a function of Garrard's protractor which disagrees with the industry accepted SME one to produce 2° of lateral error. The tonearm socket was rather large in diameter thus making for an insecure fit for the headshell, and in addition the headshell still felt loose when firmly screwed up, due to play in the internal components of the socket itself. Furthermore, the vertical bearing was spring loaded, which further reduced arm rigidity. General finish was good, but the speed control proved very stiff and the lid hinges rattled somewhat in the 'up' position. No decoupling arrangement was present.

Lab performance

Wow and flutter measured well, and although a very good figure was recorded for rumble, the comparator table only carries a 'good' rating due to subjectively noted problems.

Speed drift was low and the tolerance of loading more than satisfactory, while a moderately slow 4 second start up time was measured. Acoustic breakthrough was a little worse than average, and transmission in the 70Hz range was rather high. On grounds of vibration resistance and feedback margins, only an 'adequate' rating was achieved.

Two major breakups were present below 1kHz, the first at 260Hz and the second at 800Hz. Further breaks occurred up to 4kHz, above which things settled down. Mechanically the friction results were fine, but biasing was double that required (at least the ratio was correct) while both cue operation and downforce were satisfactory. Effective moving mass was estimated at 12g, which placed the arm in the medium class, best suited to 10-20cu cartridges.

Sound quality

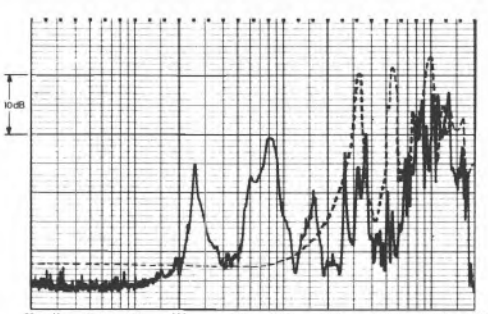
A trace of motor noise was audible at high listening levels thus degrading the overall rumble rating to 'good'. Hum levels were fine using the supplied cartridge, but proved slightly poorer with a moving-coil model. Overall quality was rated as 'adequate' — a little disappointing at the price. Bass performance was marginal, with an upper range overhang and a loss of the lower registers, while the midband was noticeably louder and harder than average. High treble 'splash' could be heard, although admittedly to a small degree, while stereo presentation was flattened, with some vagueness of image positioning.

Conclusions

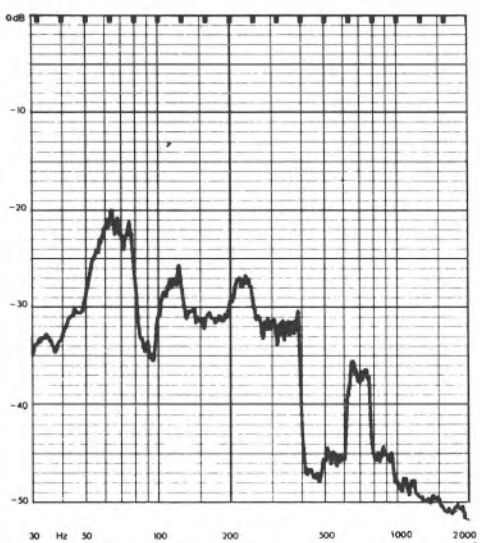
Though the dynamic wow problem of the *DD75* has been solved in this new player, and the arm is of reasonable quality, the subjective performance does not warrant a recommendation.

Note. Garrard informed us by phone that the headshell fixing would be improved by publication time.

GENERAL DATA	Integrated Player
Motor Section	
Type	manual, direct drive
Platter mass/damping	1.55kg/adequate
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/5 pin DIN
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.095%/0.075%
Speed accuracy/drift/variation under load	adjustable/<0.05%/-0.02%
Start up time to audible stabilisation	4.0secs
Rumble (av DIN B wtd L/R)	72/73dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	12g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	adequate
Facilities for adjustment	overhang
Finish and engineering	fair
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	25mg/20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/300mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.5secs/1.5secs
Downforce calibration error 1g/2g	-0.075g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45(w) x 36(d) x 15(h)cm/6.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	good/adequate
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£90



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

A GOOD HI-FI SYSTEM DESERVES THE SUPREME PERFORMANCE OF THE E.T.1000

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Beyer Dynamic

1 CLAIR ROAD
HAYWARDS HEATH
SUSSEX

Grace G707

Grace, Linn Products Ltd., 235 Drakemire Drive, Glasgow G45 9SZ. 041 634 3860

RECOMMENDED

This retested arm is a rigid yet low mass design with a fixed plastic headshell (adjustable for tilt) and employs a straight chromed alloy tube with secure gimbal bearings free of play. Essentially little decoupling was provided on the rotating counterweight assembly, while a pivoted weighted lever applied bias compensation via a thread, the arrangement offering reasonably low friction.

The instructions supplied were rather poor, with minimal guidance on alignment, and we felt that only a relatively experienced user could be expected to set up the arm correctly, using the information supplied. It is perhaps fortunate that the arm is distributed by Linn Products, and is in fact often fitted to their *LP12* turntable, their dealers being relied upon to provide a valuable setting up service as part of their sales package.

Low friction values were recorded but the supplied bias system set to 1.5g gave values virtually double that required for normal elliptical styli. However the ratio of rim-to-centre values was correct. Set up with a protractor, the geometrical accuracy was very good, with tilt, height and overhang provided. Cue operation was satisfactory and downforce calibration accurate. Effective mass was low at 6g and suitable for medium to high compliance cartridges, and extra weights may be necessary for low mass, low compliance model (otherwise moderate bass lift in the 20-40Hz region may occur.) A better than average characteristic was apparent from the arm resonance graph despite the anomalies in the 280-500Hz range and the related harmonic spike at 850Hz. Above this range the characteristic was commendably even with fair control and maintained energy to the 20kHz limit. A minor resonance appeared at 80Hz — too low for a bending mode and possibly due to the stiff counterweight elastic 'liner'.

In agreement with the previous issue a 'very good' rating was established using either a *LP12* or an ATR deck. The bass register was considered tight extended and powerful, with accurate placement while stereo was detailed with good depth and precision. The arm presented an interesting contrast to the SME *III*, which we felt to be on the rich side of neutrality, the *G707* conversely sounding slightly on the bright and coarse side of this balance. These facts are of considerable importance at this high quality level, when chosing a matching cartridge.

On the basis of sound quality alone, this arm would merit a recommendation. Fortunately the high price is justifiable on the grounds of its overall performance, both subjective and objective.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	6g
Type of headshell	Fixed
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	20mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	weighted lever & thread 240mg/290mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/2secs/2.5secs
Downforce calibration error 1g/2g	-0.025g/-0.05g
Amount of damping	none
Arm resonances	above average
Subjective sound quality	very good
Motor recommended	TD160,LP12 etc
Estimated typical purchase price	£125

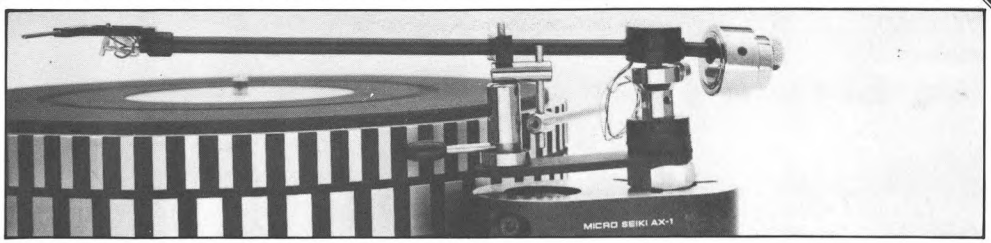
Arm resonances (compared to cartridge resonances, dotted).

Hadcock GH228 Super Arm

Hadcock GH228

Hadcock, G. F. C. Hadcock, Audio Division, The Old Vicarage, Doveridge, Derby DE6 5NN. 088 93 2452

RECOMMENDED



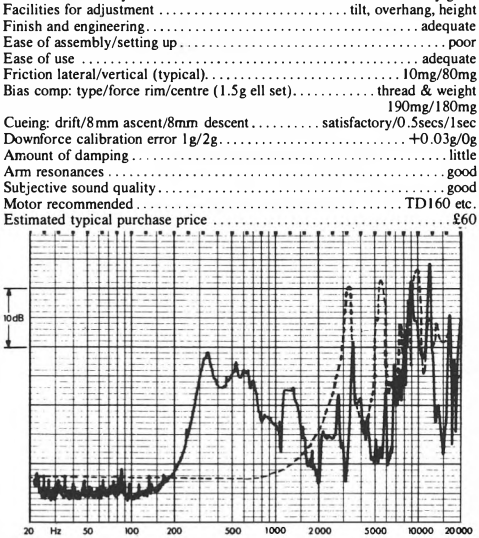
Recommended in the last issue, some criticisms were voiced concerning this design, particularly with respect to difficulties encountered in alignment and use, and though the manufacturer has worked on these problems, it is only fair to point out that they are still not completely under control some two years later. It took an experienced operator several hours to properly install the arm and set up a cartridge, and the relative ease with which it became maladjusted was frustrating, and militated against its use by anyone except a keen and forgiving enthusiast. The micrometer for downforce adjustment barely worked on both samples we looked at; the correct lateral balance on the counterweight was all too easily dislodged as was the veritable gantry of loose fitting rods for the cue device and arm lock. A steel unipivot cone with a four ball 'race' for support was fitted inside a small well which was filled with a high viscosity damping fluid, the latter applied using a syringe.

Some friction problems were noted in the previous issue and were again encountered here, the 6mg specification in the vertical plane proving invalid. While an excellent 10mg or less was noted in the lateral plane, the vertical value, although satisfactory, was closer to 100mg, probably as a result of 'flats' on the bearing surface (these clearly visible under a microscope.) Bias compensation was of the right degree if not in the correct ratio, and downforce calibration was highly accurate. When properly set up, the geometry was very good, while cue operation was satisfactory and moving mass usefully low at an estimated 6g including mounting hardware. The arm resonance characteristic was classed as good, since the first break is placed higher than average at 330Hz, with a relatively even energy distribution several octaves above this point. A more erratic resonance picture formed above 7kHz, but energy was nevertheless maintained to 20kHz. The subsonic damping had a rather small effect and should not be relied on to control a 'difficult' cartridge.

The 'good' sound quality of the previous issue has fortunately been maintained here. Of a well-balanced nature, the midrange was quite pleasant and neutral with attractive stereo depth and fair detail and precision. The upper range tended to a touch of brightness which can suggest slightly increased disc distortion, while the bass range was somewhat softened, and although certainly not boomy, nonetheless did not reveal transient detail or locational information as well as the ADC *LMF1,* for example.

Despite the engineering and operational difficulties, it cannot be denied that the *GH228 II* both sounds and works well when carefully adjusted and it thus gains a recommendation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	6g
Type of headshell	Fixed
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	tilt, overhang, height
Finish and engineering	adequate
Ease of assembly/setting up	poor
Ease of use	adequate
Friction lateral/vertical (typical)	10mg/80mg
Bias comp: type/force rim/centre (1.5g ell set)	thread & weight 190mg/180mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.5secs/1sec
Downforce calibration error 1g/2g	+0.03g/0g
Amount of damping	little
Arm resonances	good
Subjective sound quality	good
Motor recommended	TD160 etc.
Estimated typical purchase price	£60



Arm resonances (compared to cartridge resonances, dotted).

Hitachi 350

Hitachi, Hitachi Sales (U.K.) Ltd., Hitachi House, Station Road, Hayes, Middx. UB3 4DR. 01-848 8787

Features, facilities, setting up and use

A relatively inexpensive direct drive auto return deck, the *HT350* incorporated the Hitachi unitorque motor which is designed to minimise the 'cogging' all to common with earlier direct drive motors (occurring during rotation from pole to pole.)

While the external finish was excellent, the internal construction was rather light and insubstantial. The lid hinges were weak and did not fit well into the plinth slots provided*, and while some vibration existed in the vertical plane deriving form the flexible rubber feet (resonance at c.6Hz), little freedom of lateral movement was apparent.

The instructions were considered to be neither detailed nor very clear, and it is fortunate that the deck proved easy to set up and use with the exception of the recommended procedure for aligning a new cartridge; the latter was clumsy and involved an overhang measurement. A Hitachi 2g spherical tip cartridge was supplied ready fitted and was perfectly aligned.

Lab performance

The unitorque motor and its associated control circuit were unfortunately prone to dynamic wow on this model — in other words, audible wow and pitch variations when playing music of wide dynamic range. In addition, despite the reasonable torque and long term loaded speed stability, almost 1% of wow overshoot over a 1 second recovery time occurred, when a mild 3g loading was removed. However on steady state loading wow and flutter values were in fact quite low, and rumble almost in the excellent class, but a long 4.6 seconds was required for the motor to start up and audibly stabilise in pitch. Only adequate shock immunity was demonstrated, although feedback margins were surprisingly good and were 4dB improved with the lid down. Measured acoustic breakthrough was somewhat better than average.

The arm resonance graph illustrated the frequently encountered socket mode at 210Hz, followed by a large peak in the 800Hz region. Fairly clean above this point, the energy was maintained to 20kHz, although the isolated break at 10kHz is a rather severe one. Friction was moderate, biasing quite accurate, and downforce and cue operation both fine. Effective arm mass was estimated at 15g with no subsonic damping present.

Sound quality

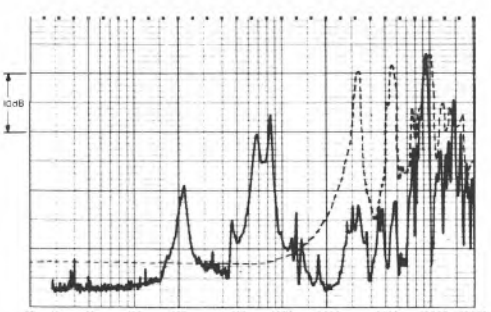
The rather disappointing sound quality rating turned out to be only 'adequate', this the result of the mild audible program wow taken in conjunction with other subjective factors. A low bass deficiency was evident with a softened and emphasised upper bass — almost a boomy tendency. The midrange showed muddling with a loss of detail, and the effect on treble sounds that was noted with one or two other decks was also apparent here — an almost fizzy quality was added. Hum induction was satisfactorily low even using a moving-coil cartridge.

Conclusions

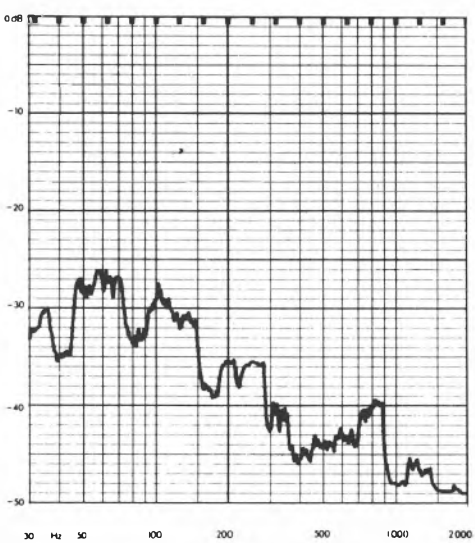
The HT350 cannot be recommended due to its overall ranking on sound quality grounds, in addition to the trace of audible program wow.

*Apparently intended to allow quick removal of the lid, where height is restricted.

GENERAL DATA	Integrated Player
Motor Section	
Type	direct drive, auto return
Platter mass/damping	1.05kg/good
Finish and engineering	good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	3¹₃; 45 rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.065%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.09%/<0.06%
Speed accuracy/drift/variation under load	adjustable/-0.34%/-0.20%
Start up time to audible stabilisation	4.6secs
Rumble (av DIN B wtd L/R)	75dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	40mg/15mg
Bias comp: type/force rim/centre	spring/120mg/150mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.5secs/4.0secs
Downforce calibration error 1g/2g	+0.1g/+0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45.4(w) x 36.6(d) x 13.7(h)cm/4.2cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Hitachi PS48

Hitachi, Hitachi Sales (U.K.) Ltd., Hitachi House, Station Road, Hayes, Middx. UB3 4DR. 01-848 8787

Features, facilities, setting up and use

Also employing a unitorque motor, the *PS48* is a moderately priced direct drive model from Hitachi which includes an auto return facility at end-of-side. The die cast platter rim carried strobe markings illuminated by a mains powered neon lamp, and the heavy plinth was well finished in a walnut effect vinyl covering. The record mat was rather light and did not offer maximum record surface support or good platter damping, while the large well-stuck BEAB lables that were common to the lids of all 3 Hitachis assessed, proved very difficult to remove cleanly. A better idea would be to stick these on the instructions or alternaltively the underside of the plinth. Internally the deck was well constructed, exhibiting tidy wiring and a sensible assembly; for example, isolating the mains transformer on rubber grommets.

Lab performance

In contrast to the *HT350*, the *PS48* motor was free of dynamic wow and no overshoot was detectable upon speed recovering after load removal. Torque was also good, and slowing under a 3g load acceptable. Speed drift was fine, and very good wow and flutter figures were recorded, while rumble at better than 70dB Din B weighted was also highly satisfactory and proved inaudible on subjective testing. Acoustic breakthrough was poorer than average in the low bass range, ie 30-80Hz, but improved above this, and quite good feedback margins were also observed with the lid either up or down. Shock immunity however was only just adequate.

The arm resonance curve was classed as average with the first headshell socket mode appearing at 250Hz, and several moderately controlled breakups occurring at higher frequencies, and at 10kHz the energy spike was both large and isolated. With headshell mass including screws at 12.5g, a high 17g effective mass was estimated, and thus low compliance cartridges are preferred to give the best tracking and a freedom from severe subsonic interference. Friction values were acceptable, bias compensation in the correct ratio if a trifle low in value, and downforce calibration was good with fine cue operation.

Sound quality

Overall the subjective sound quality was classed as average — a promising result at this price level. No wow or rumble was audible and hum induction was very good with all cartridge types. The bass register was judged to be slightly lumpy with the commonly found upper emphasis and low bass loss, while midrange was a trifle hard and forward, the upper mid moderately coarsened, and the treble by comparison a little dull. Stereo was satisfactory with some depth veiling and ambiguity.

Conclusions

Overall the *PS48* offers a solid consistent performance at a realistic price — average quality at a below average price. This performance/price combination clearly merits a recommendation.

Hitachi PS48

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

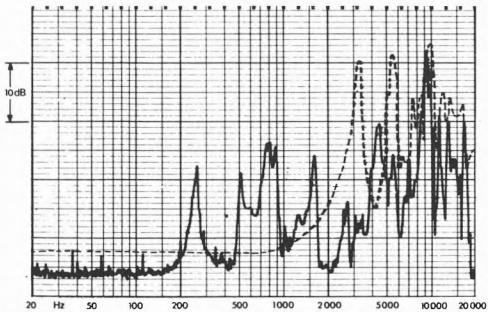
Type	auto return, direct drive
Platter mass/damping	1.65kg/adequate
Finish and engineering	good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.075%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.95%/<0.06%
Speed accuracy/drift/variation under load	adjustable/-0.1%/-0.4%
Start up time to audible stabilisation	2.5secs
Rumble (av DIN B wtd L/R)	74/71dB

Arm Section

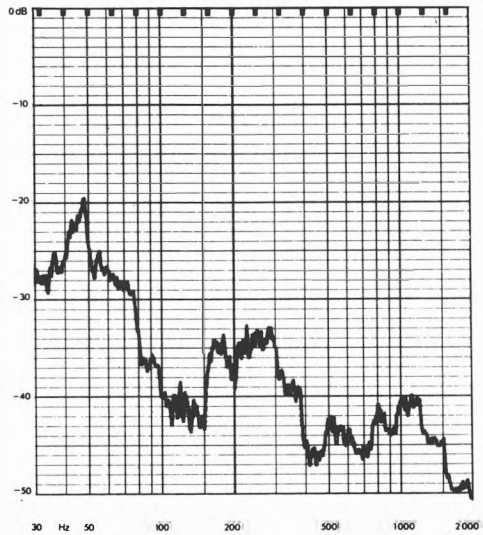
Approximate effective moving mass (excl cart. inc screws)	17.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	12.5g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	fair
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	100mg/10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/140mg/160mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.0secs/3.5secs
Downforce calibration error 1g/2g	+0.05g/0g
Amount of damping	none

System as a whole

Size/rear clearance for lid	47.6(w) x 37.6(d) x 16.4(h)cm/4.0cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	very good/very good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimted typical purchase price	£120



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Hitachi 550Q

Hitachi, Hitachi Sales (U.K.) Ltd., Hitachi House, Station Road, Hayes, Middx. UB3 4DR. 01-848 8787

Features, facilities, setting up and use.

Although *HT550Q* represents Hitachi's top-of-the-line model, its price is only at the average level for the test group as a whole. As the 'Q' suffix suggests, the unit's speed was locked to a highly accurate quartz oscillator, the use of a direct drive motor going almost without saying. An auto return design, the deck was heavily constructed with a substantial mineral loaded plastic baseplate. Internal assembly and wiring were to a reasonable standard — though one printed circuit was sufficiently badly attached to result in warping — while the mains transformer was not decoupled from the plinth. The auto return operated smoothly, and the unit proved easy both to set up and use. An elliptical Hitachi cartridge (Audio Technica derivative) was supplied as standard, tracking at 1.5g, although fitting of an alternative model again involved a clumsy method of overhang measurement.

Lab performance

Wow and flutter was very good in all modes of measurement, as was the rumble performance, while hum levels were excellent with the supplied cartridge and pretty good using the super moving coil. Start up was moderate at 2.7 seconds with speed accuracy and stability near perfect thanks to the quartz speed reference, and the motor showed good torque with no servo overshoot. Acoustic breakthrough was somewhat poorer than average particularly from 200-300Hz, although a 'good' classification was just achieved on listening room feedback margin (the figure some 6dB better with the lid up.) Vibration and shock resistance were only adequate.

The arm resonance curve showed a typical characteristic, these of course differing from one deck to another, but nonetheless difficult to differentiate on performance grounds. The first break occurred at 220Hz with low amplitude, this followed by another severe isolated mode at 800Hz. Friction levels were reasonable, bias compensation spot on, and downforce highly accurate, while the effective mass was estimated at 14g (best suited to 10-20cu compliance cartridges.) No subsonic damping was provided.

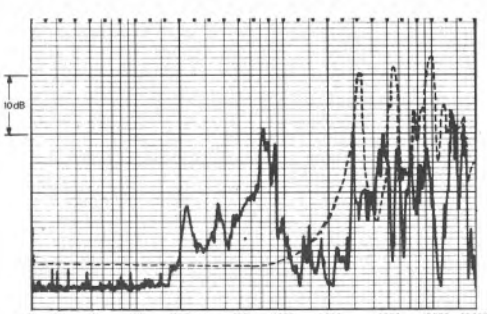
Sound quality

On subjective grounds both rumble and wow were considered inaudible. Overall quality rated as 'average' — just about right for the price. The bass register was quite well defined if a trifle 'generous', and while stereo depth was veiled, frontal imaging was satisfactory. The mid balance however was considered dulled and possessed a little coarseness, but was not unpleasant nevertheless.

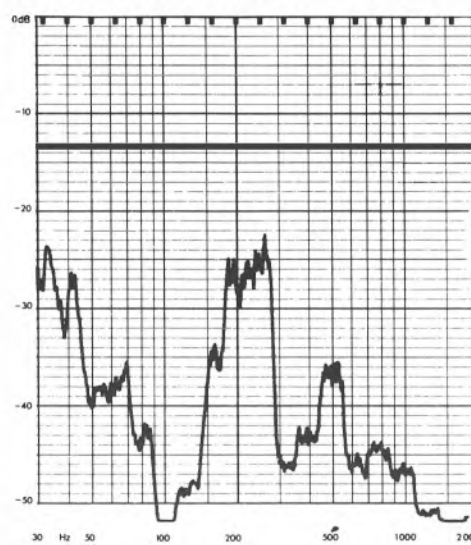
Conclusions

This turntable provides a secure and reliable overall performance at a realistic price. As with so many others in the report sound quality will be maximised by solid shelf mounting, positioned as far as possible away from the loudspeakers.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto return quartz direct drive
Platter mass/damping	1.9kg/good
Finish and engineering	very good
Type of mains/connecting leads	3core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.066%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.09%/0.07%
Speed accuracy/drift/variation under load	quartz/0%/0%
Start up time to audible stabilisation	2.7secs
Rumble (av DIN B wtd L/R)	72/76dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	60mg/15mg
Bias comp: type/force rim/centre	spring/110mg/140mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.0secs/3.5secs
Downforce calibration error 1g/2g	+0.05g/0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	48(w) x 38.1(d) x 13.9(h)cm/5.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£160



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

ITT 8011

ITT, ITT Consumer Products (U.K.) Ltd., Maidstone Road, Sidcup, Kent DA14 5HT. 01-300 7733

Features, facilities, setting up and use

This new ITT turntable, in common with the 8012 also reviewed, is manufactured for ITT in Japan and comes fitted with a medium quality Audio Technica *AT12XE* cartridge set at a 1.75g downforce. A direct drive model, an auto return facility is offered and a fully electrically isolated 2-core mains cable is standard, together with the fitting of a 5 pin DIN audio connector, presumably compatible with the range of ITT receivers and amplifiers. Internal construction was fairly good although the transformer had no mechanical isolation, and while the external finish was satisfactory, no serious attempt had been made to decouple the plinth from the mounting surface.

A single fine speed control was present for both 33 1/3 and 45 rpm, its accuracy depending on the precise setting of the ratios during production. Unfortunately this was not the case, as when adjusted for 33 1/3 the higher speed was 2% out, thus requiring readjustment when speeds were changed. The geometrical alignment was not very sound, with a close on 2° list or tilt on the headshell, plus a lateral alignment error in the installed cartridge. The latter was not considered to be a good choice for the arm, since its relatively high compliance resulted in a measured subsonic resonance below 5Hz, well into the most severe record warp region.

Lab performance

Wow and flutter was satisfactory, if unexpectedly poor for a direct drive, and a peak wow (linear unweighted) of 0.16% was noted. While slowing under load was significant at 0.4%, the good overshoot control ensured that dynamic wow will be absent. Rumble was classed as very good, and start up time fairly rapid at 2 seconds, while speed drift over approximately half an hour was on the high side at 0.3%. Measured acoustic breakthrough was somewhat below average, transmission peaking at around 70Hz, with the corresponding feedback margin just adequate (measuring 5dB better with the lid raised.) Vibration and shock immunity were both relatively good.

The arm resonance graph was fairly good with the exception of rather severe midband resonances — the first a headshell socket mode at 220Hz and a second a more serious one at 700Hz. Lateral friction was rather high at typically 75mg, reaching 140mg at end-of-side. Downforce calibration was fine and biasing pretty good, while the cue exhibited lateral drift, although the ascent and descent times were sensible. The geometrical errors have been noted above.

Sound quality

Rated as 'below average' the *8011* using the test cartridge sounded significantly poorer than the reference systems, revealing mid coloration and uneven slightly boomy bass with a 'loud' forward quality. Hum levels were just satisfactory with a moving coil although quite good with the supplied 111 cartridge.

Conclusions

Taking into account the sound quality, the incompatibility of the supplied cartridge with the undamped 16g effective mass arm, and finally the poor geometrical alignment, this deck cannot be recommended.

GENERAL DATA Integrated Player

Motor Section

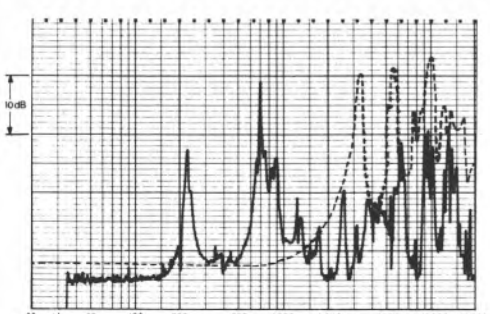
Type	auto return direct drive
Platter mass/damping	1.2kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/DIN
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.12%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.16%/0.10%
Speed accuracy/drift/variation under load	adjustable/+0.30%/-0.40%
Start up time to audible stabilisation	2.0secs
Rumble (av DIN B wtd L/R)	70/72dB

Arm Section

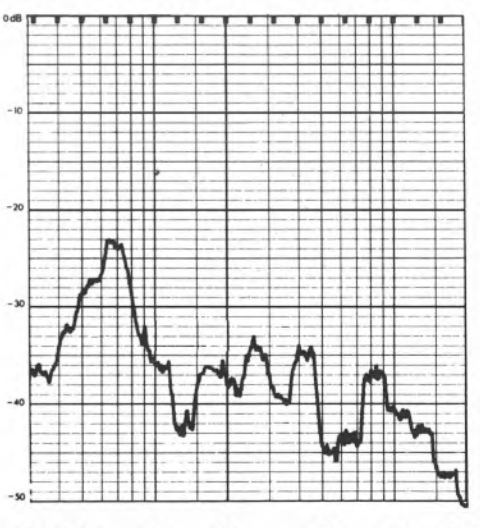
Approximate effective moving mass (excl cart, inc screws)	16g
Type of headshell	universal detachable
Headshell mass (inc screws)	7.5g
Geometric accuracy	fair
Facilities for adjustment	overhang
Finish and engineering	fair
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	140mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/190mg/200mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.25secs/3.0secs
Downforce calibration error 1g/2g	0g/+0.025g
Amount of damping	none

System as a whole

Size/rear clearance for lid	48(w) x 37(d) x 14.8(h)cm/4.8cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	below average
Hum level/Acoustic feedback	satisfactory/adequate
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£96



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

ITT 8012

ITT, ITT Consumer Products (U.K.) Ltd., Maidstone Road, Sidcup, Kent DA14 5HT. 01-300 7733

Features facilities setting up and use

The sister model to the *8011*, the *8012* was barely £15.00 more expensive, and provided fully automatic operation with front-mounted controls accessible with the lid down. The same Audio Technica cartridge was fitted here as in the *8011*, and was just as well aligned in the lateral plane, although the headshell was again tilted some 2° relative to the vertical. The automatics did not work on arrival and inspection revealed that a spring/selector lever had not been properly assembled, but a few moments adjustment was all that was needed to set this spring on the required 'post' and cure the fault. When operated the automatic sequence proved almost frustratingly slow, and the instructions did not include information on alignment of a new or different cartridge — a serious omission.

Moderately soft feet were fitted to the high density 'particle' board plinth, but the resonance was rather high at 12Hz, being nearly two octaves above the cartridge subsonic resonance (it should ideally be an octave below). Though lateral freedom was fair, the non-adjustable feet were not high enough to reliably elevate the bottom of the plinth clear of the supporting shelf. The lid was of the 'live' polystyrene types, although well finished, and the whole turntable was undoubtedly attractively presented.

Lab performance

While the DIN peak wow reading was very good at 0.06%, some 0.15% of pure linear wow was recorded — a fairly poor result for a direct drive turntable. Loaded speed stability and drift were good, but the motor showed significant overshoot upon speed recovery, and freedom from dynamic wow cannot be guaranteed; rumble was fine however. The heavier construction of this model helped in producing better acoustic breakthrough results than for its cheaper relative, and in fact feedback was classed as very good, both with the lid raised and shut; shock resistance was only adequate..

The arm was differently constructed to the *8011*, a fact confirmed by the resonance graph. In this case energy levels were better controlled up to 2kHz with the first mode appearing at a higher frequency of 350Hz (compared with 220Hz for the *8011*.) Some irregularity was apparent, downforce calibration was fine. Vertical friction was excellent, horizontal fair at 75mg, increasing to 300mg on the runout groove as the automatic 'tripped' to return the arm to its rest position.

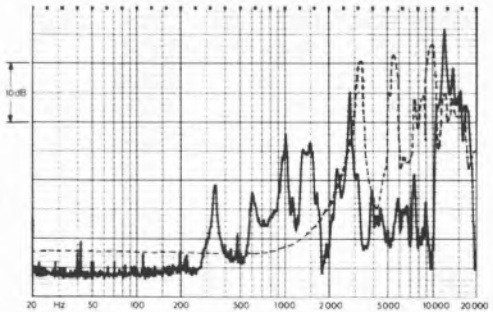
Sound quality

Again rated as 'below average', this ITT turntable showed considerable hum breakthrough with a moving-coil cartridge and hence these types cannot be recommended. The treble range possessed a rather 'splashy' almost distorted character, in all probability related to the arm resonance graph. Midrange was 'loud' and 'forward' with a depth veiling and moderate coloration, although the bass register was considered fairly good.

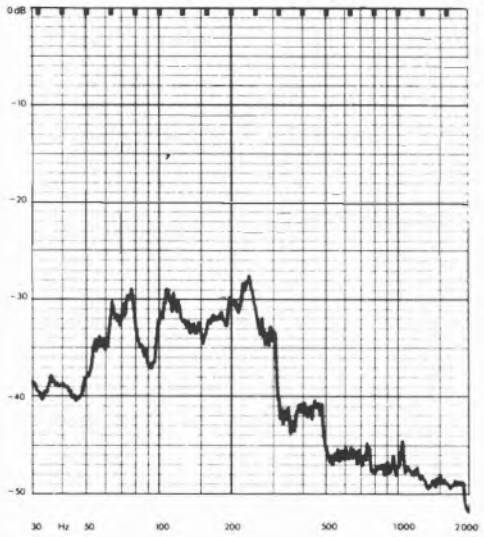
Conclusions

As with the *8011*, the cartridge supplied was not really compatible and the overall performance excludes any recommendation.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic direct drive
Platter mass/damping	1.7kg/very good
Finish and engineering	very good
Type of mains/connecting leads	2 core/DIN
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.15%/<0.06
Speed accuracy/drift/variation under load	adjustable/+0.05%/-0.2%
Start up time to audible stabilisation	
Rumble (av DIN B wtd L/R)	71/72dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	17g
Type of headshell	universal detachable
Headshell mass (inc screws)	11.0g
Geometric accuracy	fair
Facilities for adjustment	overhang
Finish and engineering	fair
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	75mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/400mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/2.0secs/4.0secs
Downforce calibration error 1g/2g	0.0g/+0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	48(w) x 38.2(d) x 15.4(h)cm/4.2cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/Acoustic feedback	adequate/very good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£110



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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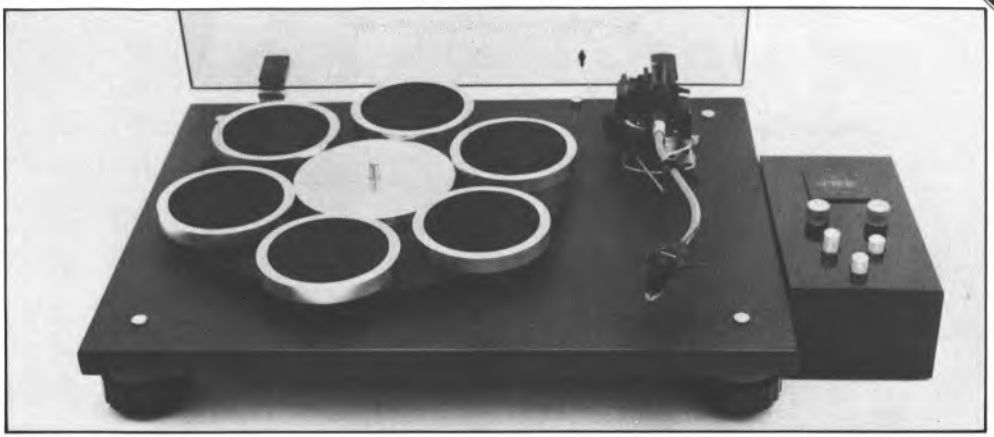
JBE series 3

RECOMMENDED

Janorhurst Ltd., Century House, Shortmead Street, Biggleswade, Beds. 0767 314252



This unusually styled 'open' motor unit is normally supplied without an arm and can be fitted with either a SME or a 'universal' round hole cutout to accommodate the pickup arm of your choice. Three versions of the plinth are available, the ¾" thick slab being manufactured from solid clear or black acrylic or grey slate. (The latter was reviewed here, the acrylic models selling for some £20.00 less.)

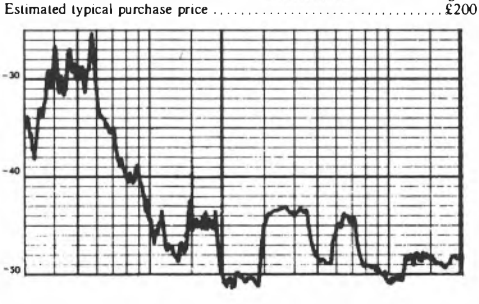
At present the early series of Matsushita motor is fitted to the deck, but we have been informed by the manufacturers that by the time we go to print the latest series motor which is free of dynamic wow will be standard.

The heavy (1.9kg) and unusual 'platter' is fabricated from polished alloy discs with a reasonable record contact area provided by dense and absorbent polyurethane foam inserted into the central core of the six outer discs. The acrylic lid was hand fabricated from flat sheet (like those fitted to the Michell decks), and was notably 'dead', while the electronics and power supplies came in a separate black acrylic box

The expected dynamic wow was noted. Rumble was very good, drift highly satisfactory and start up a little slow at 3.5 seconds, while the acoustic breakthrough results were distinctly better than average. The heavy plinth and lid were distinct assets here. The latter's beneficial effects were confirmed by the very good feedback rating with the lid either up or down, and this was augmented by the good rating for shock resistance. The isolated transformer supply unit also resulted in fine hum levels.

On a solid shelf this model gave good sound quality marred only by the mild wow problem, which should be rectified by the manufacturers. Assuming this to be the case, then a recommendation can be made.

GENERAL DATA	Motor Unit
Type	manual direct drive
Platter mass/damping	1.9kg/very good
Finish and engineering	very good
Type of mains leads	3 core
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.07%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.095%/0.08%
Speed accuracy/drift/variation under load	adjustable/<0.1%/-0.3%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	73/72dB
Size/rear clearance for lid	43.4(w) x 34.3(d) x 15.5(h)/8.4cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good (see text)
Hum level/Acoustic feedback	very good/very good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£200



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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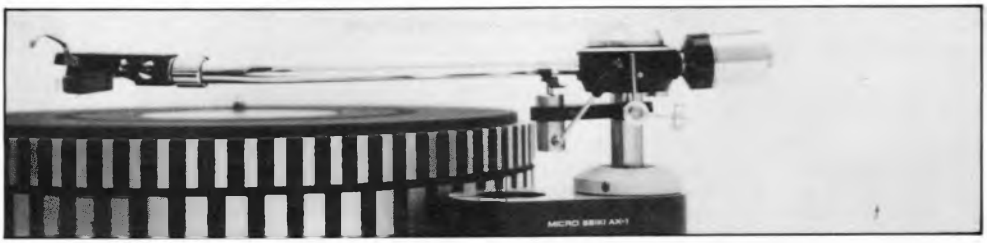


Features, facilities, setting up and use

Conventionally designed, the arm is similar in principle to many of the universal models fitted to current Japanese turntables. Horizontal freedom was provided by a precision ball race in the pillar section, with a further pair of races acting in the vertical plane. The counterweight was of the rotating type with a sliding scale, the assembly slightly decoupled from the arm tube by means of a stiff rubber bush. A pivoted weighted lever was coupled to the arm pivot section, providing outwards compensation for the inward bias pull resulting from the stylus friction and arm offset angle. The perforated alloy headshell carried the standard plug fixing and weighed 8.5-9.0g including screws, and while the plug/socket engineering resulted in a good fit, the socket itself caused the headshell to tilt about 2° in the vertical plane. It is also important to note that a quite considerable 14.5 cm was required between the arm top and the cable base when mounting the arm in a plinth.

Lab performance

Vertical friction was excellent, but horizontal values were only fair with evidence of some notching at certain positions, while the bias compensation varied inversely from rim to centre and was around 70% too high. Downforce calibration was within 10% and cue operation satisfactory. Warpage in the cue platform caused a 3mm differential in lift height depending where the arm was placed. The effective mass was suitable for medium compliance cartridges, and was estimated at 14g with no damping provisions.

An examination of the arm resonance curve indicated a 'below average' rating; while the tight socket/plug arrangement improved the first break to 340Hz, the entire curve was dissected by numerous sharp resonances of large peak-to-trough ratios.

Sound quality

Fitted to a high performance turntable *(DDX1000)* the overall sound quality was classed as 'average' which is disappointing for a 'component' arm. Dispersed and overwide stereo imaging was observed with a 'loud' 'forward' quality, and a consequent loss of depth impression. Upper midrange sounds were coarsened, with added hardness, and a trace of treble 'fizz' or sibilant slurring was also evident.

Conclusions

Stereo quality might well be a little improved with a straight headshell fixing, but the sound quality prevents a recommendation at this price level.

GENERAL DATA	Toneann
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.5g
Geometric accuracy	fairly good
Facilities for adjustment	height, overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Ease of use	fairly good
Friction lateral/vertical (typical)	65mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	falling weight & lever 270mg/220mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1.0sec/1.5secs
Downforce calibration error 1g/2g	–0.05g/–0.2g
Amount of damping	none
Arm resonances	below average
Subjective sound quality	average
Motor recommended	N/A
Estimated typical purchase price	£30

Arm resonances (compared to cartridge resonances, dotted).

RECOMMENDED

JVC QLA2

JVC, JVC (U.K.) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2. 01-450 2621

Features facilities setting up and use

The least expensive of the JVC range of direct drive quartz locked turntables to be reviewed in this report, the *QL-A2* is similarly styled to the *F4*, and offers auto return operation.

Rather stiff rubber-bush feet were used, which imparted inadequate structural isolation, and while slight vertical movement was possible, very little was available in the lateral plane. Constructional quality was reasonably good despite some rough edges on the plastic plinth moulding, but no separate chassis earth was provided for the signal leads and this omission is likely to result in poorer hum levels; the latter was indeed confirmed on use with a moving-coil cartridge. An interesting by product of the quartz locked speed control is that only the most expensive models have any facility for varying the speed. I have long held the opinion that the so called 'advantage' of such a facility when included on servo-type and direct drive models lacking quartz control was in fact rather more a necessity, in order to allow adjustment of the large short and long term speed drifts that frequently occur with non-synchronous motors.

Lab performance

Excellent wow and flutter levels were recorded together with very good rumble results. Start up was rapid at 1.5 seconds, although slight overshoot occurred on speed recovery, the decent amount of motor torque should ensure an absence of dynamic wow on program. Measured acoustic breakthrough was quite reasonable and ' behaviour was correspondingly good with the lid up or down. As expected from the skimped foot isolation, shock resistance was poor.

The arm resonance curve was average, with the inevitable shell/socket mode appearing in damped form at 230Hz, while the overall spectrum appeared quite dissected, with an isolated peak dominating the 10kHz region. Geometry was fairly good although only overhang adjustment was provided, but biasing was spot on, downforce accurate, and both cueing and friction were fine. The effective mass placed the deck in the medium class, and the counterweight decoupling provided suprisingly effective subsonic damping.

Sound quality

No rumble or wow could be heard in the reproduction, and the overall rating on subjective grounds was classed as 'adequate' — not too bad considering the price. The sound was characterised as somewhat brash and bright — low frequency definition was impaired, some high frequency splash was audible, and a loss of stereo depth and positional detail was evident.

Conclusions

On the grounds of its excellent motor plus arm technical performance at the price, and working on the supposition that sound quality should be improved somewhat by a rigid shelf positioning some distance from the speakers, the *QL-A2* can be recommended.

JVC QLA2

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

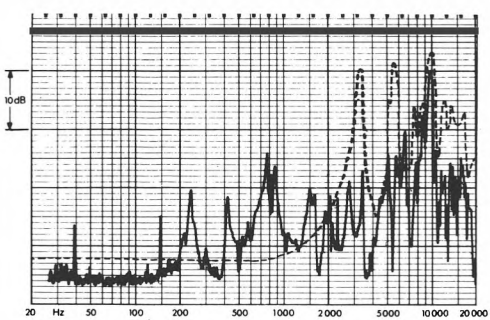
Type	auto return quartz direct drive
Platter mass/damping	1.25kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/phonos, integral earth
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd $\alpha 2$)	≺0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	≺0.05%/0.075%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	73/74dB

Arm Section

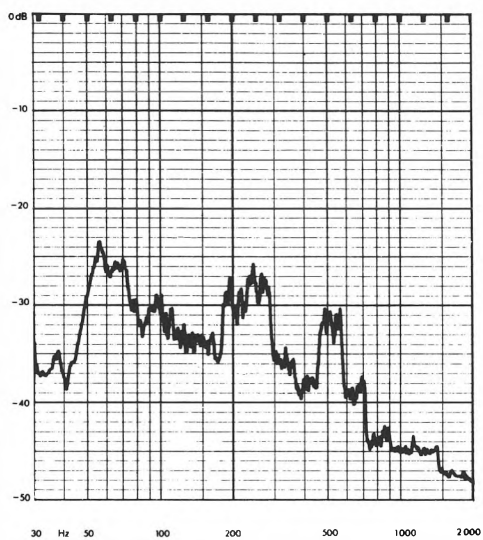
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	10.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assemblt/setting up	fairly good
Friction lateral/vertical (typical)	50mg/20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/150mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/2secs/3secs
Downforce calibration error 1g/2g	+0.025g/+0.005g
Amount of damping	moderate

System as a whole

Size/rear clearance for lid	46(w) x 36.5(d) x 15(h)/4.5cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	adequate/good
Vibration or shock sensitivity	poor
Ease of use	very good
Estimated typical purchase price	£110



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

JVC QLF4

JVC, JVC (U.K.) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2. 01-450 2621

Features facilities setting up and use

Of the three JVC models reviewed the *QL F4* is the only one offering fully automatic operation. Visually it resembles the *QL-A2*, and as the type number suggests a quartz reference oscillator for accurate speed is incorporated, this controlling the flat profile direct drive motor via a frequency generator servo system.

In common with the *QL-A7*, the *F4* arm has adjustments for tilt, height, and overhang, and was well aligned. No cartridge was supplied, the universal socket headshell ready to accept any compatible model. Estimated effective mass at 14g with moderate damping, a 1.25-2g tracking cartridge with a 10-20 cu would be suitable. The non-adjustable rubber feet did not provide much freedom of movement from shock or vibration isolation, although the attractive single band strobe was extremely clear and flicker free, the led illumination derived from an internally generated reference frequency.

Lab performance

Good wow and flutter was recorded with the 0.12% linear flutter reading somewhat on the high side. The quartz lock ensured superb speed accuracy and stability, while the lack of overshoot and the attendant good torque meant that dynamic wow could not occur. Start up was rapid at 1.5 seconds and rumble very good at 73-74dB, proving quite inaudible in practice. However, acoustic breakthrough levels were rather poor especially in the 50-80Hz range. In apparent contradiction, feedback was classed as good (lid up or down) but shock resistance was poor.

A rather peaky character was revealed by the arm resonance graph, somewhat below average in terms of control and quality of breaks. Conversely the arm proved to be well adjusted and had excellent downforce plus biasing, with low friction and an effective cue action.

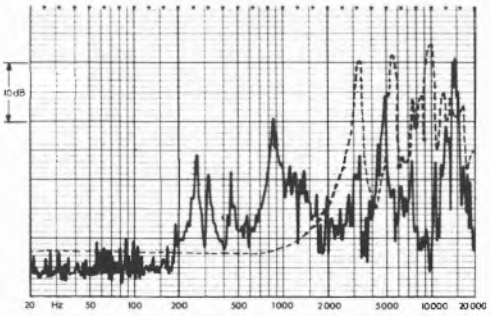
Sound quality

Partly due to the stable tracking performance of the arm and the good feedback margins that were achieved in the auditioning location, this deck achieved an 'average' rating for sound quality, agreeing fairly well with its price. A trace of that 'loud' midrange effect was present, with a softening of bass detail, upper bass life and low bass recession. The midrange musical balance tended to the 'cold' side, with a thinner elevated upper band. Fairly good hum levels were obtained with a sensitive moving-coil cartridge and moving magnet types proved excellent in this respect.

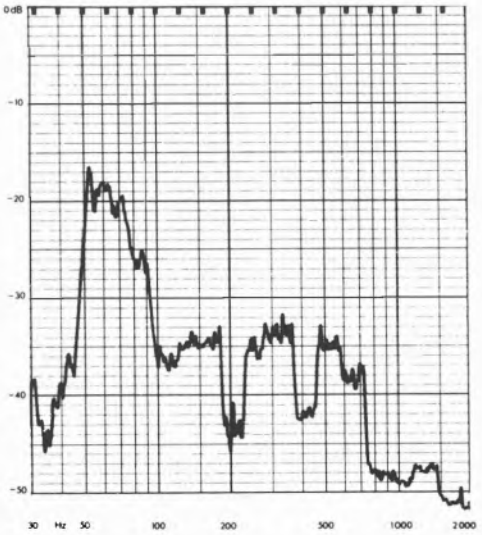
Conclusions

While the value for money is insufficient for the *QL-F4* to gain a recommendation in this report, it remains a reasonable turntable with well above average arm quality except for its wide band resonance characteristics.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic quartz direct drive
Platter mass/damping	1.25kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓, 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.07%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.10%/0.12%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	73/74dB
Arm Section	
Approximate effective moving mass (excl cart. inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	10.5g
Geometric accuracy	good
Facilities for adjustment	tilt, overhang
Finish and engineering	good
Ease of assembly/setting up	fairly good
Friction lateral/vertical	50mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/165mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/4.0secs
Downforce calibration error 1g/2g	-0.025g/-0.1g
Amount of damping	moderate
System as a whole	
Size/rear clearance for lid	46(w) x 36.5(d) x 14.9(h)cm/4.2cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	adequate/very good
Vibration or shock sensitivity	poor
Ease of use	very good
Estimated typical purchase price	£210



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

JVC QLA7

JVC, JVC (U.K.) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2. 01-450 2621

Features facilities setting up and use

The *QL-A7* is an auto return quartz lock turntable closely related to certain other models in the JVC range, namely the *QL-7* (a manual version) and the *QL-70* (a motor unit supplied without arm.) Both the *QL-7* and *QL-70* use plinths of slightly lighter construction that the *QL-A7*, and this may influence their breakthrough and shock resistance to some degree.

Belonging to the more expensive group of models, JVC have taken some care in their design of this deck, and numerous user adjustments are provided. For example, the arm has provision for height, tilt and overhang control, and incorporated sufficient decoupling to offer quite effective subsonic damping. The motor, of JVC's own design, used friction pad braking for rapid speed stop, although the speed change from 45 to $33\frac{1}{3}$ was quite slow. The ubiquitous and tedious overhang 'alignment by measurement' system again featured in the instructions.

All controls operated smoothly, and the general feel and standard of engineering was high. The large rubber feet were adjustable for levelling, but gave little lateral freedom as well as too high a vertical plinth resonance (at about 12Hz).

Lab performance

Very good wow and rumble figures were noted with excellent quartz speed accuracy and stability, plus high torque and a fast 1.5 second start up and no possibility of dynamic wow. The intrinsic main bearing rumble was very low at –78dB DIN, so the measured 73dB rumble figure carried some motor 'pole' noise, the latter confirmed upon auditioning. Acoustic breakthrough was about average — no severe peaks were present but relatively large breakthrough persisted to beyond 200Hz. Feedback on the test location was adequate — better with the lid up than down. Shock resistance was also just adequate and reasonably good hum suppression was achieved with the test moving-coil cartridge.

Excellent friction levels were present with bias compensation close to the correct values and in the right ratio, and downforce calibration fine. Cue ascent was rather slow at 3.5 seconds but no drift was present. Despite the fairly heavy shell the effective mass was estimated at 14g, and the presence of useful subsonic damping was noted. An average characteristic was shown by the resonance curve, possessing a generally dissected appearance, with headshell modes at 220Hz and upwards.

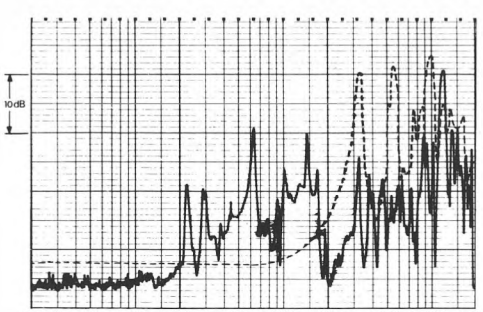
Sound quality

While a trace of motor noise was audible, the turntable gained an above average sound quality rating — just about appropriate for the price. The mid balance sounded thin, with a slightly coloured 'splashy' upper treble. The lower mid-range appeared a trifle muddled and veiled, while the bass register showed uneveness and a loss of the lowest range energy plus a lift in the upper bass.

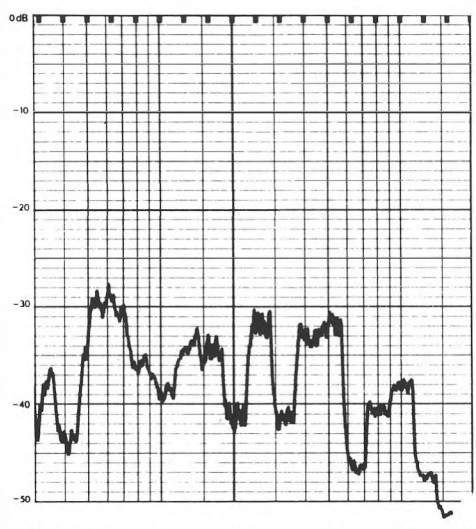
Conclusions

While this is definitely quite a good turntable, on the basis of its price versus performance, it does not justify a recommendation.

GENERAL DATA	Integrated Player
Motor Section	
Type	Auto stop quartz direct drive
Platter mass/damping	2.1kg/good
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓: 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.065%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.09%/0.07%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	72/73dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass	10.5g
Geometric accuracy	good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	very good
Ease of assembly/setting up	fairly good
Friction lateral/vertical (typical)	≺10mg/≺10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/125mg/145mg
Cueing: drift/8mm ascent/8mm descent	negligible/3.5secs/3.5secs
Downforce calibration error 1g/2g	+0.05g/0.1g
Amount of damping	moderate
System as a whole	
Size/rear clearance for lid	48.1(w) x 40.3(d) x 16.5(h)/6.2cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/adequate
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£270



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

A tip for anyone with £20 to spend on a cartridge.

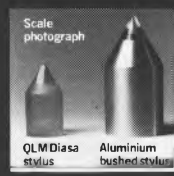
The ADC QLM 36 Mk III is available from most stockists for around £20.

Not a lot to pay for a cartridge these days. But, as you'd expect from the people who patented the Induced Magnet system, this is no ordinary £20 cartridge.

Its biggest difference lies in its smallest part: the stylus tip. We call it a Diasa stylus.

The tip is, naturally, a diamond – and it's bonded to a sapphire. The two stones are shaped together to a perfect ellipse, just as though they were one pure diamond stone (as found on cartridges costing £60 and more). Then the stylus is bonded directly onto the cantilever.

In cumbersome contrast, most styli in this price bracket consist of a tiny diamond tip carried by a heavy aluminium bush – which is connected in turn to the cantilever. This method, though cheap and easy to produce, adds extra mass where it's needed least, and gives rise to all sorts of nasty resonances.



So, in theory at least, the QLM 36 Mk III starts with a big advantage. But theory is all very well. The question is: can you hear any difference?

Judging by the reaction from leading specialist magazine, 'Hi-Fi Answers,' the answer is a resounding 'yes.'

'Treble detail was excellent without being sharp,' they said.

'The QLM 36 tracks well at 1.3 grams' and 'extracts a lot of information from one's records in a most delightful way.'

The reviewer was also at pains to point out that the QLM 36 is 'quite suitable for a wide range of turntables with integrated arms,' and he concluded that it 'is most definitely recommended at around £20.'

By the sound of things, this is one tip you just can't afford to ignore.

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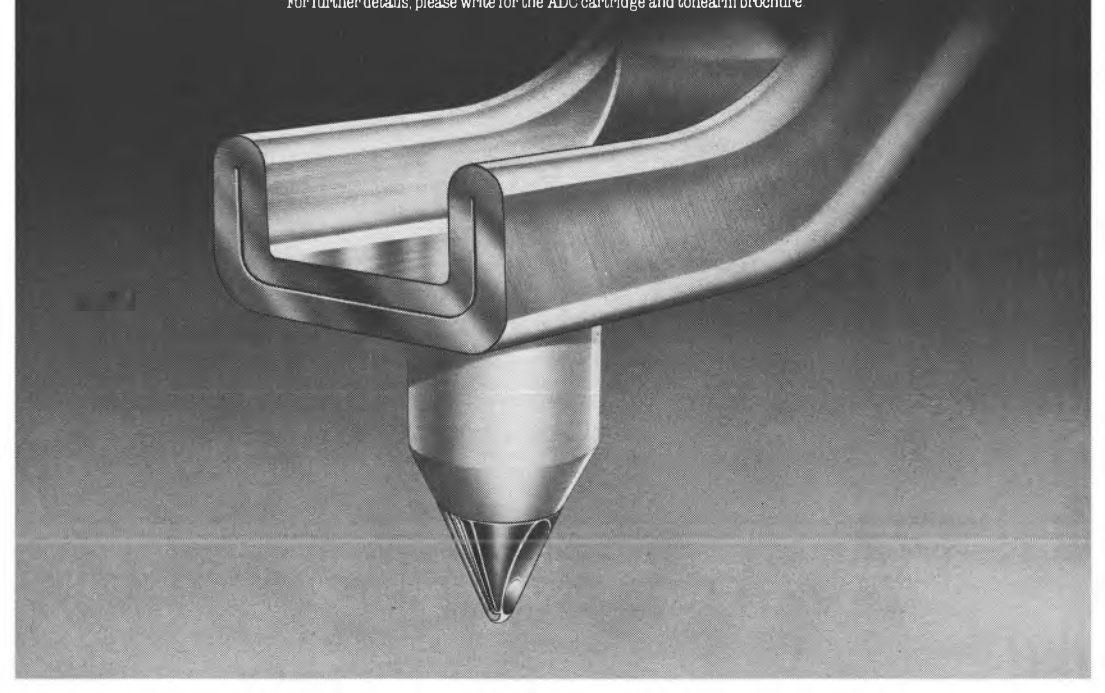


Linn Sondek LP12

Linn-Sondek, Linn Products Ltd., 235 Drakemire Drive, Glasgow G45 9SZ. 041 634 3860

RECOMMENDED

Having survived essentially unchanged for many years now, this turntable has gained an enviable reputation for its sound quality. However, credit is also due to the dealers who set up the decks as well as to the above average arm and cartridge usually fitted, namely a Grace *G707* and Supex *900E*.

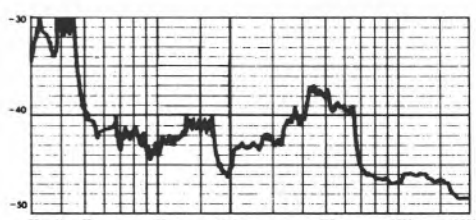
This simple single speed turntable carried a heavy die cast platter on a coil sprung floating sub-chassis, powered *via* a belt from a synchronous motor. Care had clearly been taken over every detail, from the substantial oil filled single point main bearing, to the balance of the sub-chassis and the vital dressing of the arm leads, so the latter do not disrupt the working of the spring isolators. The latter, is conjunction with the heavy mass, results in a fundamental resonance in the 4-5Hz range — offering genuine isolation from the environment.

Some wow was recorded — 0.15% linear peaks — but it is unlikely to be audible, and the DIN peak weighted reading was very good. Rumble was almost in the excellent class. Absolute speed accuracy was a trifle high at +0.2% but the good torque minimised speed variations due to loading, and unweighted rumble was particularly good at 45/47dB. While start up was slow at 5 seconds, acoustic breakthrough was very good, being well controlled over most of the range, the 500Hz rise traceable to excitation of the arm board.

A rating of 'very good' applied if used with a top rank arm, although other arms of lesser quality also sounded suprisingly good. The usual bass boom was conspicuously absent, with a clear, even, and well-located bass down to the lowest frequencies. The usual low-mid colorations were also absent and the deck proved relatively tolerant of location. Neither wow nor rumble were audible although a few samples have apparently had motors with some mechanical noise.

Expensive but probably worth it, considering the dealer backup, the *LP12* can be firmly recommended on the basis of its sound quality.

GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	3.85kg/good
Finish and engineering	very good
Type of mains leads	three core
Speed options/variable?	33⅓;/no
Wow and flutter (DIN pk wtd σ2)	0.066%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.14/0.08
Speed accuracy/drift/variation under load	+0.22%/synchronous/-0.1%
Start up time to audible stabilisation	5secs
Rumble (av DIN B wtd L/R)	73/74dB
Size/rear clearance for lid	44.5(w) x 35(d) x 14.5(h)/6.5cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/Acoustic feedback	excellent/very good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£250



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Marantz 6170

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

Features facilities setting up and use

One of a new range of turntables recently released by Marantz, the *6170* is a relatively inexpensive direct drive model, with an auto return facility. Fitted with the latest Matsushita motor, the deck used a die cast platter with integral stroboscope markings, the latter seen through an illuminated viewing window. The finish was attractive, a plastic moulding spray-painted in a light metallic gold, while the internal construction was quite good, although the mains transformer was not isolated from the plinth. In addition, the latter was not effectively decoupled from the environment, since the rubber feet offered very little lateral freedom and only a limited range is the vertical plane, and produced a vibration frequency of 8Hz — right in the cartridge subsonic frequency range. Two fine speed controls were fitted for 33⅓ and 45 rpm, and all facilities operated smoothly.

Lab performance

While wow and flutter readings were almost in the excellent category, rumble was only classed as 'good' at 67/64dB, although it is not known whether this is typical of the new motor. However, the latter did possess better loaded speed stability that its predecessor, together with reduced speed overshoot, and these factors should eliminate the dynamic wow problem of the old Matsushita motor. Speed drift was rather high at –0.3% over half an hour, while measured acoustic feedback was about average, the band at 200-300Hz being rather high. In practice acoustic feedback was pretty good although vibration resistance came out as poor.

The resonance curve showed a none too promising characteristic with the entire midrange 250 to almost 2kHz badly dissected, matters improving somewhat at higher frequencies. Friction levels were reasonable and bias compensation a trifle high while the cue and downforce calibration were both fine. Geometrical accuracy was considered good, while the effective mass was at an estimated 14g, with no subsonic damping.

Sound quality

No wow was detectable, while rumble, although just audible, was still quite satisfactory. Rated as 'average' overall the turntable was considered to have a fair bass register, if on the 'full' side. The midrange was a trifle coarse and loud, with reduced depth information, although frontal imaging was fairly good. By comparison, the treble range was slightly dull.

Conclusion

Best suited to low to medium cartridges (8-15cu), the *6170* is an attractively packaged turntable giving a fair performance at a below average price, and can thus be recommended, particularly if used on a firm surface.

Marantz 6170

RECOMMENDED

GENERAL DATA — Integrated Player

Motor Section

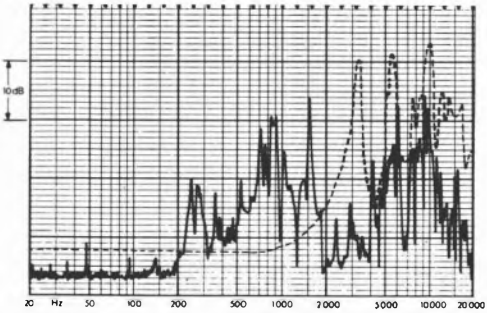
Type	auto stop, direct drive
Platter mass/damping	1.5kg/good
Finish and engineering	good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	≤0.7%/≤0.7%
Speed accuracy/drift/variation under load	adjustable/–0.3%/–0.2%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	67/64dB

Arm Section

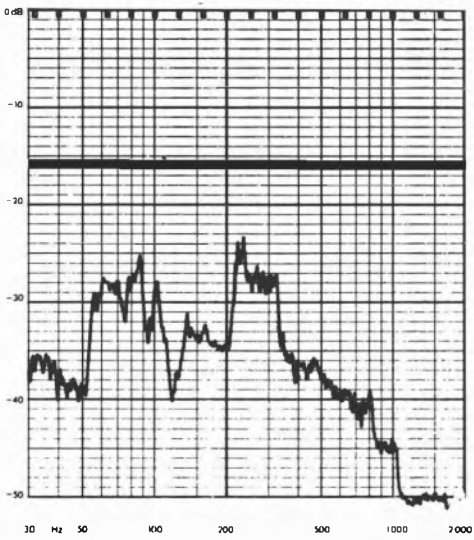
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	9.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	50mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/220mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.0secs/4.0secs
Downforce calibration error 1g/2g	–0.05g/–0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	45(w) x 36(d) x 13.5(h)cm/6.4cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable)

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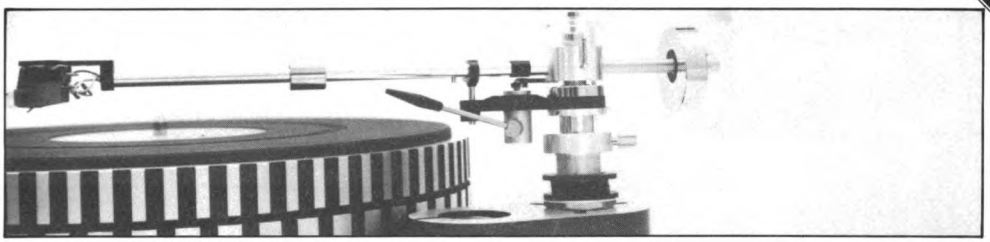


The Mark II version of this arm was reviewed in the previous issue, where some reservations were expressed during initial testing concerning headshell rigidity. The importer reacted sharply by an attempted product withdrawal — unnecessary in the circumstances as design modifications were already in the pipeline, and by independant purchase of a second sample through retail channels, *Choice* was able to confirm that an improvement had in fact been effected. Since then, further development has taken place.

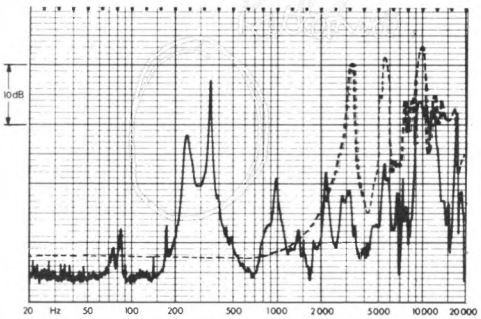
For those unfamiliar with the model, it is a low mass unipivot arm with viscous silicone fluid damping of Japanese manufacture. Finish and engineering were both very good, with excellent fit of component parts, and the instructions were also very good. The arm proved quite easy to set up and align, considering its unipivot design. The headshell was adjustable for overhang and tilt, but was essentially a rigid fixture locked by a hex screw.

While typical friction values were low at 25mg, an increase to 40mg was registered towards end-of-side in the lateral plane, probably due to lead-out wire torsion. The bias mechanism did not introduce significant extra friction, but only marginally increased towards the disc centre, and the values were almost double that required. Cue operation was satisfactory — some drift was apparent but with sensible ascent and descent time, while downforce calibration, geometrical accuracy and adjustments were very accurate. The minimum effective moving mass was very low at 5g and with the option of sufficient viscous damping at the subsonic resonance this meant that the arm could be used successfully with the higher compliance cartridges. Arm resonances were classed as average with the first break appearing at 80Hz (probably a counterweight mode since this is fitted on a rubber bush). The tube flexure modes occurred at 250 & 350 Hz, while at higher frequencies the relatively small number and fair control of the remaining resonances was a promising sign.

A 'good' result was obtained on the listening test, the sound quality characterisations including a fairly firm and extended bass with good detail and locational accuracy, a slightly 'tubey' and thinned midrange, and a marginally brittle and bright treble. Stereo information — depth and detail — was well presented. This arm makes an interesting contrast to the *GH228,* not in terms of being better or worse, just different, with its own balance of qualities.

The sound quality rating qualifies this arm for a recommendation, but mass proved so low that we recommend an extra 5 or 10g headshell plate for the best results with low compliance models, particularly those of low mass such as the Entré.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	5g
Type of headshell	Fixed
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	overhang, tilt, height
Finish and engineering	very good
Ease of assembly/setting up	good
Ease of use	good
Friction lateral/vertical (typical)	40mg (see text)/25mg
Bias comp: type/force rim/centre (1.5g ell set)	thread and lever 260mg/280mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1sec/2secs
Downforce calibration error 1g/2g	–0.05g/0g
Amount of damping	moderate
Arm resonances	average
Subjective sound quality	good
Motor recommended	TD160 etc.
Estimated typical purchase price	£70



Arm resonances (compared to cartridge resonances, dotted).

You can't buy any product reviewed in this publication

None are for sale. Because every product reviewed has been supplied by a manufacturer or importer for review. And no two samples of any product will ever be exactly the same.

Certainly, you can walk into any dealer and ask for something that appears to be identical. The manufacturer's name, the model number, the location of the controls, the cosmetics – these will be the same. Of that you can be certain.

But you can't be sure that the sample you buy and the sample that has been reviewed have been assembled with exactly the same care. That there is no batch variation between the components used. Or that the quality control department wasn't having an off-day when your sample left the factory.

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Of course, you could be lucky. You might end up with a sample that's better than the review might have led you to believe. But, then again, you might not.

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Michell Electronic

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

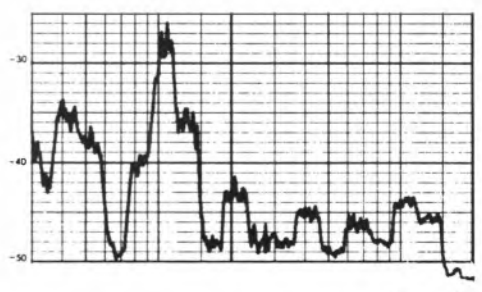
The Michell Engineering *Electronic* was finished in black laminated and glass clear fabricated acrylic, which gave the unit both a functional as well as an 'engineered' appearance. The entire motor/electronic control/power supply was built as a single rubber encased isolated module which may be readily removed from the plinth for service exchange, while a long seamless rubber cord coupled power from the motor to the solid aluminium platter via an intermediate perspex wheel, the latter carrying the strobe markings. A gravity stay held the lid open and required some care in use, while in place of conventional feet, two springy aluminium strip suspension brackets with dense sponge rubber pads on their underside are employed. Excellent vertical freedom with a usefully low 5HZ resonance was thus imparted, but the design resulted in restricted lateral freedom.

Pretty good wow and flutter results were recorded, but the load variation stability was barely satisfactory at an 0.6% slowing under a 3g load dustbug. In addition the drive ratio to the strobe wheel was slightly in error, resulting in an 0.5% slow absolute reading. Start up was average at 2.5 seconds, while rumble was very low at 71-72dB DIN B, with a small degree of motor breakthrough. Acoustic breakthrough was fairly good, although the lift at 100Hz was none too promising.

Rated as 'above average' on sound quality grounds, little comment was made concerning colorations, except in the bass register, which showed some slight softening and loss of definition. Two other effects were just audible, namely a trace of motor noise and a mild instability of pitch on wide dynamic range program — however this was insufficient for it to be termed 'program wow'.

Close to recommendation, this model is capable of good sound quality when mounted correctly.

GENERAL DATA	Motor Unit
Type	manual belt drive
Platter mass/damping	2.1kg/good
Finish and engineering	good
Type of mains leads	3 core
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.062%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.13%/0.08%
Speed accuracy/drift/variation under load	-0.5%/◄0.1%/-0.6%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	71/72dB
Size/rear clearance for lid	44(w) x 42.7(d) x 19(h)/8.0cm
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/very good
Vibration or shock sensitivity	satisfactory
Ease of use	good
Estimated typical purchase price	£180



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Michell Focus motor unit

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

Both Michell *Focus* models were supplied in early prototype form, in anticipation of full production by publication date, and as such certain of the problems encountered during testing will have been cured by the time the units appear on sale.

Of similar construction to the *Electronic,* the inexpensive *Focus* also used black and clear fabricated acrylic. An effective coil spring isolation system was fitted, together with vibration absorbing pads, these endowing the unit with good freedom of movement and a desirably low 4Hz plinth resonance. However, the necessarily stiff lid hinges made it difficult to raise the lid without jogging the spring plinth and it was also found that the platter assembly 'rang' readily, although this ceased immediately a record was placed on the platter. A synchronous motor supplied power via a precision rubber cord, and as with the *Electronic,* the platter mat was a permanently attached thin 'suede' covering of excellent quality.

This turntable ran slightly slow at –1%* and showed fair load stability but exhibited some of the speed overshoot* normally found on servo-system players. This effect was traced to the drive cord and sprung motor bracket, which together 'gave' under load, producing an extra 'lift' as the load was removed. Sufficient power was available to produce a basic 1.5 second start up, but some 4 seconds was required for the belt tension to stabilise.

Wow and flutter (steady state) measured well, with rumble fairly good and, more importantly, proving inaudible on audition. Acoustic breakthrough was much better than average and feedback immunity was very good, while shock resistance and hum levels were both satisfactory, the latter using both conventional as well as moving-coil cartridges. (NB this rating depends on the arm fitted as well as the location of the leads.)

Definitely rated 'above average' the sound quality was quite neutral with only a trace of bass softness and emphasis, and a marginally thickened, 'richer' balance. It was found to suit the matching *Focus* arm well.

Despite its teething problems, this motor can be recommended for its sound quality as well as its appearance. It should however be noted that there is restricted clearance if fitting arms other than the *Focus.*

*Michell aim to have coped with these problems by publication date.

GENERAL DATA	Motor Unit
Type	manual belt drive
Platter mass/damping	2.1kg/good
Finish and engineering	good
Type of mains leads	3 core
Speed options/variable?	33⅓; 45 rpm/no
Wow and flutter (DIN pk wtd σ2)	< 0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	< 0.06%/0.1%
Speed accuracy/drift/variation under load	–1.0%/synchronous/-0.3%
Start up time to audible stabilisation	1.5/4.0secs
Rumble (av. DIN B wtd L/R)	64/69dB
Size/rear clearance for lid	43(w) x 37.6(d) x 15.2(h)/8.5cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	satisfactory
Ease of use	good
Estimated typical purchase price	£100

Michell Focus arm

RECOMMENDED

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

Initially this arm will be fitted to the *Focus* player, but eventually it will be available as a separate component, being supplied as such for the purposes of this review.

Of low mass unipivot design, considerable thought has been devoted to the geometrical aspects of correct cartridge alignment. Lateral adjustment was covered by two separate facilities, namely a slot in the magnesium headshell casting plus a micrometer type sliding section in the pillar assembly, the latter useable (with care) during play. As such accurate two point zero error tracking can be obtained. The shell also had tilt adjustment, while the arm height could be controlled during play using another wheel in the pillar. Some viscous damping was provided, mainly to stabilise the unipivot, and the centre of mass at the counterweight had been brought below the jewelled pivot, the latter placed in the record surface plane. Further damping was also available, as moderate friction has been deliberately introduced through the use of a sliding coned bearing surface. The arm on the prototype used a rather tough alloy, it being intended that the production models should employ a pure aluminium grade with improved self damping. In addition, some minor problems were encountered with both cue control and bias operation, but in general the arm was both well made and finished, and if you have some experience, should prove relatively simple to set up.

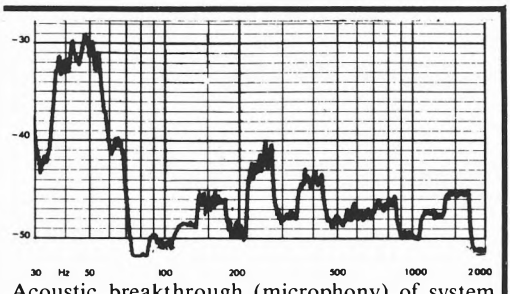
Reasonable friction values were noted* and the bias compensator thread arm did not introduce any significant extra friction. Cue operation and downforce were fine, and the effective mass was very low at 5g, and hence suitable for medium-high compliance cartridges (25-40cu). However, if lower compliance moving-coil models are used, these might benefit from an extra 5-10g at the headshell in the form of a small plate. On the review sample the resonances were classed as 'average', with the 100Hz mode probably the counterweight fixing and subject to improvement. The first arm tube break was fairly high in frequency at 360Hz, the characteristic being fairly typical thereafter.

Auditioned on a *DDX1000,* the prototype was considered to be somewhat 'brash'† and bright with a coarsened 'loud' mid character. To some degree this masked image detail with a consequent loss of depth, although the bass register was notably powerful, firm and extended. For reasons we are not fully able to explain, the sound quality rating improved to an 'above average' rating when the arm was fitted to the matching *Focus* player, the coarseness being somehow ameliorated.

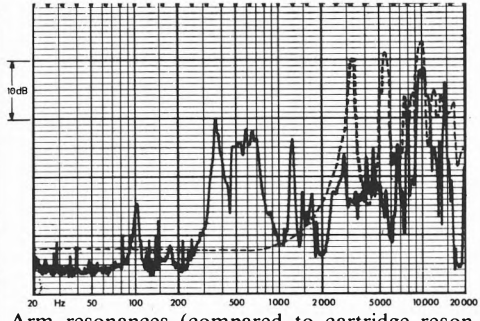
Assuming that the hoped for improvements occur in production this arm should be accorded a recommendation, more particularly if used with the companion *Focus* turntable.

*Will be reduced by 50% in production.
†May improve with the new arm tubes.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	5.0g
Type of headshell	Fixed
Headshell mass (inc screws)	N/A
Geometric accuracy	excellent
Facilities for adjustment	angle, overhang, height, tilt damping
Finish and engineering	very good
Ease of assembly/setting up	fairly good
Ease of use	good
Friction lateral/vertical (typical)	50mg/35mg
Bias comp: type/force rim/centre (1.5g ell set)	thread & weight/ see text/see text
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/5.0secs
Downforce calibration error 1g/2g	-0.05%/-0.1%
Amount of damping	moderate
Arm resonances	average (see text)
Subjective sound quality	above average
Motor recommended	Focus
Estimated typical purchase price	£60



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).



Arm resonances (compared to cartridge resonances, dotted).

Micro-Seiki MA505

Micro-Seiki, Harman U.K., St. Johns Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049 481 5221

Features facilities setting up and use

Reviewed in the previous issue, the *MA505* universal tone arm has been retested, using the *DDX1000* turntable it normally partners as well as several others, including the Monitor Audio *ET500*.

The design included full geometrical adjustment for tilt height and overhang, but no damping was provided. An unusual spring method of downforce application was incorporated, which utilises a tungsten wire laterally tensioned via a series of cams, thus resulting in frictionless bias compensation. This may be controlled while a cartridge is tracing a record, thus greatly facilitating optimisation of the tracking parameters. Height could also be adjusted during play via a smooth operating cam. Last but not least, finish and engineering were both to the usual excellent standard that we have come to expect from high quality Japanese products.

Lab performance

Superb arm friction was recorded together with fairly accurate bias values, the latter about 30% high but in the right ratio. Downforce was highly accurate, and cue drift negligible with sensible rates, while the effective mass was estimated at 15g, indicating compatability with low to medium compliance cartridges in the 8-15 cu range. The vibrational resonance graph was pretty average with the headshell/socket mode present at 300Hz, and a typical spread of fairly well controlled resonances thereafter.

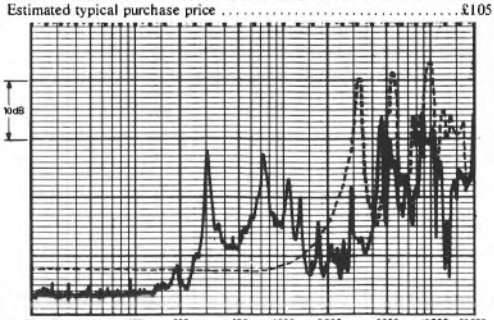
Sound quality

A good sound quality rating was established, which is a worthwhile result, if a little disappointing at this price level. The bass register was powerful and extended with only mild transient blurring, while the mid coloration was considered very low with a lightish balance and a moderate treble emphasis. The latter lent a touch of brightness and slight sibilant 'splash', while stereo depth and precision were considered to be pretty good.

Conclusion

Despite the good sound quality rating, this arm just misses a recommendation when one also takes into consideration its price, but if its unique adjustments and controls are deemed important, then this arm is well worth considering with appropriate cartridges.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	14-15g
Type of headshell	Universal detachable
Headshell mass (inc screws)	10g
Geometric accuracy	very good
Facilities for adjustment	height, tilt, overhang
Finish and engineering	excellent
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	<10mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	lateral tension/ 200mg/225mg
Cueing: drift/8mm ascent/8mm descent	negligible/2secs/4secs
Downforce calibration error 1g/2g	<0.01g/<0.04g
Amount of damping	none
Arm resonances	average
Subjective sound quality	good
Motor recommended	DDX1000 etc
Estimated typical purchase price	£105



Arm resonances (compared to cartridge resonances, dotted).

Micro-Seiki DDX1000

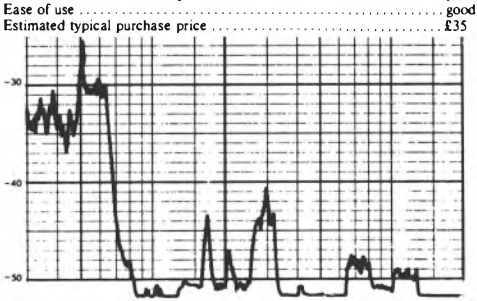
Micro-Seiki, Harman U.K., St. Johns Road, Tylers Green, High Wycombe, Bucks. HP10 8HR. 049 481 5221

A massive tri-lobed alloy block comprised the 'plinth', the lid being a separate box assembly with integral hinges. An equally massive arm mounting block can be fitted to each lobe, both SME and standard hole sizes being available, while the oversized platter possessed such large machine strobe markings that they could be seen at a distance of twenty five feet. Unfortunately, impressive looking but ineffectual hydraulic/rubber feet with levelling provision had been fitted, the only recourse being to mount the deck on a substantial wall shelf. Theoretically, bouncy steel coil springs would have provided a solution to this problem, but probably the designers felt them to be uncommercial.

Both wow and rumble were excellent, torque and stability very good, and start up satisfactory considering the fairly high platter mass. The substantial skeleton construction was expected to perform well on acoustic breakthrough grounds, and this was indeed the case, with even better results that those obtained from the Sondek. The overall shock isolation was inevitably poor, the breakthrough curve alone by no means giving the entire picture Feedback margins were good and hum very good, but vibration immunity was only adequate, the latter rating being essentially shelf-limited.

Aside from shelf induced effects, namely a lumpy bass and a loss of extreme bass power, no other coloration could be detected. Wow and rumble were quite inaudible; so in essence the sound quality was limited by the location, and a strong structural wall shelf remote from the speakers would exploit this deck's potential to the full. Lack of effective isolation and its high price precludes a recommendation, but if used as suggested, very good results are possible with this model.

GENERAL DATA	Motor Unit
Type	manual direct drive
Platter mass/damping	2.85kg/good
Finish and engineering	excellent
Type of mains leads	two core
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	<0.06/<0.07
Speed accuracy/drift/variation under load	adjustable/+0.1%/-0.1%
Start up time to audible stabilisation	2.5 secs
Rumble (av DIN B wtd L/R)	75/76dB
Size/rear clearance for lid	39.5(w) x 37.8(d) x 11.7(h)/none
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/good
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£35



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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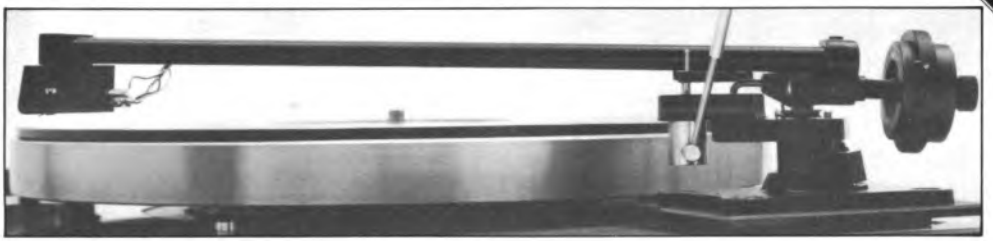
RECOMMENDED



This brand new model represents the company's first venture into tonearm design, and was initially supplied to us in pre-production form, its performance subsequently verified by a production sample provided before press date.

A pair of robust high precision bearings were used, allowing virtually no play, with viscous damping incorporated in SME fashion, using an arc-shaped well under the arm tube, a selection of paddle sizes being included. The detachable arm tube was a tough alloy section clamped rigidily at the pivot, and a headshell as such did not exist — rather, a substantial threaded mounting block in magnesium was used, rigidly attached at the correct offset angle to the tube. A miniature gold plated plug and socket linked the arm to the Neumann lead out cables beneath the mounting base (SME fixing centres), while the counterweight carried a special high loss flexible termination bush.

Recorded friction was extremely good despite the tightness of the pivot structure, a feature essential to the designer's aim to attain maximum rigidity. A full bias range was provided but no calibration data was as yet available, the thread and pivot lever system correctly introducing negligible extra friction. In use, we set bias for the maximum trackability of each cartridge employed. Downforce calibration was highly accurate while the cue worked well, and the effective mass was in the lightest category at a estimated 5g — remarkable for so strong a structure. Any sensible degree of subsonic damping could be attained, and geometry was excellent, with height, tilt and overhang all provided. The arm resonance curve was rated as well above average on several points; above 6kHz the energy spectrum was both even and well maintained, with no dominant breakups; only four significant resonances were not accounted for by the test cartridge, with the first controlled breakup deferred to a relatively high 500Hz, and the second more serious one not appearing until 900Hz.

Rated as excellent, this arm could not be displaced from its high ranking position by any other model. The *744* bass, although slightly dry was very clear, with excellent transients and locational information, while the midrange was a trifle cold, but very neutral with excellent stereo depth and precision. The treble range was well balanced open and clear, with no hint of splash or slurring, and transients were handled especially well.

Demonstrating both excellent engineering plus superior sound quality, and proving relatively easy to use, this arm carries a strong recommendation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	5g
Type of headshell	special arm detachable
Headshell mass (inc screws)	N/A
Geometric accuracy	excellent
Facilities for adjustment	tilt, height, overhang, damping
Finish and engineering	very good
Ease of assembly/setting up	good
Ease of use	very good
Friction lateral/vertical (typical)	15mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	lever, thread, pulley/ adjustable
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/2secs
Downforce calibration error 1g/2g	=0.02/<0.02
Amount of damping	variable
Arm resonances	very good
Subjective sound quality	excellent
Motor recommended	TD160, LP12etc
Estimated typical purchase price	£110

Arm resonances (compared to cartridge resonances, dotted).

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The great majority of shops buy turntables to meet *popular* demand resulting from magazine articles and also those turntables that are easy and simple to set up where such a service is offered. We, at Hampshire Audio, have not been influenced by magazine reviews for previously advertised reasons, nor are we concerned if the equipment is difficult to set up. However, it would appear that the Linn Sondeck LP12 has, as a result of magazine articles, acquired a certain mystique and we do know from extensive experience that the Linn Sondeck LP12 is one of the most time-consuming turntables to set up for maximum performance. Mystique or not, the Linn Sondeck offers the listener more detail than any other turntable we have come across and because of our enthusiasm for the LP12, we often suggest using one in systems that our customers say do not justify such a fine piece of equipment. This initially blinkered attitude of the customer is unfortunate but we are most willing to discuss with visitors to our demonstration studios why the LP12 can be used successfully, with lesser equipment. However, such quality does demand a generous budget allowance for a turntable and as often this is not possible we are not at a loss to demonstrate an alternative unit at a lower price. All items are backed by our normal two-year labour and parts guarantee with, of course, our pre-sales check which we insist on even for turntables. Outside the guarantee period servicing on items supplied is charged out at no more than actual cost. Finally, being small, dedicated and knowledgeable, we are one of those few remaining shops where *real* personal satisfaction can still be found when buying hi-fi equipment.

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Monitor Audio ET500

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

RECOMMENDED

This turntable's predecessor appeared as a stop-press addition to the previous issue, and while it fared reasonably well it was to some degree censured for its use of the Matsushita motor, possessing a mild dynamic wow effect. This motor was in fact fitted to the deck supplied for review here, but as with the JBE, the manufacturer has since informed us that by publication date this old motor will have been replaced by the new version.

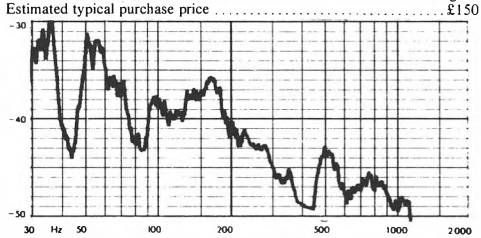
Important changes to the *ET500* since the last issue include the new calculator type touch controls which replace the old electric sensing buttons, these proving expensive to produce in relation to their ergonomic value, and a lead laminated high mass plinth and new acrylic lid of low resonance properties. A well made separate power supply was also included.

Results applying to the old motor version showed good steady state wow and flutter, very good rumble, significant slowing under load and speed overshoot upon recovery, the latter servo problem responsible for the slight dynamic wow on program. Acoustic breakthrough measured well, much improved by comparison with the last issue, and hum levels were also good. Acoustic feedback was classed as pretty good and improved with the lid down, while shock resistance was satisfactory.

An 'average' rating was described, the wow problem being partly responsible, and as with the DDX1000 and other similar good direct drive turntables with inadequate vibration isolation, the ultimate sound quality is dependant on the location and strength of the shelf or structure on which they are mounted. On a normal cabinet the *ET500* showed the frequently encountered upper bass emphasis. low bass loss, and slight lower-midrange coloration, but carefully mounted these effects can be greatly ameliorated.

Assuming that the new motor is fitted and that some care is taken in the location of this model, then it can be recommended as capable of good sound quality.

GENERAL DATA	Motor Unit
Type	manual direct drive
Platter mass/damping	1.7kg/good
Finish and engineering	good
Type of mains leads	three core
Speed options/variable?	33⅓/45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.1% (see text)
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.2%/0.1%
Speed accuracy/drift/variation under load	adjustable/-0.1%/-0.4%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	71/72dB
Size/rear clearance for lid	47(w) x 38(d) x 13.7(h)/7.6cm
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	good (see text)
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	fairly good
Ease of use	good
Estimated typical purchase price	£150



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Philips AF677

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

Features facilities setting up and use

A replacement for the inexpensive and highly recommended *GA437* included in the last issue, the *AF677* belongs to a completely new range of models from Philips, with certain features and styling common to the entire group. All use a new Philips servo speed system called 'direct control' which is not to be confused with direct drive. The players are belt driven, and whereas in the past such servo systems have taken their feedback/error control from a generator on the motor shaft, Philips have positioned the tacho generator in a far more logical place, namely on the platter hub.

The *AF677* is an auto return player incorporating a sub-chassis with a moderate degree of 'float' mainly in the vertical plane. However, there was insufficient suspended mass to produce a low suspension frequency, and the design brought the suspension resonance too close to that of the arm/cartridge combination. Philips have also designed a new die cast aluminium detachable headshell (unfortunately not interchangeable with the normal SME type), and a clever stylus balance was built into the arm rest. The old steel platters have been replaced by non magnetic aluminium ones, and the overall construction and finish were to a fairly high standard. All controls operated well, and the deck was easy to set up, the latter procedure facilitated by the intelligently designed finger-operated transit catches. A GP400 II (spherical tip) cartridge comes ready fitted.

Lab performance

Wow and flutter was classed as very good, with rumble levels rating almost as high and beating the specification (see sound quality). Running some 0.3% slow (acceptable) the proof of the servo control was given by the unmeasureable slowing under load, while drift was fine and start up rapid. In addition the servo did not possess significant overshoot, which is impressive for so inexpensive a player. Shock resistance was good and acoustic feedback even better, but hum was only satisfactory except when using normal cartridges. Acoustic breakthrough on the graph was average above 100Hz but rather poorer below — some 10dB worse that the *877* for example, another model from the Philips range.

The arm showed fairly good geometrical accuracy (slight headshell tilt) and was well adjusted with good downforce calibration and reasonable friction. Cue operation was fine but the bias compensation was excessive, in the right ratio but double the amount required, and the user should accordingly compensate when setting the dial. Dissected by two dominant regions, some favourable qualities were nonetheless evident from the resonance graph, noteably the first break occurring higher than average at 400Hz. The 1.5kHz-1.2kHz range was under good control, no other serious anomalies being present.

Sound quality

Using a reference cartridge the deck rated as below average but this is nevertheless reasonable

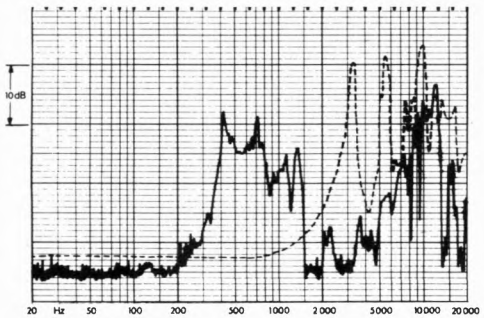
RECOMMENDED

when considering the price. The bass was felt to be a trifle light and the midrange to possess a slightly coloured 'boxy' and 'dead' quality. Stereo depth was reduced and the high treble seemed relatively accentuated and slightly tizzy. A trace of motor noise was also audible at high volume settings.

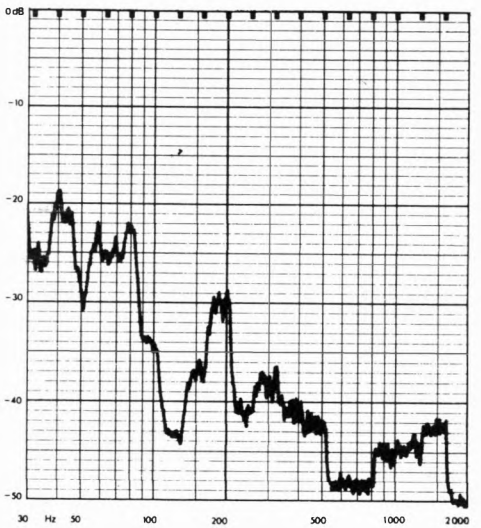
Conclusion

In the context of its integral cartridge, plus measured and subjective performance ratings and competitive price the *AF677* definitely qualifies for a recommendation.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto-return, belt drive
Platter mass/damping	0.7kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/DIN
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	=<0.07/0.1
Speed accuracy/drift/variation under load	-0.3%/+0.1%/=<0.05%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	70/67dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	9g
Type of headshell	special detachable
Headshell mass (inc screws)	7g
Geometric accuracy	fairly good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	50mg/60mg
Bias comp: type/force rim/centre	spring/300mg/400mg
Cueing: drift/8mm ascent/8mm descent	negligible/2secs/2secs
Downforce calibration error 1g/2g	-0.075g/0.0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	41.8(w) x 34.4(d) x 14.5(h)/7.6cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	average/very good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£70



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Philips AF777

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

Features facilities setting up and use

Increasing in sophistication and price, the *AF777* incorporates fully automatic operation, as well as a +/−3% fine speed control for both $33\frac{1}{3}$ and 45 rpm, any deviation from correct speed being indicated by either a '+' or a '−' lamp. Unfortunately in design terms this adjustment was necessarily imprecise, since its true speed depends on the electrical backlash present for the centre 'O' led lamp indication. Accessories provided included an alignment jig and a second headshell with overhang adjustment, while the same cartridge as was supplied with the *677* was also included here, fitted to the fixed alignment shell. A similar floating sub-chassis and the same direct control servo system were also incorporated, while welcome technical touches included cartridge output muting except when playing a disc, this linked to the cue control. All facilities worked well and the standard of engineering and finish were pretty good.

Lab performance

Due to backlash in the 'O' correct speed lamp, up to +/−0.5% speed error was possible before it switched over to the + or − error indicators. Load stability was good, drift fairly low and start up rapid, and although wow and flutter was not quite as good as with the *677*, rumble attained a very good rating. The 0.12% linear flutter recorded was a trifle on the high side, while the measured acoustic breakthrough was also disappointing, as it proved similar to that of the cheaper *677*. Hum was satisfactory with the reference moving coil and excellent with the supplied *GP400 II*, while feedback was rated as barely adequate although shock resistance was rather better.

Reasonable friction levels were recorded although much poorer that the spec. Downforce calibration was fine, but biasing was on the high side with the wrong ratio of rim to centre. Cueing was fine, the arm being well aligned, and a facility not usually found on this type of deck was included, namely adjustment for height. The arm resonance curve was very similar to that of the *677*, exhibiting the same relatively high 400Hz point for the first break, and a fair characteristic thereafter, although the 10kHz isolated prominence could produce audible effects.

Sound quality

With inaudible wow and rumble the *777's* overall sound quality was classed as average, which is fine for the price. Some mid coloration was evident with a degree of perspective flattening, the reproduction appearing a little 'loud' and forward with a touch of treble 'splash'. Finally, the bass register felt to be lacking in depth and weight.

Conclusion

The package represented quite good value, and thus qualifies for a recommendation, although we were a little disappointed that such a floating sub-chassis player did not sound rather better.

Philips AF777

RECOMMENDED

GENERAL DATA — Integrated Player

Motor Section

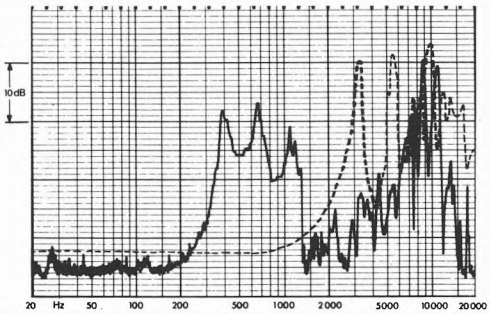
Type	auto-return, belt drive
Platter mass/damping	0.7kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/DIN
Speed options/variable?	33⅓: 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.08%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.07/0.12
Speed accuracy/drift/variation under load	-0.05%/-0.2%/-0.05
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	70/71dB

Arm Section

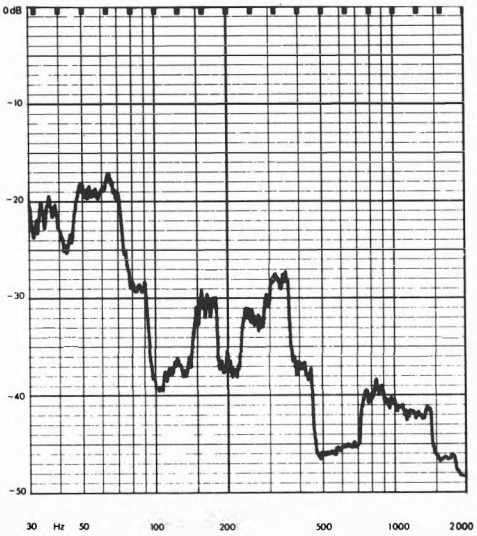
Approximate effective moving mass (excl cart. inc screws)	9g
Type of headshell	special detachable
Headshell mass (inc screws)	7g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly	very good
Friction lateral/vertical (typical)	45mg/70mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/300mg/280mg
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/1.5secs
Downforce calibration error 1g/2g	+0.025g/0g
Amount of damping	none

System as a whole

Size/rear clearance for lid	41.8(w) x 34.3(d) x 14.5(h)/7.5cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/average
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£90



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Philips AF877

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

Features facilities setting up and use

The *877* is one of two top-of-the-line models, the other being the closely related *977*, which is not included in this report. Unlike the *977* which uses quartz speed control, the *877* employed the same speed system as the cheaper *677* and *777*, and in common with all these models the deck was belt driven and incorporated a floating sub-chassis. However, the *877* uses a more substantial glass fibre reinforced plinth plus higher mass platter than its cheaper relatives, while the speed indicator has also been expanded to comprise 9 lamps, in four +/− 1% steps; whereas the *977* is a fully automatic deck, the *877* simply has an auto-stop facility.

Philips' electronic touch controls were used for speed change and start/stop, with bias compensation set by a large dial calibrated for various styli types (a spring mechanism of low lateral friction.) The standard of construction was very high with good quality engineering throughout. A fairly expensive Philips cartridge was ready fitted, in this case a *GP401 II* with an elliptical tip, as opposed to the spherical-tipped *400 II* fitted to the cheaper players.

Lab performance

Very good wow and flutter as well as rumble figures were recorded, although a trace of motor noise could nevertheless be heard at high listening levels with wide dynamic range program. Speed accuracy was satisfactory at +/−0.2% depending on the control settings, while load stability was excellent, drift low, and start up achieved in 1.5 seconds.

From the graph it can be seen that acoustic breakthrough has been improved in comparison with the less expensive models, being now a little better than average; while shock immunity was good, feedback was less so. Hum levels (DIN signal leads) were barely adequate with a moving coil cartridge (Supex 900 E Super) but were fine using a conventional type such as the supplied *GP401 II.*

Reasonable but below spec friction values were recorded, and although biasing was claimed to increase towards the centre the reverse was in fact found to be the case, the values being double that required; in contrast, downforce was about 10% low. Cue operation was fine and the effective mass is at the low end of the medium range, at an estimated 9g, suiting cartridges in the 12-25cu compliance bracket. A 10Hz arm/cartridge resonance was claimed by the manufacturers, but our sample gave nearer 7Hz, which is dangerously close to the sub-chassis resonance frequency. The graph did illustrate improved damping in the 300-1500Hz range but was poorer than the *677* and *777* around the 4kHz region.

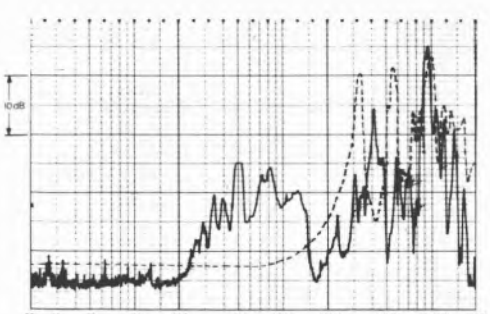
Sound quality

Rated as below average on its sound quality, the *777* was felt to be preferrable. The mid register seemed both cold and mildly coloured, detail was muddled and a loss of both stereo depth and location was apparent. The bass register was, however, considered to be quite good.

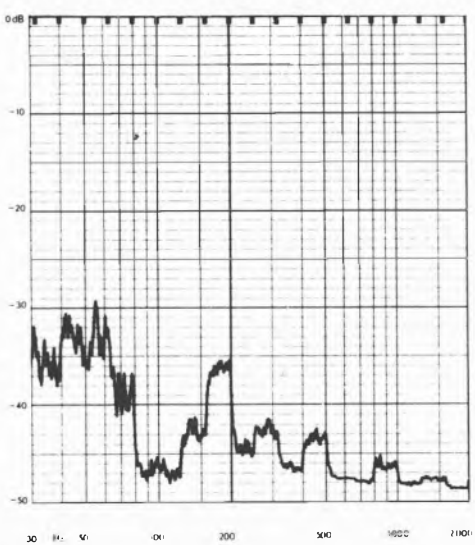
Conclusions

Overall the balance tips in favour of the cheaper *777*, and in consequence the *877* does not gain a recommendation. It would appear that there were minor quality control problems on our sample particularly in regards to arm friction and biasing.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto return, belt drive
Platter mass/damping	1.0kg/good
Finish and engineering	very good
Type of mains/connecting leads	two core/DIN
Speed options/variable?	33⅓, 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.07%/0.08%
Speed accuracy/drift/variation under load	adjustable/-0.1%/-0.05%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	73/73dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	9g
Type of headshell	special detachable
Headshell mass (inc screws)	7g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	55mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/320mg/300mg
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/1.5secs
Downforce calibration error 1g/2g	-0.05g/-0.15g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	41.8(w) x 34.5(d) x 14.3(h)/7.5cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/Acoustic feedback	adequate/good
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£130



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Pioneer PL514

Pioneer, Shriro (UK) Ltd., Shriro House, The Ridgeway, Iver, Bucks. SL0 9JL. 0753 652222/7

Features facilities setting up and use

The range of Pioneer turntables reviewed in the last issue have since been superceded, with the highly recommended *PL112D* now replaced by the *PL512.* The deck reviewed here is basically the same as the *512* with the addition of an auto return mechanism, and thus the test results should be valid for both.

The *514* was a belt drive model, a large synchronous/induction motor supplying power to the light 1.05kg platter. Styling was uncomplicated, using clear acrylic and a sparkle texture with light grey finish for the plinth, the latter in fact consisting of plastic veneer on a conventional but substantial chipboard base. No real attempt had been made to isolate the unit from the environment as the plain rubber feet had limited vertical travel and very little lateral play, the plinth resonance thus approximately located at a high 10Hz.

The arm had no height or tilt adjustment. The 9.5g headshell is moulded in plastic, with slitted apertures for cartridge overhang adjustment, the latter used to align the cartridge lateral tracking angle (a rather clumsy and inaccurate method.) General operation and constructional quality were good but the arm showed considerable bearing play in the horizontal plane.

Lab performance

The first unit supplied produced poor 54dB Din B rumble levels but a second sample gave the rather better 66dB result reproduced in the table (see also subjective comments). Wow and flutter was very good with good load stability and rapid start up, while absolute speed was a little high at +0.6%. The acoustic breakthrough curve showed an average characteristic with no unduly isolated prominences, but feedback in the test location was only just adequate which is partly a function of the poor vibration immunity. Hum levels were again just adequate using a moving-coil model, although they proved fine with a conventional type.

Also rated as average in terms of its arm response,a slight counterweight/decoupling mode occurred at 100Hz, followed by the first arm/headshell break at 240Hz, the energy spectrum being somewhat dissected thereafter. Friction values were acceptable, with biasing and down-force calibration both very good, but cue operation lift time was excessively slow — slower in fact that the descent.

Sound quality

Subjective sound quality rated as 'average' which is good for the price, but motor breakthrough was clearly audible at realistic listening levels. Low bass was subdued and depth masked, with the treble slightly prominent and coloured.

Conclusion

Reasonably priced, the poor audible and measured rumble were the main barrier to its recommendation; in fact these results as well as the overall arm quality would appear to be inferior to that of the previous model.

GENERAL DATA Integrated Player

Motor Section

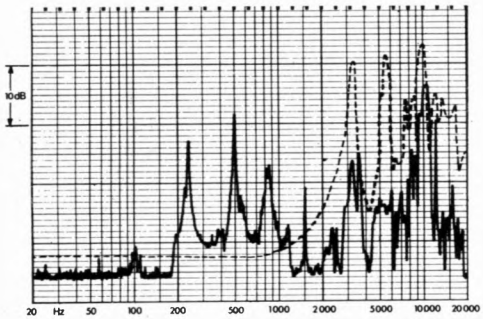
Type	auto return, belt drive
Platter mass/damping	1.05kg/adequate
Finish and engineering	fairly good
Type of mains/connecting leads	3 core IEC plug/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.075%/0.08%
Speed accuracy/drift/variation under load	+0.6%/synchronous/–0.2%
Start up time to audible stabilisation	1.0secs
Rumble (av DIN B wtd L/R)	66dB

Arm Section

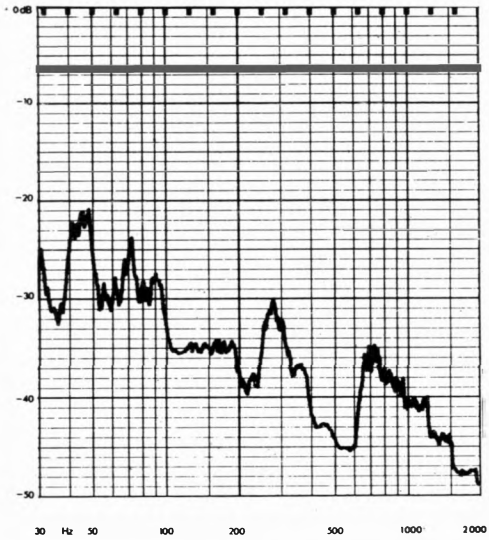
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshelf mass (inc screws)	10.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	fairly good
Friction lateral/vertical (typical)	80mg/75mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/125mg/250mg
Cueing: drift/8mm ascent/8mm descent	negligible/4.0secs/3.0secs
Downforce calibration error 1g/2g	–0.025g/0.0g
Amount of damping	none

System as a whole

Size/rear clearance for lid	44(w) x 36.5(d) x 13.6(h)cm/5.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	adequate/adequate
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£65



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Many adjectives are used to flatter the horn. Rich. Full. Harmonic. Poetic. Haunting.

An instrument of extraordinary appeal, it has often been likened to the human voice for its singing quality.

Always a challenge for Hi-Fidelity reproduction, the horn boasts one of the widest ranges of pitch of all instruments.

To reproduce this sound accurately, Technics have virtually eliminated wow, flutter and rumble.

And to the critical ears of the Royal Philharmonic's horn section this was no mean achievement.

Take the SL1400 Mk2 (centre). It's a masterpiece of turntable technology.

You'll hear every nuance of Mozart's magic in his horn and woodwind compositions, every fast semi-quaver in Handel's water music.

Drift is a mere 0.002%.
Wow and flutter 0.025% WRMS.

With the powerful torque, rated speed can be achieved in 0.7 seconds. But the real breakthrough is the total pitch control. Speed can be increased or decreased in increments of 0.1% with a total variation of ±9.9%.

On the left we feature our SL3200 Direct Drive turntable.

Its superb rotational accuracy preserves the clear cool note of the horn to perfection and wow and flutter are down to 0.03% WRMS.

Rumble is −73dB (DINB) and feedback is counteracted by a 'resonance damping' base material.

Accurate speed control is achieved and can be monitored by a stroboscope and there are individual pitch controls for both 33 and 45 rpm speeds.

On the far right we present the SL220. For a belt drive turntable the SL220 gives a staggering 0.045% WRMS wow and flutter rating. The true intonations of the horn will not be missed.

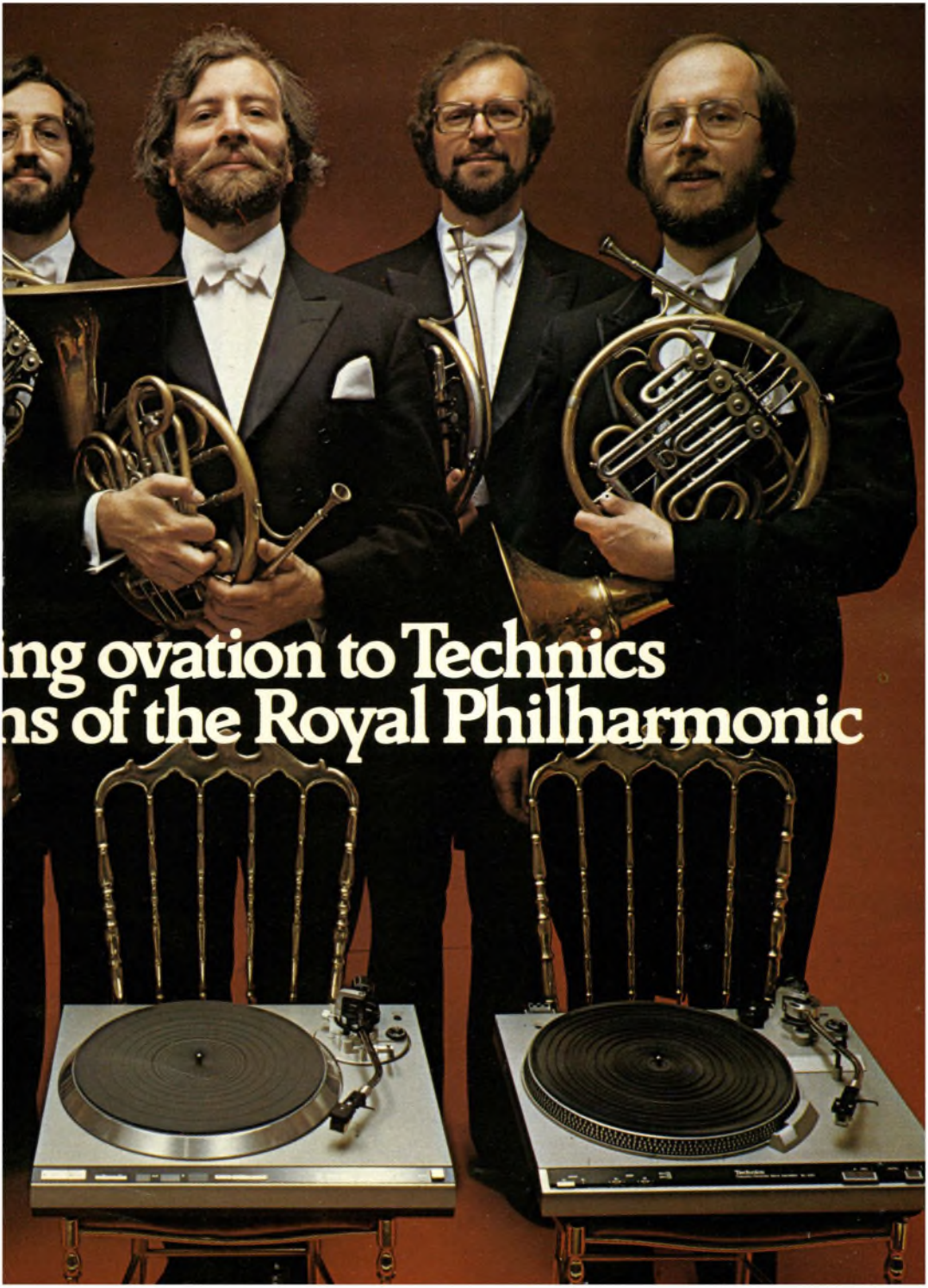
The rumble figure of 70dB (DINB) all but eliminates motor noise problems. Independent pitch controls can vary record speed by up to 6% and speed accuracy can be checked with the aid of a stroboscope.

Listen to the horn on Technics. You'll find it rich, full and harmonic. Even haunting and poetic.

Technics

107/109 Whitby Rd., Slough, Berks. SL1 3DR. Tel: Slough 27516

SL1400 MkII Quartz Locked Direct Drive turntable, £269.95. SL220 Belt Drive turntable, £87.95. SL3200 Direct Drive turntable, £119.95. All prices inclusive of VAT and correct at time of going to press.


ng ovation to Technics
ns of the Royal Philharmonic

RECOMMENDED

Pioneer PL516

Pioneer, Shriro (UK) Ltd., Shriro House, The Ridgeway, Iver, Bucks. SL0 9JL. 0753 652222/7

Features facilities setting up and use

Visually and structurally similar to the *512/514* models, the *516* was also an auto return belt drive deck, but in this instance fitted with a servo control d.c. type motor and variable fine speed control. As with the *514*, primitive plinth decoupling was in evidence, with a 10Hz working resonance — above that of the subsonic arm/cartridge combination. It is of course desirable to separate these 2 resonances to avoid their mutual interaction and consequent magnification of unwanted vibration.

A strobe was incorporated with bright neon illumination, but the clumsy overhang method of cartridge alignment was again specified in the instructions, with the headshell socket displaying a significant 2° tilt on the vertical axis.

Lab performance

Compared with the *514*, the rumble showed considerable improvement to 70dB Din B, while wow and flutter remained very good. Start up was rapid at 1 second, with no detectable servo overshoot, and the high torque ensured good load variation stability. Measured acoustic breakthrough data also revealed a slight improvement over the *514*, as did the feedback margins and shock immunity.

The family characteristic of these three Pioneer arm resonance responses was clearly to be seen here: the 250Hz shell/socket resonance plus a rather dissected spectrum and a prominence at 10kHz. Arm friction was reasonable, biasing rather high towards end-of-side, and as with the *514*, cue rise time was excessive. Downforce was quite accurate, while effective mass worked out at 14g with no damping, and in view of the plinth resonance, lowish compliance cartridges are recommended in the 8-15cu range.

Sound quality

The sound quality of the *516* was placed at the 'average' level, which is good for the price. Rumble was virtually inaudible and the sound was pleasant if low bass light, a trifle upper bass boomy, and with a forward 'flattened' tendency in the midrange. A touch of treble 'splash' was also evident, and the tilted headshell took the edge off cartridge separation, thus impairing depth rendition.

Conclusion

On performance *v* price ground the *516* carries a recommendation, but I would like to have seen tighter production tolerances for the headshell vertical alignment.

Pioneer PL516

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

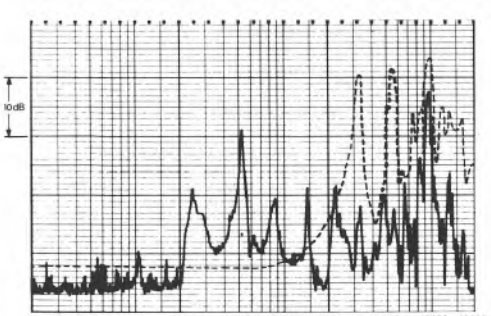
Type	auto return, belt drive
Platter mass/damping	1.1kg/good
Finish and engineering	very good
Type of mains/connecting leads	three core iec/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.066%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.1%/0.09%
Speed accuracy/drift/variation under load	adjustable/ 0.1%/-0.15%
Start up time to audible stabilisation	1.0secs
Rumble (av DIN B wtd L/R)	70dB

Arm Section

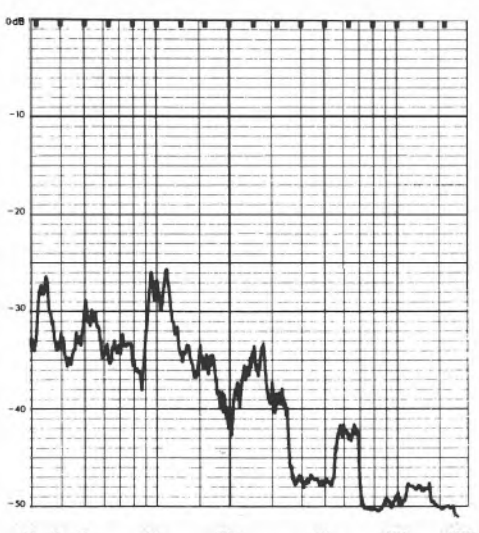
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	10.5g
Geometric accuracy	fairly good
Facilities for adjustment	overhang
Finish and engineering	fair
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	80mg (bias effect)/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/150mg/320mg
Cueing: drift/8mm ascent/8mm descent	negligible/4secs/3secs
Downforce calibration error 1g/2g	+0.1g/+0.05g
Amount of damping	none

System as a whole

Size/rear clearance for lid	44(w) x 36.5(d) x 13.4(h)/5cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£85



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Pioneer PL518

Pioneer, Shriro (UK) Ltd., Shriro House, The Ridgeway, Iver, Bucks. SL0 9JL. 0753 652222/7

Features facilities setting up and use

The *PL518* has some close relatives, namely the *PL540* and *PL560* which possess some additional facilities such as metered indication of speed and automatic operation. In all other respects however a similar performance should pertain as for the tested *518*.

Essentially the same arm as was fitted to the *514* & *516* was again used here, with a 10.5g black plastic headshell, the material used for these shells being a special glass reinforced resin of selected damping properties. A decoupling/termination was fitted to the rear section of the arm near the counterweight, which is intended to be effective at middle frequencies rather than at the main subsonic arm/cartridge resonance. The overall assembly was quite heavy, and slightly better than usual isolation feet were fitted, endowing this plinth with a 8Hz resonance (which nonetheless is still too high). On this model the headshell was aligned correctly, but the only geometrical adjustment provided was for overhang, so care must be taken when choosing a cartridge to ensure vertical tracking angle compatibility as well as matching compliance to the total effective mass.

Lab performance

Both wow and rumble were very good, and the reasonable torque delivery (0.3% load slowing) plus minimal servo-overshoot should ensure an absence of dynamic wow. Speed drift was acceptably low and start up average at 3 seconds. An 'average' acoustic breakthrough curve was recorded — a little better above 80Hz and a little worse below, while shock resistance was good with feedback immunity fairly good.

Arm results were similar to those of the other Pioneer decks, exhibiting acceptable friction, correct ratio biasing (if some 30% high) and good downforce calibration. Once more cue lift was excessively slow at 5 seconds. Arm resonance characteristics were virtually the same as for the 514 & 516, again being classed as 'average'.

Sound quality

No audible wow or rumble could be detected and although hum levels were only satisfactory with a moving coil Supex, they improved when using a conventional cartridge, the overall sound quality being classed as 'average'. Only slight thickening and muddling of detail was apparent and stereo depth loss was quite small. The balance was pleasant if deficient in low bass and softened in the upper bass, while the midrange appeared slightly prominent.

Conclusion

A competent design whose subjective performance is maximised by sensible location, the *PL518* retails at a reasonable price and is thus to be recommended.

Pioneer PL518

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

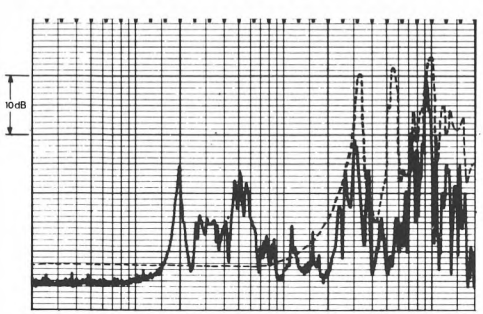
Type	auto return, direct drive
Platter mass/damping	1.5kg/fairly good
Finish and engineering	good
Type of mains/connecting leads	three core iec plug/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.08%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	< 0.07%/< 0.07%
Speed accuracy/drift/variation under load	0.1%/+0.1%/-0.3%
Start up time to audible stabilisation	3secs
Rumble (av DIN B wtd L/R)	73/74dB

Arm Section

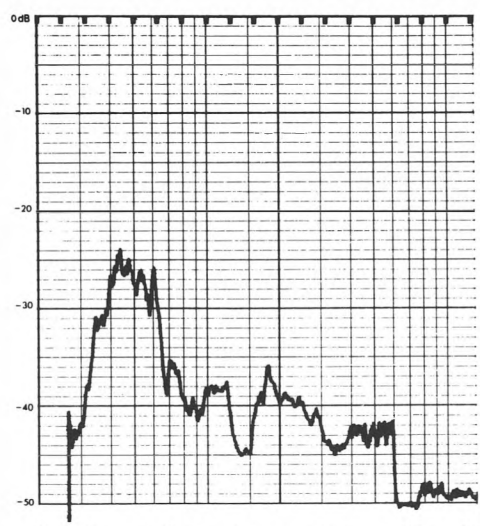
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	10.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	fairly good
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	60 (bias) mg/40mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/300mg
Cueing: drift/8mm ascent/8mm descent	negligible/5secs/4.5secs
Downforce calibration error 1g/2g	-0.025g/+0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	44(w) x 36.8(d) x 14.5(h)/5cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	satisfactory/fairly good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£120



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Realistic/Tandy Lab250

Tandy Corporation, Branch UK, Bilston Road, Wednesbury, W. Midlands. 021-556 6101

Features facilities setting up and use

This deck is manufactured in Japan for the American marketing organisation Radio Shack, this company represented in the UK by the Tandy chain stores. The *Lab 250* was a moderately priced belt driven deck employing a synchronous/induction motor, the latter recognised as being the same as that fitted to the Garrard *GT25P*. The turntable came complete with a fitted cartridge, namely an Audio Technica *AT12E* tracking at a 1.5g downforce, and the deck incorporates an auto return facility and the universal SME-type detachable headshell socket system. The clumsy overhang measurement method for the alignment of additional cartridges was again specified, it being unfortunate that the cartridge supplied possessed a serious 5° lateral tracking angle error.

The unit came fitted with a moulded continental 2 pin power plug with side contact earth connectors, and this would have to be removed by the purchaser for UK use. Fairly soft feet were fitted which gave a small amount of plinth decoupling but the resulting resonance was placed too high at 12Hz.

Lab Performance

Wow and flutter was satisfactory with an 0.14% DIN peak reading — some sensitive listeners might just be aware of such a level. Speed was an acceptable 0.2% slow with a further reasonable slowing of 0.3% under load.

Start up was rapid at 1.25 seconds while rumble was pretty good on measurement (see also sound quality), and acoustic breakthrough just about average. Feedback margins were fine with the lid both raised and lowered, while hum levels were very good, even using a moving-coil cartridge. Vibration sensitivity was also classed as good.

The arm resonance characteristic was undoubtedly disappointing being dissected by numerous sharp discontinuities of considerable peak-to-trough ratio, the first bending mode appearing at a low 200Hz. Friction was moderate, biasing close to the required values and downforce accurate. Cue operation was spot on, and geometric accuracy fine, if correctly set up using a protractor.

Sound quality

With some favourable characteristics the sound quality as determined using the reference cartridge, was judged to be 'average' — a good result considering the price, and taking into account the average listeners' tolerance of mild wow effects. A touch of coarseness was evident in the middle register with a flattened stereo perspective and a 'loud' effect, while detail rendition was quite good and the bass just a little 'tubby'. Stereo imaging showed a mild widening of the central stage.

Conclusion

The performance was quite good for the price and the inclusion of a reasonable cartridge plus auto return facility gains this model a recommendation. Note that the supplied cartridge may require realignment before use.

Realistic/Tandy Lab250

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

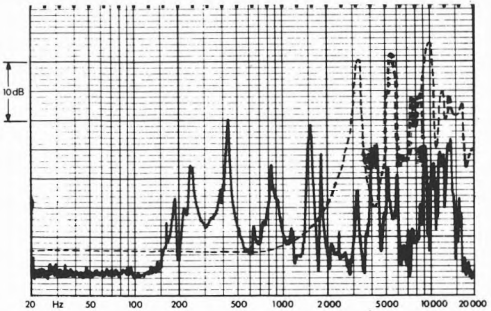
Type	auto return belt drive
Platter mass/damping	1.2kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	3 core (non standard plug) /earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.14%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.15%/0.10%
Speed accuracy/drift/variation under load	-0.30%/synchronous/-0.30%
Start up time to audible stabilisation	1.25secs
Rumble (av DIN B wtd L/R)	68/71dB

Arm Section

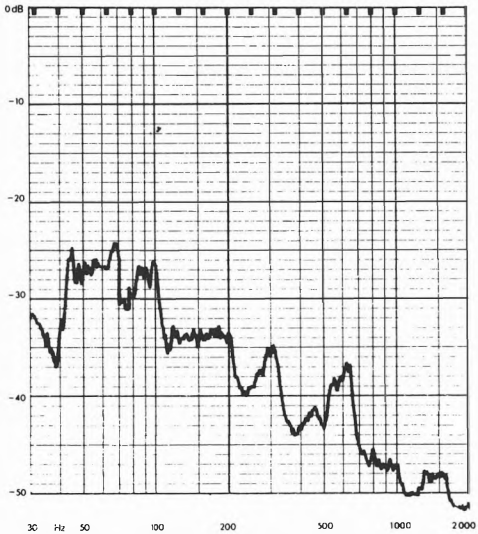
Approximate effective moving mass (excl cart, inc screws)	15.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	7.0g
Geometric accuracy	fair
Facilities for adjustment	overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	50mg/40mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/180mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.25secs/2.0secs
Downforce calibration error 1g/2g	-0.05g/0g
Amount of damping	none

System as a whole

Size/rear clearance for lid	44.2(w) x 35.9(d) x 15.9(h)/5.2cm
Typical acoustic breakthrough and resonances	adequate
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	very good/good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£80



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Realistic/Tandy Lab500

Tandy Corporation, Branch UK, Bilston Road, Wednesbury, W. Midlands. 021-556 6101

Features facilities setting up and use

A quartz locked direct drive turntable, the Lab 500 exhibited many ergonomic as well as visual similarities to the ITT *8012,* believed to have originated from the same Japanese factory. Some American influence was shown by the incorporation of a special slimline headshell of standard socket fixing, which had inbuilt a special permanently aligned version of a Shure cartridge, believed to be the *M95ED.* Tracking force was set to 1g, which we felt to be a trifle on the optimistic side in view of the estimated moving mass of 15g, with the stylus compliance in the 30-40cu range.

A typical arm/cartridge subsonic resonance of 7Hz was estimated — on the low side and close to record warps; a tracking force of 1.25-2.5g would give greater safety margin on tracking.

Fully automatic operation was provided but due to the fixed cartridge/headshell, no geometrical adjustments were included, and it was unfortunate that the supplied assembly appeared some 2-3° out of alignment as referred to the SME protractor.

Lab performance

Very good wow and flutter was recorded but rumble proved inferior to that produced by its less expensive brother, the *250.* The measured 68/7dB result improved to 75dB with power off (platter still rotating), this indicating the presence of electro-mechanical 'pole' noise. Torque was high, resulting in rapid 1.5 second start up with no significant servo-overshoot. Speed accuracy was superb due of course to the quartz control, and while acoustic breakthrough was fairly good (a trifle high in the 250Hz range), the vibration isolation was only rated as adequate. However, feedback margins appeared very good, with the lid both open and shut.

Arm friction was very satisfactory while biasing was quite accurate, as was the downforce calibration. Cue ascent was considered slow at 4 seconds, although no lateral drift occurred. It should be noted that an accessory headshell could be purchased to permit the use of another cartridge in addition to the one supplied, and this was in fact done to generate the arm resonance curves, which showed a typically average characteristic.

Sound quality

Using both the supplied as well as the reference cartridge, the sound quality was considered just about average — fair enough at the price. Some motor rumble could be heard at higher listening levels, the overall sound quality characterised as a little 'loud' with a sharpened high treble and a loss of stereo depth and positional accuracy. The bass register was, however, considered fairly good.

Conclusion

While the *Lab 500* represents fairly good value, of the two Realistics tested, the honours must go to the Lab 250. Space did not allow us to examine a third model in the range, which comes between these two models on price.

GENERAL DATA Integrated Player

Motor Section

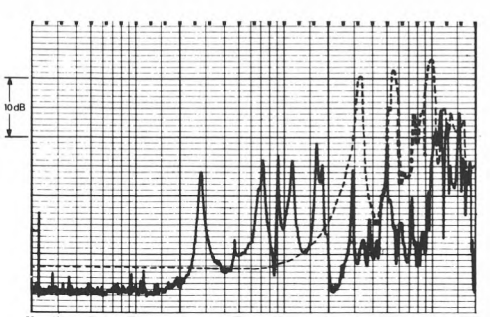
Type	automatic quartz, direct drive
Platter mass/damping	1.7kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.075%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.10%/0.11%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	68/70dB

Arm Section

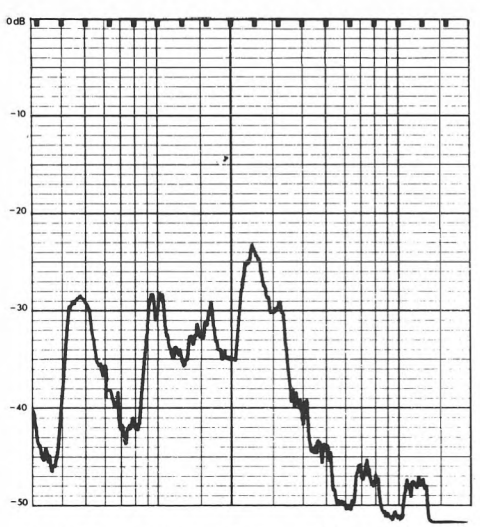
Approximate effective moving mass	15.0g (estimate)
Type of headshell	special integral cartridges; universal socket
Headshell mass (inc screws)	N/A
Geometric accuracy	fair
Facilities for adjustment	none
Finish and engineering	fairly good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	30mg/20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/110mg/175mg
Cueing: drift/8mm ascent/8mm descent	negligible/4.0secs/4.5secs
Downforce calibration error 1g/2g	–0.05g/–0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	48(w) x 38.6(d) x 15.8(h)cm/4.3cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/very good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£170



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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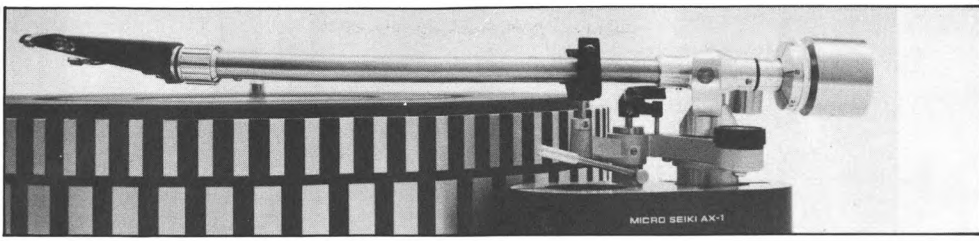
Rega Lustre

Rega, Rega Research Ltd., Swaines Industrial Estate, Ashingdon Road, Rochford, Essex. 0702 546674

RECOMMENDED



Due to long supply delays, we acceded to the manufacturer's request not to include the Rega turntables on grounds of unavailability; however the arm is available as a seperate item via their dealer network, although the absence of packaging, instructions etc. means that it is expected to be set up on a motor unit by the dealer.

Lustre are a noted Japanese manufacturer of pickup arms who supply special custom made versions, Rega Research being one of those companies who buy arms for their own range of turntables. Superficially, the Rega looks like an archetypal Japanese arm with detachable universal headshell fitting and the usual rotating scale/counterweight assembly; in fact, Rega have controlled a number of manufacturing details in order to optimise the design, including bearing tolerance and accuracy, main arm tube material, and a special side-entry low profile cable fixing. The engineering standard was clearly high.

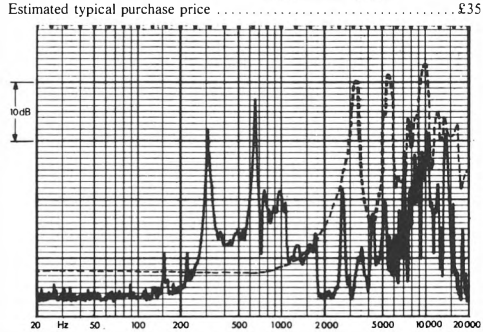
Bias compensation was specified as magnetically energised, although we were not able to check this, but certainly no additional friction resulted from its operation. Height adjustment proved none to easy but could be accomplished using packing nuts on the pillar. No tilt provision was made.

Friction was low and the bearings were well adjusted, showing very little play. Downforce calibration was within 5% with cue operation very satisfactory, the effective mass being in the 'heavy' category at an estimated 16g. No damping was provided and the use of a low compliance cartridge (8-15cu) is preferable. Arm resonances were classed as about average; although the obvious resonances at 300Hz (first break), 650Hz and 2.6kHz were quite severe, the intervening areas showed good control, and the even energy distribution above 2kHz was promising.

Fitted to a reference player, the Rega arm was considered to deliver a good standard of sound quality. While the bass register was a trifle generous, good depth and localisation were evident, but mild mid coloration was apparent — a coarsening of upper range information and a 'tubey' effect. This coarsening lent a touch of sibilant splash, but despite these qualifications stereo image depth and detail held up well and overall the impression was better than that given by a number of more costly and well known detachable headshell models.

On a good turntable the sound quality/performance/price relationship dictates a recommendation; however Rega could consider a proper pack and instructions for this model, and possible a more sensible arrangment for height control to assist cartridge alignment optimisation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	16g
Type of headshell	Universal detachable
Headshell mass (inc screws)	approx 8g
Geometric accuracy	good
Facilities for adjustment	overhang, (height by packing)
Finish and engineering	very good
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	25mg/<10mg
Bias comp: type/force rim/centre	magnetic/100mg/115mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.5secs/2.0secs
Downforce calibration error 1g/2g	–0.05g/–0.1g
Amount of damping	none
Arm resonances	average
Subjective sound quality	good
Motor recommended	LP12, Rega etc
Estimated typical purchase price	£35



Arm resonances (compared to cartridge resonances, dotted).

Revox B790

Revox, F.W.O. Bauch Ltd., 49 Theobald Street, Borehamwood
Herts. WD6 4RZ. 01-953 0091

Features facilities setting up and use

Representing the first Revox entry into the turntable field, the *B790* is a highly innovative design. Perhaps the closest comparable model is the current B & O *4002*, as both decks are equipped with servo-controlled parallel tracking arms, and likewise, factory fitted cartridges are standard; in the case of the Revox, one of Ortofon's top line induced magnet models, the *M20E Super*. Whereas the B & O arm is a fairly standard length, driven from a concealed track at the rear of the platter, the short stub arm of the Revox is concealed in a rectangular box which is swivelled over the playing surface after a record has been put on the platter. If any manual interference is attempted during play the cartridge instantly retracts. However despite the sophisticated engineering involved (or perhaps because of it?) the arm needed to be visually tracked to the record start using the control buttons provided, although end-of-side return was automatic. In general superbly engineered, a version of the coil-spring floating subchassis top deck plate was incorporated. The motor was a direct drive unit, apparently from Dual, using a Revox quartz control system with digital speed readout and also equipped with 'fine' variable speed.

Its special design made certain aspects of testing very difficult, notably downforce, friction and arm resonances, and a minor doubt is still present concerning possible increased warp wow caused by the very short arm.

Lab performance

Revox have achieved an exemplary performance with this motor, with wow and rumble undoubtedly at the limits of our test facilities. Motor torque was excellent, with a rapid 0.9 second start up and negligible overshoot, and speed accuracy to the expected superb quartz standard. Acoustic breakthrough above 60Hz measured extremely well although deteriorated at very low frequencies, and the shock immunity proved outstanding — clearly the deck has been optimised for this parameter. On the test location feedback was also excellent provided that the lid was not tipped back excessively.

A very low 3g effective mass was estimated for the arm, this proving highly compatible with the supplied cartridge, as a 'perfect' 10Hz subsonic resonance was recorded. Alignment was very good, friction low in the estimated 25mg region, and cue operation excellent. The arm resonances graph is of course non-standard, and relates to a side or lateral excitation of the accelerometer using a M20E cartridge; by fitting this to a conventional reference arm a scaled version of the resonances are also shown, to aid comparison. A vital point concerns the first break deferred to 400Hz, and the generally even characteristic thereafter.

Sound quality

Auditioned with the supplied cartridge the sound quality was rated as good. Low bass seemed softened, and upper midrange a little thin with a touch of coarseness, exhibiting mild coloration. On

the plus side the stereo quality was pleasant with good image precision and detail.

Conclusion

A superb motor with foolproof arm, and offering many special facilities, the *B790* cannot and is not really intended to compete with audiophile turntable systems. In engineering terms it represents good value, but a recommendation depends entirely on how important its individual facilities are to the purchaser.

GENERAL DATA — Integrated Player

Motor Section

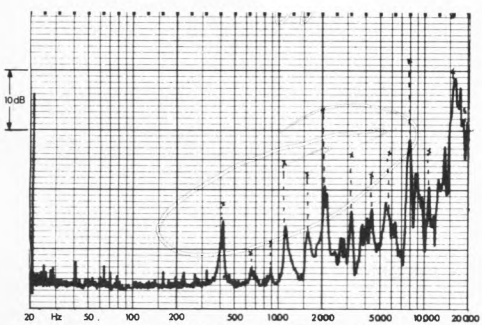
Type	auto return quartz direct drive
Platter mass/damping	1.2kg/adequate
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	< 0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	< 0.07%/< 0.06%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	0.9secs
Rumble (av DIN B wtd L/R)	76/75dB

Arm Section

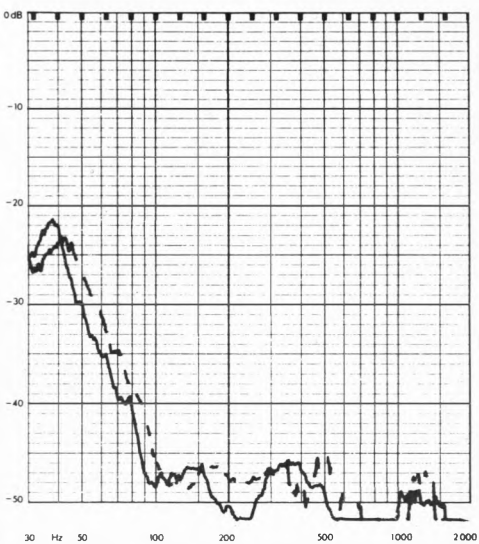
Approximate effective moving mass (excl cart. inc screws)	3.0g
Type of headshell	non detachable
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	no user adjustments
Finish and engineering	very good
Ease of assembly/setting up	excellent
Friction lateral/vertical (typical)	estimated 25mg/estimated 25mg
Bias comp: type/force rim/centre (1.5g ell set)	none required/0/0
Cueing: drift/8mm ascent/8mm descent	negligible/0.23secs/1.0sec
Downforce calibration error 1g/2g	preset/preset
Amount of damping	none

System as a whole

Size/rear clearance for lid	45.0(w) x 38.0 (d) x 14.5(h)/0cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/excellent
Vibration or shock sensitivity	excellent
Ease of use	very good
Estimated typical purchase price	£388



Arm resonances, fitted cartridge. Dotted lines marked 'x' represent an attempt to show how resonances would have been exaggerated using the more 'energetic' reference cartridge.

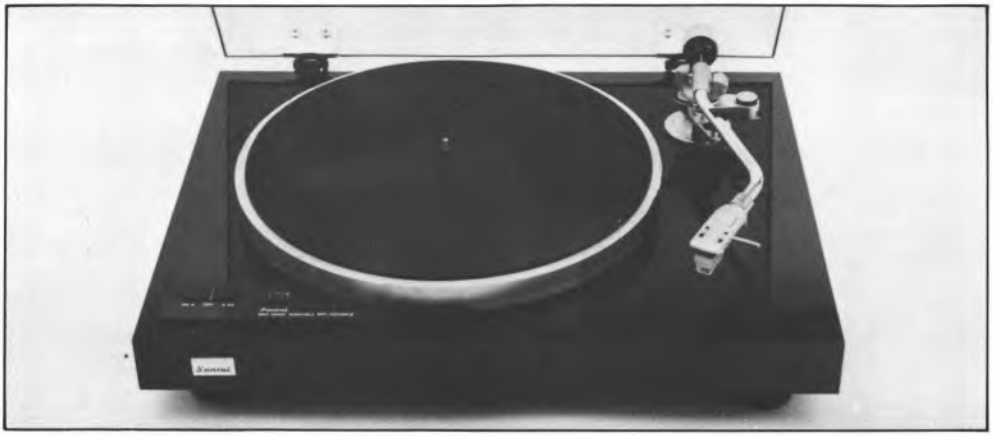


Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Sansui SR222 II

Sansui UK Ltd., (temporary address) 353 Kentish Town Road, London NW5
01-485 4345, 01-267 5200



Features facilities setting up and use

This model was reviewed in its Mark I version in the previous issue, but since then revisions have been made to the mechanics and styling; for example, the plinth finish in now in an immaculate deep black gloss.

A manually operated belt driven deck, power was supplied by a four pole synchronous/induction motor. Essentially simple in construction, plain non-adjustable feet were fitted to the hardboard base, the suspended resonance being high at 12Hz. The instructions recommend a periodic maintenance routine every three months if the deck is frequently used, this consisting of lubricating main platter and motor bearings, using oil supplied.

The arm description included mention of special steps that the namufacturers have taken to reduce coloration, comprising a low mass damping material in the arm tube and extensive use of rigid zinc castings for the pivot and pillar components. The detachable headshell carried the usual universal fittings, and general engineering quality was good for such an inexpensive deck, with well adjusted arm bearings as well as accurate arm alignment.

Lab performance

Very good readings were obtained for wow flutter and rumble, while speed accuracy was fine, load stability reasonable, and start up rapid at 0.8 of a second. The acoustic breakthrough curve was reasonable except in the 50-80Hz region, and hum levels were good even using a Supex moving coil (although admittedly this combination is unlikely in practice!) However feedback and vibration isolation were only just adequate.

The arm resonance curve was interesting as the basic range was rather well controlled, apart from three serious resonances at 220Hz, 700Hz, and 3.2kHz. The arm demonstrated excellent low friction accurate downforce calibration and sensible cue rates, although at the 1.5g bias setting, not only was lateral drift pronounced but the bias compensation was also erratic; correct at the inner groove it was too low at the outside record diameter. Effective mass was suprisingly low at 11g, placing it in the medium range and suited to 10-20 compliance cartridges.

Sound quality

Rated as above average — suprising in view of its feedback data — the *SR222 II* was characterised as offering a fairly well defined bass register, although some excessive fullness was noted. Stereo imaging was quite good, with fair depth presentation, the midrange being reasonably balanced if somewhat veiled, and no undue exaggeration or loss was apparent at high frequencies.

Conclusion

Recommended for a rigid shelf location at some distance from the speakers, the technical and subjective performances were both undoubtedly good for the price. This model is thus recommended, although it is hoped that the bias anomaly was simply an isolated sample fault.

Sansui SR222 II

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

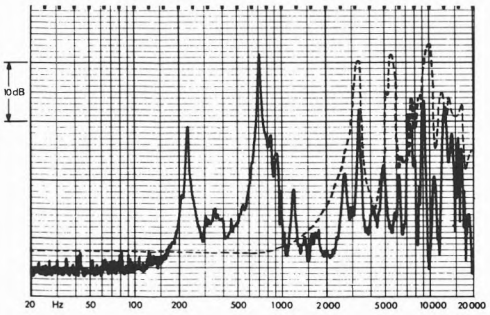
Type	manual belt drive
Platter mass/damping	0.7kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.1%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/<0.06%
Speed accuracy/drift/variation under load	+0.1/synchronous/-0.3%
Start up time to audible stabilisation	0.8secs
Rumble (av DIN B wtd L/R)	74/72dB

Arm Section

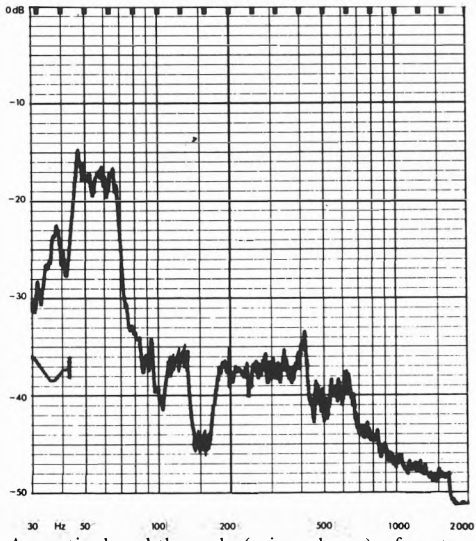
Approximate effective moving mass (excl cart, inc screws)	11g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	<20mg/<20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/65mg/200mg
Cueing: drift/8mm ascent/8mm descent	poor/0.25secs/2.5secs
Downforce calibration error 1g/2g	-0.025g/-0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	45.2(w) x 37(d) x 14.5(h)cm/5.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/adequate
Vibration or shock sensitivity	adequate
Ease of use	fairly good
Estimated typical purchase price	£60



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Sansui SR636

Sansui UK Ltd., (temporary address) 353 Kentish Town Road, London NW5
01-485 4345, 01-267 5200

Features facilities setting up and use

Another Sansui model with a jet black lustre plinth, the *SR636* was a direct drive turntable with a manually operated arm. The motor servo control was locked to an internal oscillator (not quartz in this instance), and electronic braking was also present to aid rapid change from 45 back to $33\frac{1}{3}$ rpm.

The arm exhibited some interesting features including a tapered socket arrangement for headshell locking, which improved the tightness of the fit. Decoupling was applied to the counterweight and a resonance damping medium lined the arm tube. The die-cast headshell carried a tilt correction, while arm height and overhang were also adjustable.

Large non-adjustable steel coil spring/rubber insulator feet were fitted, endowing the assembly with a fairly free resonance at around 7Hz, this still somewhat on the high side. Our first sample showed a servo fault on $33\frac{1}{3}$ rpm which resulted in a high rumble breakthrough (–50dB Din), but as the servo was fine on 45, we assumed this to be only a sample fault.

Lab performance

Wow and flutter was excellent (despite servo effect) and rumble very good (at 45rpm). Speed accuracy and drift were both very low, as was the variation under load; these results, together with the observed minimal speed overshoot imply a near quartz-locked performance. Start up was typical at 3 seconds, while the high mass of this player together with its non-resonant lid helped to produce quite a good acoustic breakthrough curve. Hum levels were fine, feedback good, but shock resistance was poor, this linked to the failing isolation below 30Hz.

Estimated at 17g, the effective mass suggested that only low compliance cartridges should be used (8-15cu types), preferrably of low body mass. Friction was excellent with negligible play; geometry was fine, downforce quite accurate, and biasing very close to the required values.

Cue operation was satisfactory except for the slow ascent. The arm resonance curve was not outstanding, but some features were notable; for example, despite the high headshell mass the fairly rigid socket system kept the first break up at 300Hz. Three significant modes followed at 900, 2000, and 3000Hz, but the behaviour settled down thereafter at the higher frequencies.

Sound quality

Rated significantly above average, wow and rumble (45rpm) proved inaudible. A degree of bass loss with an attendant softening of upper bass definition was apparent, while some midrange muddling and hardening were also noticed, the balance tending to the thin side, subduing ambience slightly. Stereo imaging and detail were both fairly good.

Conclusion

Undoubtedly a good quality player, on grounds of value for money the *SR636* fails to receive a recommendation by a relatively small margin.

GENERAL DATA Integrated Player

Motor Section

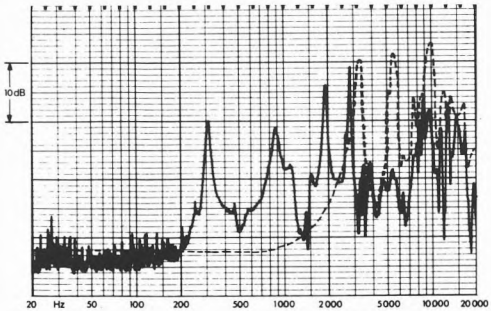
Type ..... direct drive
Platter mass/damping 1.8kg/adequate
Finish and engineering ..... very good
Type of mains/connecting leads ..... 2 core/earth + phonos
Speed options/variable? ..... $33\frac{1}{3}$; 45rpm/yes
Wow and flutter (DIN pk wtd σ2) ..... ≺ 0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz) ..... 0.08%/≺ 0.07%
Speed accuracy/drift/variation under load ..... ≺ 0.05%/≺ 0.05%/+0.05%
Start up time to audible stabilisation 3secs
Rumble (av DIN B wtd L/R) 72/73dB

Arm Section

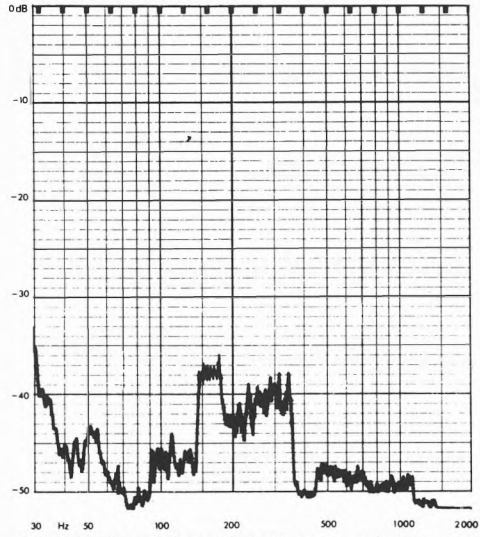
Approximate effective moving mass (excl cart, inc screws) 17g
Type of headshell ..... universal detachable
Headshell mass (inc screws) 11g
Geometric accuracy ..... good
Facilities for adjustment ..... height, swivel, overhang
Finish and engineering ..... very good
Ease of assembly/setting up ..... good
Friction lateral/vertical (typical) 15mg/15mg
Bias comp: type/force rim/centre (1.5g ell set) ..... falling weight (lever) 180mg/220mg
Cueing: drift/8mm ascent/8mm descent negligible/2.5secs/3.5secs
Downforce calibration error 1g/2g ..... +0.05g/+0.1g
Amount of damping ..... none

System as a whole

Size/rear clearance for lid ..... 49(w) x 39(d) x 12(h)/6cm
Typical acoustic breakthrough and resonances ..... fairly good
Subjective sound quality of complete system ..... above average
Hum level/acoustic feedback ..... excellent/good
Vibration or shock sensitivity ..... poor
Ease of use ..... good
Estimated typical purchase price £220



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Sansui SR838

Sansui UK Ltd., (temporary address) 353 Kentish Town Road, London NW5
01-485 4345, 01-267 5200

Features facilities setting up and use

Closely related to the *SR636,* the *838* possessed basically the same features as that model, including the 'CR' oscillator which facilitated fine speed adjustment; however it further incorporated a second oscillator with quartz reference for ultimate accuracy. I feel the latter to be redundant in view of the basic system's already excellent characteristics, and thus I cannot see any real justification for the extra £40.00 that its inclusion dictates.

Since they are so alike, the tests on the *838* reads more like a check on Sansui production consistency than a new product evaluation. A strip down of the deck revealed top class engineering; for example, the main bearing quality was to a standard rarely seen on a UK manufactured deck. Nonetheless the same ineffective isolation feet were fitted to this model as were used for the *636.*

Lab performance

Similarly fine results to the *636* were obtained, namely excellent wow and flutter, speed accuracy, and load stability. Measured rumble was very good, although interestingly enough, a slight trace of tacho-frequency servo 'whine' was detected at high listening levels, using records with quiet surfaces. Acoustic breakthrough was similar to that of the *636*, if a little worse, while shock resistance was poor, but feedback margins pretty good.

Friction levels were low but biasing was on the high side at +40%; however downforce was fine, although cue ascent was rather slow as before. All Sansui arms used the same clumsy overhang method for cartridge alignment, but otherwise the geometry was very good, and the arm resonance curve predictably paralleled that of the 636; note the slight frequency error on the graph towards the end — the 20kHz end point appears at a marked 17Hz.)

Sound quality

The comments made about this deck were virtually indistinguishable from those pertaining to the *636*; however in addition, no subjective difference was noted with quartz lock either on or off. The rating was thus as before — 'above average'.

Conclusion

Again a good quality player, the *SR838* was immaculately finished, proving compatible with low compliance cartridges, and with a firm shelf location recommended for the best results. Unfortunately, in common with the *636* its highish price precludes recommendation.

GENERAL DATA Integrated Player

Motor Section

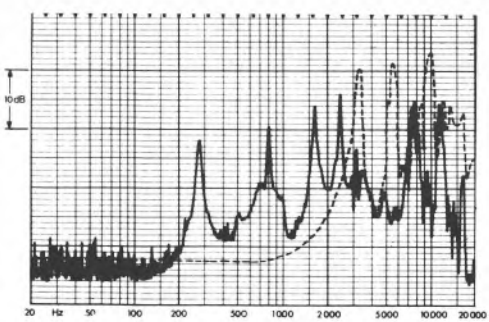
Type	manual quartz direct drive
Platter mass/damping	1.8kg/adequate
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	⩽0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/⩽0.06%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	2.5secs
Rumble (av DIN B wtd L/R)	72/73dB

Arm Section

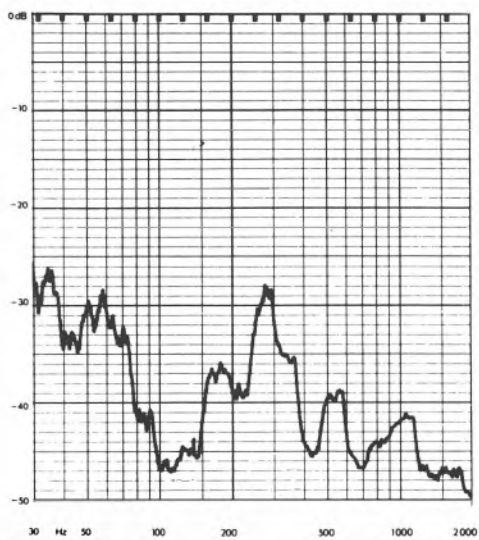
Approximate effective moving mass (excl cart, inc screws)	16.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	11.0g
Geometric accuracy	very good
Facilities for adjustment	height, tilt, overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	25mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/220mg/300mg
Cueing: drift/8mm ascent/8mm descent	negligible/4.0secs/3.5secs
Downforce calibration error 1g/2g	+0.15g/+0.15g
Amount of damping	none

System as a whole

Size/rear clearance for lid	49(w) x 39(d) x 17(h)cm/6.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£260



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Sanyo TP727 2

Sanyo, Sanyo Marubeni (U.K.) Ltd., Sanyo House, 8 Greycaine Road, Greycaines Estate, Watford, Herts. 0923 30421

Features facilities setting up and use

This *727* is the successor to the model of the same number reviewed in the previous issue, which did not gain a recommendation. The scale of improvement since effected, however, has been sufficient to bring the deck into the recommended category.

A belt drive turntable produced for Sanyo by CEC, it incorporated a dc servo motor with a rim cut platter strobe, the latter illuminated none too clearly by a mains neon. Fine control of speed was possible, with speed change accomplished electronically; an auto return mechanism was fitted to the arm.

Constructional quality was found to be quite good, with both the Fujiya motor and transformer well isolated from the steel motor board. Finish was reasonable although one or two points were criticised, namely the uneven fit of lid to plinth, and poorer than average record support. The frequently encountered but nonetheless unsatisfactory method of cartridge alignment by overhang was again specified here.

Lab performance

An above average performance was recorded, as both wow and flutter as well as rumble were very good. The servo system was free of overshoot, showed good accuracy and drift, plus satisfactory slowing under load, while start up was rapid at 0.8 of a second. Measured acoustic breakthrough was rather poor, particularly at 70 and 250Hz, with feedback being similarly rated as adequate, and vibration resistance as good. Hum suppression was poor with moving-coil models, and conventional types are thus to be recommended.

A typical resonance pattern was illustrated by the arm — a first break at 220Hz, with a succession of fairly sharp resonances, plus reasonably evenly maintained energy at the higher frequencies. Friction was adequate for a 1.5-2.5g downforce, the high recorded lateral figure mainly due to residual bias compensation. The latter, if correctly dialled, gave figures in the right ratio although at about double the required amount. Cue drift was poor, but the rates were good, and downforce calibration was fairly accurate. The headshell was well aligned, but since only overhang adjustment was available, the cartridge needs to be chosen with care — both height and effective mass must be taken into account, the latter figure suggesting compliances in the 8-15cu range.

Sound quality

An 'average' rating was obtained which is fair enough at the price. Rumble was practically inaudible with no wow, the balance being rather light, with some mid 'muddling' and a loss of extreme bass. On the whole, the sound was free of coarseness and as such, was quite pleasant.

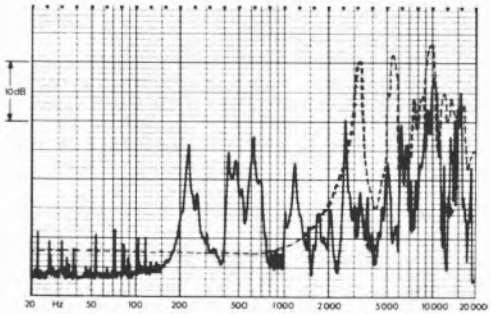
Conclusion

The generally good performance and reasonable sound quality ensures that the *727* receives a recommendation.

Sanyo TP727 2

RECOMMENDED

GENERAL DATA	Integrated Player
Motor Section	
Type	auto stop, belt drive
Platter mass/damping	1.0kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	3 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd o2)	0.07%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.075%/<0.07%
Speed accuracy/drift/variation under load	adjustable/<0.05%/-0.3%
Start up time to audible stabilisation	0.8secs
Rumble (av DIN B wtd L/R)	68/71dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.5g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	280mg/80mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/250mg/420mg
Cueing: drift/8mm ascent/8mm descent	poor/0.25secs/3.0secs
Downforce calibration error 1g/2g	-0.025g/-0.15g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45(w) x 37.8(d) x 15.5(h)cm/4.8cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	adequate/adequate
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£75



Arm resonances (compared to cartridge resonances, dotted).

Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Sanyo TP1020 2

Sanyo, Sanyo Marubeni (U.K.) Ltd., Sanyo House, 8 Greycaine Road, Greycaines Estate, Watford, Herts. 0923 30421

Features facilities setting up and use

The *1020* could be viewed as a cheaper version of the successful *TP1100,* the price undoubtedly low for a direct drive model with automatic arm return: it is however unfortunate that the even cheaper *727* outperforms it in several respects.

Superficially the *1020* plinth bore a close resemblance to the die-cast metal structure of the *1100*, but closer inspection revealed it to be made of light plastic. However, general finish and constructional quality were reasonable for the price. Despite a very good steady state performance, the direct drive motor employed in the *1020* suffered sufficiently from a speed overshoot problem to generate a mild quantity of program wow, while the alignment instructions were not only clumsy (overhang measurement) but more seriously, were in error, resulting in a 2-3° lateral alignment fault. A 15mm overhang was specified, but 17mm appeared to be the correct value. The vibration isolation feet proved to be ineffective, having no lateral freedom.

Lab performance

The merely 'good' rating in the table for wow and flutter relates to the servo overshoot, as the fine steady state results deserve higher praise. Speed drift was low, load variation satisfactory, and start up average at 2.8 seconds. Measured rumble was fine, but some slight pole noise was audible on the listening tests, while acoustic breakthrough was about average, albeit a little high in the 100-200Hz range. Feedback was fair with the lid up, but worsened by 12dB with it down, although good shock immunity was demonstrated, and hum levels were fine, even using the most sensitive of cartridges.

Effective mass was high at 18g, dictating the use of low compliance cartridges for stable results, while the arm resonances were not promising, exhibiting an obvious multiplicity of modes from 200Hz upwards. However, friction was fine, bias compensation good (if 30% high) and downforce calibration excellent. Reset using a protractor, geometrical accuracy was good, with cue operation satisfactory if a little slow to lift.

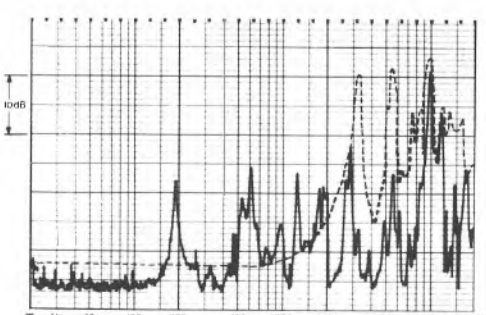
Sound quality

Rated below average on grounds of wow, rumble, and overall musical quality, the sound was characterised as moderately coloured, with a noticeable loss of detail and reduced separation of individual instrument sounds. The upper bass showed some fullness and overhang.

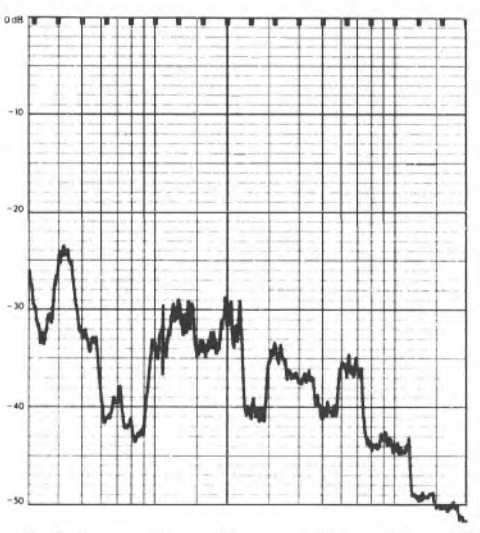
Conclusion

This model does not merit a recommendation; in particular, the motor performance and arm alignment procedure both require attention.

GENERAL DATA	Integrated Player
Motor Section	
Type	direct drive auto return
Platter mass/damping	1.9kg/very good
Finish and engineering	good quality
Type of mains/connecting leads	two core/phono
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.05 5%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.07%/0.075%
Speed accuracy/drift/variation under load	Better than 0.1%/ better than 0.05%/0.2%
Start up time to audible stabilisation	3.3secs
Rumble (av DIN B wtd L/R)	76/78dB
Arm Section	
Approximate moving mass (excl cart, inc screws)	17-19g
Type of headshell	detachable
Headshell mass (inc screws)	9g
Geometric accuracy	average
Facilities for adjustment	overhang only
Finish and engineering	good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	50.0mg/10.0mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/175mg/240mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.25secs/2.0secs
Downforce calibration error 1g/2g	+0.05g/0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	47.5(w) x 38(d) x 15.2(h)/3.9cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	very good/very good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£90



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Sanyo TP 1100 II

Sanyo, Sanyo Marubeni (U.K.) Ltd., Sanyo House, 8 Greycaine Road, Greycaines Estate, Watford, Herts. 0923 30421

Features facilities setting up and use

Recommended in the last issue, the *TP1100* appeared this time as a slightly revised Mark *II* version. The overall standard of performance has however been maintained, and the recommendation is thus repeated.

A substantially constructed direct drive model, the same Fujiya motor was employed as in its predecessor, the deck also incorporating an auto-return arm. The general standard of engineering was good, with a notably superior die cast metal plinth. The deck was criticised in the previous issue for its poor lateral alignment, and although the same method of overhang measurement is again specified, at least the new figures and headshell bring the error down to below 1°. All controls operated smoothly and well, with the fine speed adjustment made using serrated edge wheels, and the clear strobe was a reflection type internally illuminated from beneath the recessed platter. Rather limited overhang adjustment was provided for the cartridge, which meant that the Supex *900E* could not be fitted and another similar headshell was used for the tests instead. The heavy headshell of the previous version has been replaced by rather a flimsily constructed one, which nonetheless still weighed a not inconsiderable 9g including screws.

Lab performance

Rumble was truly excellent — remarkable for a low price model — and absolutely inaudible. Wow and flutter was in the same class, with acceptable load variation, little overshoot, and fair motor torque. Drift and accuracy were also very good, the satisfactory acoustic breakthrough showing considerable improvement over the *1020;* hum levels were fine, shock resistance was good, and feedback immunity very good, the latter in accordance with the breakthrough.

Bias compensation was quite accurate and downforce excellent, with friction reasonable and cue satisfactory. Only overhang alignment was provided so the cartridge should be chosen with due regard to the height provided. Arm resonance data showed an improved characteristic by comparison with the *1020*, the few modes present visibly indicating it to be above average in this respect.

Sound quality

Rated as about average, at a well below average price, the *1100* was described as possessing a pleasant balance with moderate midrange coloration. Upper bass was a trifle heavy but definition was reasonably well maintained. The balance was on the rich side, with some dulling of transients and mild depth veiling.

Conclusion

Fulfilling its earlier promise, the *1100* continues to be recommended, but for the best results, use low compliance cartridges and a rigid shelf location.

Sanyo TP 1100 II

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

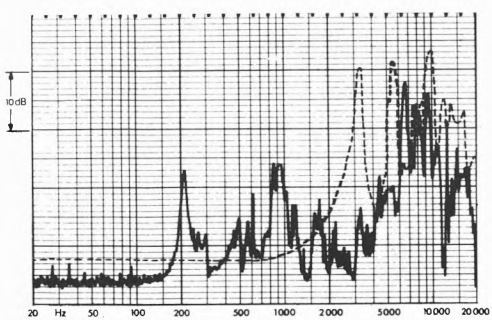
Type	auto return, direct drive
Platter mass/damping	1.2kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33¹/₄; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.07%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.07%/0.08%
Speed accuracy/drift/variation under load	adjustable/ 0.05%/–0.3%
Start up time to audible stabilisation	2.8secs
Rumble (av DIN B wtd L/R)	68/70dB

Arm Section

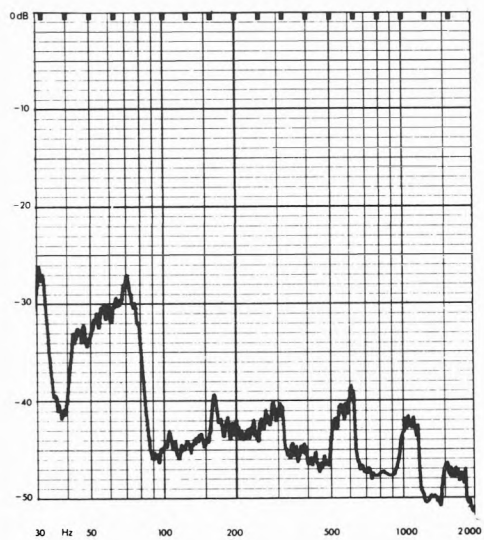
Approximate effective moving mass (excl cart. inc screws)	18g
Type of headshell	universal detachable
Headshell mass (inc screws)	10g
Geometric accuracy	fairly good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	50mg/10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/190mg/290mg
Cueing: drift/8mm ascent/8mm descent	satisfacotry/0.25secs/2.0secs
Downforce calibration error 1g/2g	0g/–0.05g
Amount of damping	none.

System as a whole

Size/rear clearance for lid	44.3(w) x 35.4(d) x 13.8(h)/4.5cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	very good/adequate
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£115



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

SME 3009 II

SME, SME Ltd., Steyning, Sussex,
BN4 3GY. 0903 814321

Features facilities setting up and use

The review of the SME *II* in the last issue was completed before the introduction of the *FD200* damper unit. This addition, plus a recent SME recommendation to use a quantity of mastic packing between cartridge body and headshell, together made a retest worthwhile. The more revealing measurement and auditioning techniques employed in this edition have resulted in greater descrimination between the fixed and detachable headshell versions, and also examined the effects of damping; the last issue recommended the model as a whole, albeit with some reservations concerning sound quality.

Engineering and finish were exemplary on this model, although some oddities were present, notably the excessive biasing and damping. This design uses a precision ball race for horizontal movement, with knife edges used in the vertical plane. The design was engineered for low mass, especially in the case of the non-detachable version. Full height, overhang and tilt facilities were present, and comprehensive instructions were provided.

Lab performance

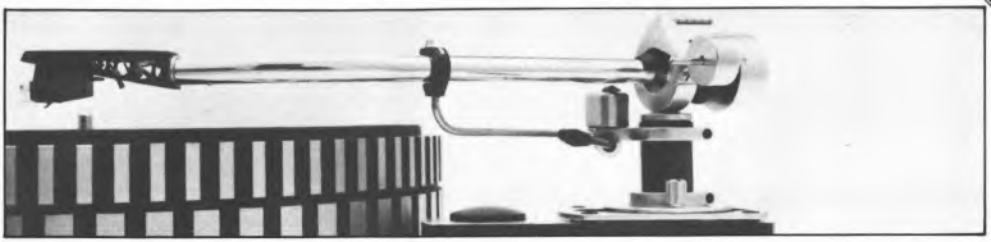
Friction was excellent and downforce calibration accurate, with cueing satisfactory on drift and exhibiting sensible rates. The bias compensation introduced negligible extra friction thanks to the pulley, although the values were nearly double that required, and while the damping if arranged as instructed proved excessive, almost any degree could be attained by diluting the fluid, (special accessory) or using the different paddle sizes. Effective mass was low at 6g for the fixed shell and medium (9g) for the detachable — the latter still a pretty low result. The arm resonances were notably different for the two models, with the non-detachable showing a superior result up to 3 or 4kHz, having better 'Q' control, together with a more evenly distributed high frequency range.

Sound quality

In the context of this report, both the Mark II fixed and detachable arms were rated as only 'average'. The general characterisations included the presence of a brashness, a lack of bass definition, with impaired stereo image depth and

SME 3009 II

RECOMMENDED

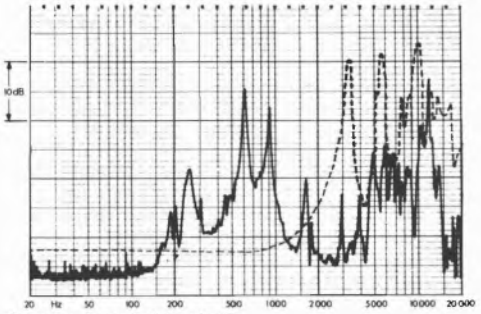


precision plus a slightly 'loud' quality. However, the non-detachable version was definitely superior to the detachable, especially using the cartridge fixing mastic. The *FD200* damper provided a significant improvement, the stereo image now better stabilised, with more bass depth and precision apparent, this final combination being classed as 'good'.

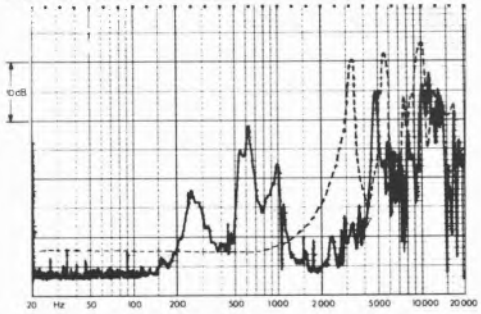
Conclusion

Of the *3009 II* versions tried, on grounds of engineering and sound quality, low effective mass and versatile damping, the SME *3009 II ND FD200* can be recommended.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart, inc screws)	9g(D)/6g(ND)
Type of headshell	Universal detachable (or ND)
Headshell mass (inc screws)	6g
Geometric accuracy	very good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	good
Ease of use	very good
Friction lateral/vertical (typical)	< 10mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	pulley, thread & weight 280mg/300mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1sec/4secs
Downforce calibration error 1g/2g	-0.075g/0g
Amount of damping	none/variable (FD200)
Arm resonances	see text
Subjective sound quality	good (ND & FD200)/satisfactory (D)
Motor recommended	TD160 etc
Estimated typical purchase price	£70



Above: detachable shell



Arm resonances (compared to cartridge resonances, dotted). Above: non-detachable

For once it sounds better to be overweight

Because the heavier the turntable platter, the greater the stability. Which is why the platter on the Ariston RD11E weighs some 4½ lbs. A figure substantially better than the average.

Many manufacturers try to get away with less. But, at Ariston, we believe that cutting corners is no more than the quickest way to produce an inferior product. So, to quote but one example, with the RD11S we allow the platter to lie to weather after casting. Put simply, that way we know the platter characteristics will not change after the unit leaves our factory.

And it goes without saying that the heavier the platter, the better the motor needed to drive it. One of the reasons why, on the RD11S, which has a platter weighing 9.5 lbs, we, unlike most manufacturers use an AC motor. Not only does this help ensure constant speed and offer greater reliability, it also avoids the problems of pulse surge associated with direct current.

Naturally, there are other factors. A free floating suspension system, belt drive, the exhaustively researched design and construction of our wooden plinth, the quality of the tone arm on the RD11E, the RD11S comes without an arm – all help produce a set of specifications that compare more than favourably with any printed anywhere.

But, more important, both the RD11E and the RD11S sound better. The musicality of turntables, unlike say loudspeakers, is not normally a consideration. Our ears tell us otherwise. And we, along with our dealers, think you should listen and judge for yourself.

But whichever model you choose, you'll be delighted to discover that neither will make as much difference to the weight of your wallet as you might have feared.

Ariston the Aristocrat

ARISTON AUDIO

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Tel: 0655 82424
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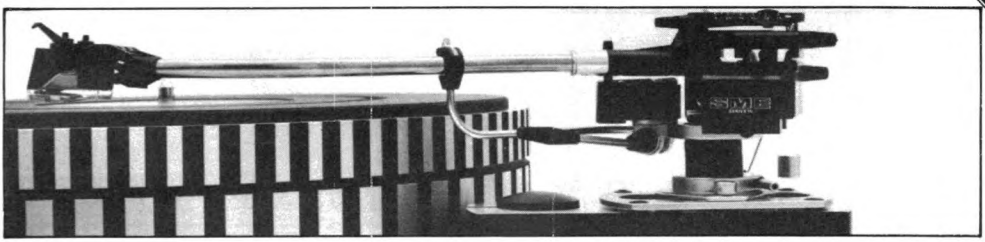
Dealers include: AT Labs, London; Audio Aids, Edinburgh; Audio Projects, Leeds; Audio T, London; Berkshire Hi-Fi, Maidenhead; Billy Vee Sound Systems, Lewisham; W A Brady, Liverpool; Erricks of Bradford, Fred Bentell, Blackpool; Hampshire Audio, Chandler's Ford; Hi-Fi Corner, Edinburgh; Hi-Fi Shop, Belfast; Holburn Hi-Fi, Aberdeen; Huddersfield Hi-Fi Centre; KJ Leisuresound, London & Watford; Lloyd & Paton, Manchester; Martins, Norwich; Neil McComack, Glasgow; Newdawn Hi Fi, Chester; REW, London; Radford Hi-Fi, Bristol; Ray Charles, Walsall; Russell Hi-Fi, Falkirk; Sheffield Sound Centre; Sound Centre, Altrincham; Spaldings, Croydon; Unilet Products, New Malden; Vennal Audio, Ayr; Victor Morris, Glasgow.

SME 3009 III

RECOMMENDED



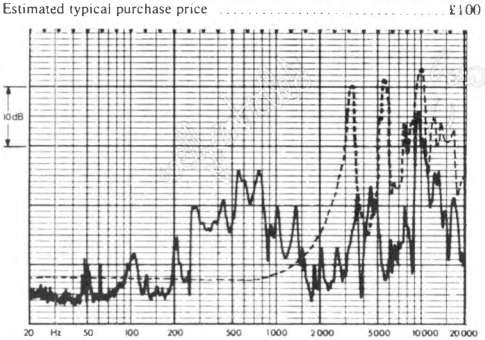
This recently introduced and fairly costly tonearm represents a large departure from established practice. It features variable effective mass down to a low minimum, variable viscous damping at the pivots, and a rigid fixed-headshell arm, which is nonetheless detachable by means of an equally rigid and lengthened socket positioned near the pivots. The connecting leads — all with gold plated terminals and pins — have two matching capacitance options, and provision for height, tilt and overhang adjustment are all included. One obvious minor weakness concerned the headshell, which had been so reduced in area as to be somewhat weakened, and thus offered inadequate support for the front section of several cartridges. Finish and engineering were very fine, with admirably detailed instructions and an alignment method close to the theoretical optimum.

Friction was very low, the horizontal figure inflated by the presence of some lead torque. As with other SMEs biasing was on the high side at double the required amount, but downforce was pretty accurate and cue operation satisfactory, with a usefully rapid ascent. Effective mass was very low, estimated at close on 5g with hardware, and suited, with damping, to the highest compliance cartridges (up to 50cu). Low compliance models will actually need additional mass to keep the subsonic resonance effects clear of the audible bass region. The arm resonance curve was not outstanding, with a minor counterweight mode visible at 50Hz and again at 107Hz, and the first tube mode appearing from 200-300Hz. A striking feature, however, was the combination of good control of resonance amplitude, together with a fairly good energy extension to higher frequencies.

Rated as significantly above the best version of the *Mark II*, the *III* achieved a 'very good' classification, using appropriate turntables e.g. a modified *TD160BC*, a Linn, and a rigid shelf mounted *DDX1000*. The mild brashness of the *II* was gone, the *III* sounding rather rich and restrained. In the final analysis slight definition losses were however noticed in both bass and midrange, the latter a trifle veiled but still portraying convincingly both depth and image precision.

The SME *III* represents a unique combination of finish, universality, low mass, style, sound quality, alignment facilities and arm detachability; as such it clearly merits a recommendation. However to achieve the best results note should be taken of the optimum settings for effective mass, damping, and bias compensation, together with some consideration for secure cartridge fixing.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	4.5g
Type of headshell	special detachable arm
Headshell mass (inc screws)	N/A
Geometric accuracy	excellent
Facilities for adjustment	tilt, overhang, height, damping
Finish and engineering	very good
Ease of assembly/setting up	good
Ease of use	very good
Friction lateral/vertical (typical)	(lead torque) 30mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	pulley, thread & weight 300mg/370mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.5secs/5secs
Downforce calibration error 1g/2g	-0.075%/-0.15%
Amount of damping	variable
Arm resonances	good
Subjective sound quality	very good
Motor recommended	STD, TD160, LP12 etc.
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).

RECOMMENDED

Sony PST1

Sony, Sony (U.K.) Ltd., Consumer Inf. Dept. Showroom, 134 Regent Street, London W1. 01-439 3874

Features facilities setting up and use

Two of the Sony turntables, designated the *PST1* and *PS212,* proved to be mechanically equivalent, but exhibited different styling to suit two parallel ranges of equipment. The price seemed surprisingly low for a 'metal' finish look, tacho-generator type direct drive model, complete with cartridge. Specifically it is the *PST1* version which is illustrated and reported on.

The tacho-system comprised magnetic pulses encoded on the platter inside rim, which were sensed by a magnetic head which controlled the flat-form linear torque direct drive motor. An auto return mechanism was fitted with a front-positioned reject button, accessible with the lid shut. The light construction and simple rubber feet resulted in a plinth resonance of between 10 and 12Hz, which is unfortunately above the arm/cartridge subsonic resonance region.

No separate earth was provided for the pickup leads, an omission which degraded hum levels but not too seriously if using the supplied cartridge. Engineering and finish were highly rated for the price, and all controls worked smoothly.

Lab performance

Wow and flutter measured very well, and rumble was also good, particularly on DIN B figures. Torque was sufficient for a 1.5 second start up, and no significant overshoot existed, while stability and load variation were both very good. The light resonant lid figured strongly in the acoustic breakthrough curve which was poorer than average below 100Hz, and feedback was also unsatisfactory with the lid up, but improved by a considerable 14dB with the lid closed — clearly the optimum position. Shock resistance was about average while hum was fine with the supplied cartridge, and still proved satisfactory using a more hum-susceptible moving-coil.

The supplied cartridge was accurately aligned, possessing a spherical tip and tracking at a 2g downforce — quite a compatible choice for the arm. Friction leveral were quite reasonable, and downforce was an acceptable 10% in error on the plus side. However, bias compensation was double that required, albeit in the correct ratio. Cue operation showed sensible rates with some lateral drift, the high bias compensation being partly responsible for this. Effective mass was estimated at 14g and is best suited to 8-15cu cartridges. The arm resonance curve was typical, with a 170Hz first break, some doninant modes at 800Hz or so, and acceptable uniformity thereafter.

Sound quality

Rated as 'adequate' with a trace of motor or perhaps transformer hum audible at high listening levels, the sound quality of this model was found to be strongly dependant on location, a sturdy shelf remote from the loudspeakers working wonders. On a normal cabinet, the sound was described as a little hard and reedy with a loss of stereo perspective and depth, and a heavy 'tubby' upper bass, with deficient lower registers.

RECOMMENDED

Conclusion

Providing this model is positioned in a sensible location, the *PST1* may be recommended. Certainly the overall package offers good value for money, and alternative cartridges to that supplied could also be fitted, bearing in mind the correct compliance range.

GENERAL DATA — Integrated Player

Motor Section

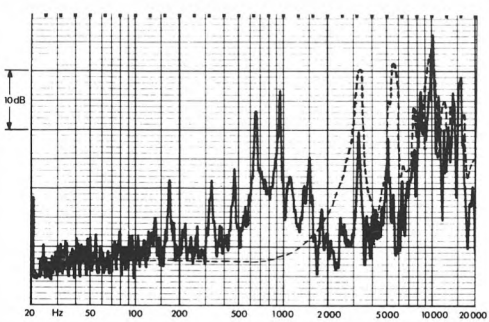
Type	auto return direct drive
Platter mass/damping	1.1kg/good
Finish and engineering	good
Type of mains/connecting leads	2 core/2 phonos (earth included)
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.08%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/0.07%
Speed accuracy/drift/variation under load	adjustable/0.1%/–0.1%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	70/71dB

Arm Section

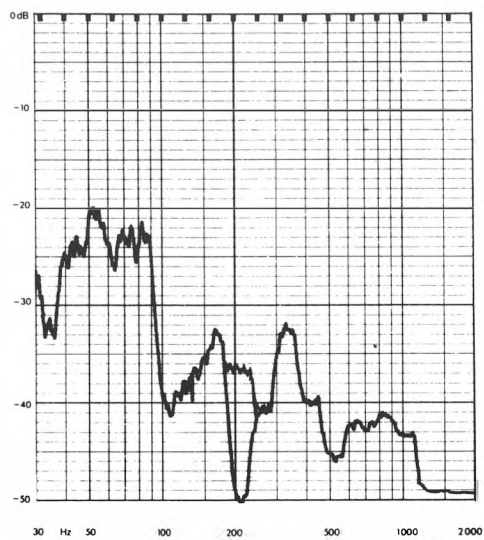
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.5g
Geometric accuracy	very good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	very good
Friction lateral/vertical (Typical)	50mg/20mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/290mg/480mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.5secs/2.0secs
Downforce calibration error 1g/2g	+0.15g/+0.20g
Amount of damping	none

System as a whole

Size/rear clearance for lid	44.4(w) x 37(d) x 13.7(h)cm/6.0cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	satisfactory/fairly good
Vibration or shock sensitivity	satisfactory
Ease of use	very good
Estimated typical purchase price	£80



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Sony PSX4

Sony, Sony (U.K.) Ltd., Consumer Inf. Dept. Showroom, 134 Regent Street, London W1. 01-439 3874

Features facilities setting up and use

The *PSX4* is related to both the *PSX6* (not reviewed) and the *PSX7*, all three possessing similar weight, appearance and dimensions. However, the facilities they offer do differ, with the *4* an auto return deck, the *6* a fully automatic model with front mounted controls, and the *PSX7* representing a more sophisticated version of the *PSX6*.

Returning to the *PSX4*, the 'X' designation refers to quartz lock drive with magnetic pulse speed detection, these pulses recorded as a stripe on the inner rim of the platter. A stroboscope was incorporated, locked to the internal reference frequency, but proving quite useless as the speed could not be varied. Like so many other quartz strobes it was there for visual effect — or perhaps to indicate a fault condition.

The deck proved to be substantially constructed and was well engineered in the Sony tradition. Liquid filled soft rubber feet were fitted, which were well damped, this imparting shock resistance but poor isolation of transmitted audio range energy. Sony were one of the very few Japanese companies to include a proper cartridge alignment protractor, in this case equivalent to the SME one.

Lab performance

High torque was present, the heavy platter coming up to speed with zero overshoot in about 1.5 seconds. Speed change was also rapid, while wow and flutter and rumble were almost in the excellent class. Speed accuracy and stability were to the expected quartz precision — theoretically less than 0.0001% in error. Measured acoustic breakthrough was better than average, although the 100-500Hz range was higher than it should have been, while hum levels were satisfactory even when using difficult cartridges. Shock resistance was found to be very good, and feedback just 'good', with the lid either raised or lowered.

The arm resonance curve showed some similarities to that printed for the *PST1*, and could only be classed as average. The early and significant break at 130Hz was not too promising, but resonances apart, fair friction levels were noted, downforce was highly accurate, and cue satisfactory. Bias compensation was again on the high side at about double the required value, but at least it was in the correct ratio increasing from rim to centre. An effective mass of 14g suggested the use of low compliance cartridges, and while geometrical accuracy was good, no height or tilt adjustments were provided.

Sound quality

Rated 'above average', wow and rumble were quite inaudible, the sound characterised as offering fairly good stereo imaging with moderate depth impairment; a generally neutral midband with a touch of coarseness and high treble 'edge' were noted, plus reasonably good bass extension, albeit with a mild loss of clarity.

RECOMMENDED

Conclusion

In its way this technically advanced turntable offered as good value as the *PST1*, and can thus be recommended.

GENERAL DATA Integrated Player

Motor Section

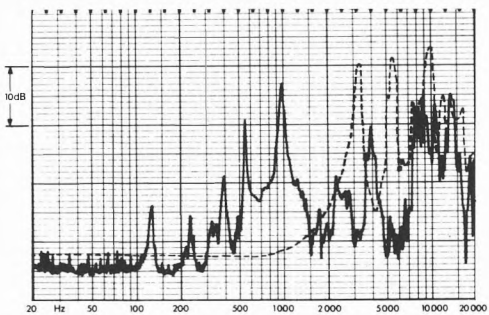
Type	auto return, quartz, direct drive
Platter mass/damping	1.95kg/adequate
Finish and engineering	good
Type of mains/connecting leads	3 core IEC plug/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	< 0.07%/0.1%
Speed accuracy/drift/variation under load	quartz/quartz/0
Start up time to audible stabilisation	1.6secs
Rumble (av DIN B wtd L/R)	73/75dB

Arm Section

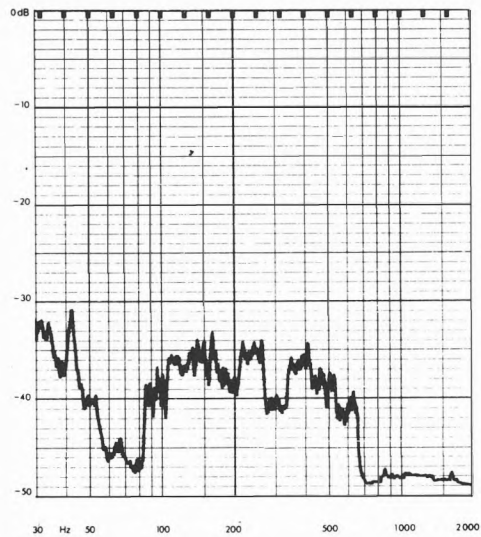
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	10.5
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	45mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/275mg/320mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/0.25secs/2.5secs
Downforce calibration error 1g/2g	+0.05g/0g
Amount of damping	none

System as a whole

Size/rear clearance for lid	44.5(w) x 37.5(d) x 15(h)cm/5.0cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£120



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Sony PSX7

Sony, Sony (U.K.) Ltd., Consumer Inf. Dept. Showroom, 134 Regent Street, London W1. 01-439 3874

Features facilities setting up and use

In common with the other Sony models, the *PSX7* came supplied with very good instructions and a decent alignment protractor. In this model, carbon fibre has been used for the arm tube, and this is claimed to improve its resonant behaviour. While an examination of the comparable curve for the *PSX4* clearly demonstrated an improvement in the *X7's* lower midrange, 200Hz-700Hz, this carbon fibre arm was definitely poorer at higher frequencies, the 10kHz spike strongly dominating the response. It remains to be seen what effect this change has on sound quality.

A fully automatic model identical in this respect to the *PSX6,* vibrationless electronic touch switches were used for the *X7* — a feature first encountered on the *PS4300* model, recommended in the previous issue and since discontinued. The 'sandwich' mat consisted of a rubber sleeve with a viscous fluid filling, the idea being to allow approximate moulding of the mat to the record surface contour to maximise contact, and then to damp the resonances. In practice, however, the mat did not appear to control the rather resonant platter casting satisfactorily, while the firm viscous feet gave an excessively high 16Hz plinth resonance, calculated to aid vibrational transmission into the cartridge. Nevertheless the structure as a whole is reasonably heavy, which will help matters.

Lab performance

As with the *PSX4/6,* the wow and rumble results were virtually in the excellent class. Stability and accuracy were predictably superb with the quartz lock, while vibration resistance was very good, and so interestingly enough was feedback — marginally better than for the *PSX4.* Hum was fine and measured acoustic breakthrough a little better than average, although with rather high points at 160 and 250Hz.

Bias compensation was again double the required amount, but at least the three arms were consistent in this respect. Downforce accuracy was fine, friction reasonable, and cue operation satisfactory with sensible rates, the lateral drift largely due to the excessive biasing. This arm possessed a similar effective mass of an estimated 14g to that recorded for the other Sony decks.

Sound quality

The altered arm resonance curve and viscous mat were clearly beneficial in terms of the subjective performance, the *X7* attaining a 'good' rating. Perceived coloration was low, and the sound balance and perspective had an 'integrated' effect, a factor common to some of the 'better' decks in the report. Detail at low frequencies was present, although low bass was subdued and stereo imaging a trifle vague.

Conclusion

Offering as it does a combination of good facilities and sound quality, plus excellent motor performance and precise engineering, the *PSX7* deserves recommendation.

Sony PSX7

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

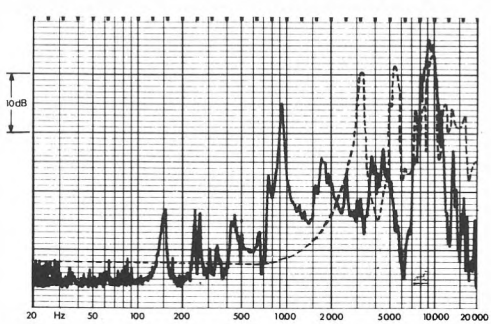
Type ..... automatic quartz, direct drive
Platter mass/damping 1.8kg/adequate
Finish and engineering ..... very good
Type of mains/connecting leads .... 3 core detachable IEC/earth + phonos
Speed options/variable? 33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2) 0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz) ..... ≤0.05%/0.09%
Speed accuracy/drift/variation under load quartz/quartz/0
Start up time to audible stabilisation 1.75secs
Rumble (av DIN B wtd L/R) 73/75dB

Arm Section

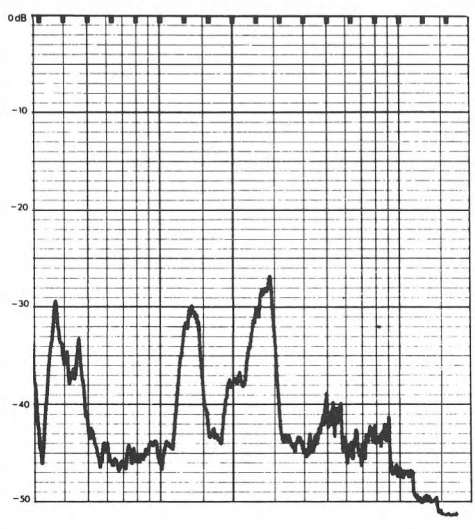
Approximate effective moving mass (excl cart, inc screws) 14.0g
Type of headshell ..... universal detachable
Headshell mass (inc screws) 10.0g
Geometric accuracy ..... good
Facilities for adjustment ..... overhang
Finish and engineering ..... good
Ease of assembly/setting up ..... very good
Friction lateral/vertical ..... 50mg (bias)/20mg
Bias comp: type/force rim/centre (1.5g ell set) spring/280mg/390mg
Cueing: drift/8mm ascent/8mm descent satisfactory/0.25secs/2.5secs
Downforce calibration error 1g/2g ..... –0.025g/–0.025g
Amount of damping ..... none

System as a whole

Size/rear clearance for lid ..... 44.5(w) x 37.5(d) x 15(h)cm/5.0cm
Typical acoustic breakthrough and resonances ..... above average
Subjective sound quality of complete system ..... good
Hum level/Acoustic feedback ..... good/very good
Vibration or shock sensitivity ..... very good
Ease of use ..... very good
Estimated typical purchase price £170



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Stax UA7

Stax, Wilmex Ltd., Compton House, New Malden, Surrey KT3 4DE. 01-940 2545

Features facilities setting up and use

This arm has been available for some time now in conventional alloy tube form, but recently another and more expensive version has been introduced, featuring a carbon fibre arm tube, and as this model also includes the alloy tube as an accessory, both the *UA7CF* and *UA7M* (alloy versions were tested.

Interestingly enough, no mass advantage accrued from the use of carbon fibre in this instance, both arm tubes weighing 13.5g. If anything, the aluminium alloy version was more rigid than the CF tube, although the latter was fitted with an unusual double pin version of the SME socket to improve socket/plug rigidity.

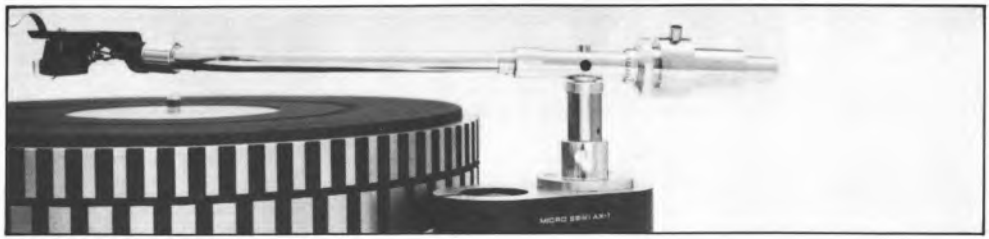
The socket/plug pins on the CF tube were all found to be gold plated but this was only true of one end of the alloy version. Tube interchangeability is achieved by duplicating the socket system at both the headshell and at the pivots; unfortunately this inevitably results in a reduction in overall rigidity. The crosslinking cartridge mounting screws were a little fiddly, and did not fit cartridges with thin mounting plates such as the Ultimo, the headshell fixing arrangements using removeable plates being considered rather a nuisance. In contrast a superb bias compensation mechanism was fitted, a needle roller minimising friction in between the moving level parts, while the suspension was a jewelled unipivot, rubber mounted for shock protection and so stabilised by a lateral ball race that one is hardly aware of its presence. Construction and finish were both to the usual high standard.

Lab performance

Comparing the two arm tubes for resonances, there did not seem to be much to choose between them, with the first break on the alloy tube only marginally higher in frequency than that of the CF version, and neither was rated as better than average. Friction was excellently low, biasing quite accurate with downforce error negligible and cue operation fine. Geometrical alignment was very good, with tilt, height and overhang all provided for. The moving mass at 16g was however a rather high, and low compliance cartridges are thus to be recommended.

Sound quality

A difference was observed in sound quality between the two models, sufficient under our test



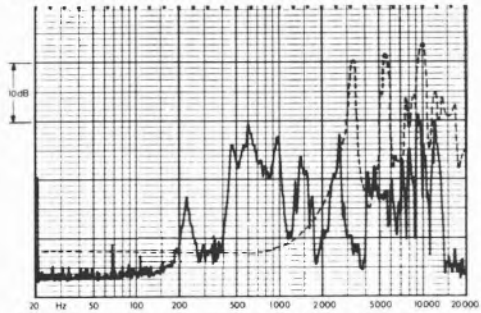
conditions and using reference cartridges, to rate the alloy as 'good' but the CF as only 'above average'. The former possessed a fairly neutral and transparent sound with good bass quality but a false 'air' was present in the upper mid, verging on coarseness, while the upper treble showed a touch of distortion emphasis or 'splash'. By comparison the CF tube possessed worsened 'splash' with a harder and apparently more coloured mid band; marginally less transparency was also noted.

Conclusion

The standard *UA7M* would appear to be the better of the two arms. The price however is rather high to justify a recommendation.

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	16g
Type of headshell	Universal detachable
Headshell mass (inc screws)	11g
Geometric accuracy	very good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	fairly good
Ease of use	above average
Friction lateral/vertical (typical)	<10mg/<15mg
Bias comp: type/force rim/centre (1.5g ell set)	weighted lever/ 150mg/300mg
Cueing: drift/8mm ascent/8mm descent	negligible
Downforce calibration error 1g/2g	-0.1g/-0.05g
Amount of damping	none
Arm resonances	average
Subjective sound quality	above average (good)
Motor recommended	TD160 etc
Estimated typical purchase price	£160 (£135)

Above: alloy



Arm resonances (compared to cartridge resonances, dotted). Above: carbon fibre

NEVER FORGET YOU HAVE A CHOICE

Not that it's easy. Trying to choose the hi-fi that's right for you can be very confusing.

Take turntables, for example. A recent issue of 'What Hi-Fi' listed a total of 115 different models costing more than £100. Some good and some, regrettably, not so good.

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STD 305D

RECOMMENDED

STD, CW & J Walker Ltd., Brentwood, Red Lane, Frodsham, Warrington, WA6 6RA. 0928 33326

The two versions available are essentially the same, except with regards to their motor type, the *Electronic* being a belt driven deck, using a small servo type motor, the drive circuitry incorporating a three digit speed display and 'touch' pads for on/off and speed selection. Unfortunately, the latter were located beneath the arm and cartridge once these had been fitted! Fine speed control to a reasonable +/−0.3% was possible for 78, 45 and 33⅓ rpm, its accuracy limited by the three figure display. The alternative version used a simple synchronous mains motor similar to that in the Thorens *TD160,* with the 'electronic' facilities omitted. Both types were fitted with a balanced and reinforced coil spring suspended sub chassis, the thick machined platter having a permanently bonded good quality mat, made in Japan by the Lux Corporation.

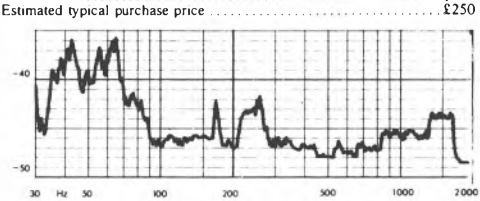
Faults noted on the review sample, this being the *Electronic* version, included an undersized record spindle, a speed servo problem, and moderate motor breakthrough, plus transformer hum; however the manufacturers have assured us that all these problems will have been taken care of by the time this edition goes to press.

The data chart shows the improvement with the second sample on w & f, drift, and rumble. Acoustic breakthrough was outstanding, shock resistance fine, and feedback good.

Classed as good on sound quality grounds, a clean, low coloration result was obtained with the second sample, in conjunction with a good arm. A slight loss of 'low bass' was however noted, and the final degree of depth on stereo information was a trifle suppressed.

On the assumption that the *Synchronous* STD, which was not tested, should prove equal or better than the *Electronic* on rumble as well as wow and flutter, this version can be recommended as one of the few suspended sub-chassis models available. By comparison, enthusiasm for the *Electronic* is muted, especially in view of its higher price; but if the 78rpm facility is important, it could prove worth the extra.

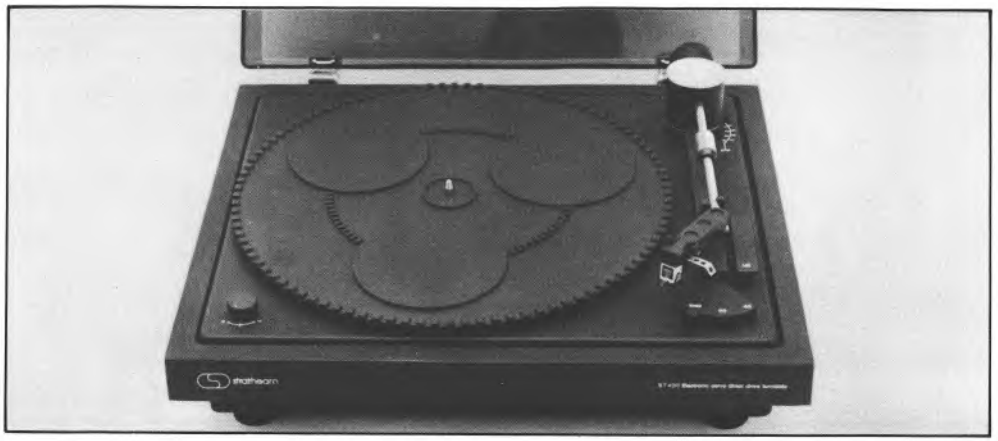
GENERAL DATA	Motor Unit
Type	manual belt drive
Platter mass/damping	1.55kg/good
Finish and engineering	good
Type of mains leads	2 core
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.12% (retest)
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.15% retest/0.1% retest
Speed accuracy/drift/variation under load	+ 1% (typical)/ −1.5%/−0.1%
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd L/R)	68dB (see text)
Size/rear clearance for lid	47.4(w) x 37.9(d) x 15.6(h)/6cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good (see text)
Hum Level/Acoustic feedback	good/good
Vibration or shock sensitivity	very good
Ease of use	adequate
Estimated typical purchase price	£250



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Strathearn ST400

Strathearn, Strathearn Audio Ltd., Kennedy Way,
Belfast B12. 0232 623231



Features facilities setting up and use

This model was reviewed in the 'stop press' section of the last edition, under its previous guise as an *STM4*. Since then it has undergone several changes; for example, it now comes in an all black finish, with a Ortofon cartridge ready fitted instead of the Shure *M75ED*.

A budget direct drive design, the skeleton motor had a rather one sided driving arrangement in the form of steel 'claws' which act on a strip of 'plastic' magnets attached to the inside of a smaller steel rim under the platter when fed with an ergising current. An inverted thrust ball main bearing was used, and despite the low price some 'electronic' content was present, including fine speed control.

This deck's predecessor was criticised on several points, some of which remained unaltered with the new model, notably poor arm rigidity at the plastic junction to the cartridge platform, and speed overshoot on off-load recovery; in fact the poor on-load stability of the *STM4* proved even worse with new *ST400*.

Lab performance

Din peak wow and flutter was fairly good but the high linear flutter content of 0.16% was a little worrying. More so, however, was the significant overshoot in the servo control response, which generates dynamic wow unless motor torque is high, and unfortunately the reverse was the case here, the 2% speed drop on a 3g dustbug loading proving severe. Together these two factors virtually guarantee audible wow on program for sensitive listeners, which indeed proved to be the case. Rumble was adequate at –63dB DIN B weighted (see sound quality) while start up (including direction uncertainty) was a little slow at 4 seconds.

Acoustic breakthrough was judged about average with feedback margins quite good and shock resistance average; hum levels were reasonable, even using a moving-coil cartridge.

The resonance data for the arm illustrated the weak headshell junction, resonating at a low 130Hz; however this headshell flexibility offered some damping of the higher modes, the next severe point not occurring until 1.5kHz. Overall the general trend was erratic. Dialed to zero, considerable residual bias was present which confused lateral friction readings, vertical friction being fine. Cueing was good, even if the lever was stiff to operate, with downforce quite accurate, but again bias was double the level required and appeared in the wrong ratio.

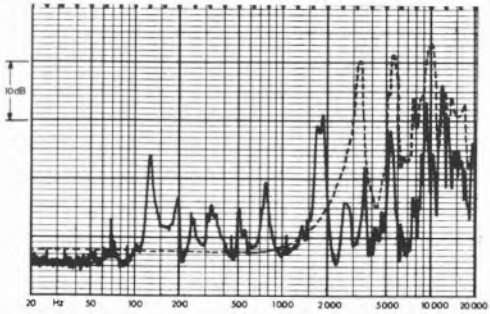
Sound quality

The trace of audible rumble and definitely audible wow both played their part in arriving at the final 'poor' rating. The sound also appeared rather muddled and confused, with just adequate stereo depth and image precision.

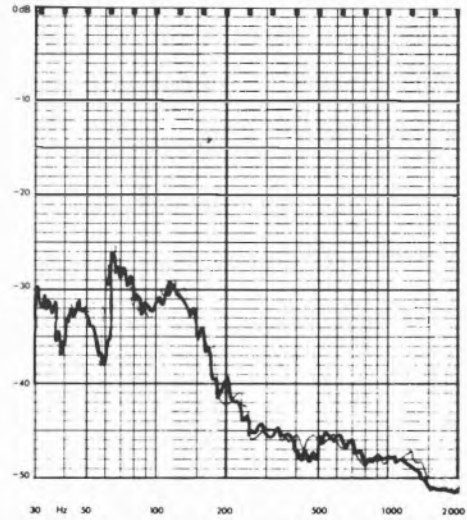
Conclusion

The conclusions are harsh but are mitigated to some extent by the low price of the unit. However, if viewed as a whole, the performance of the *ST400* cannot really be described as in the hi-fi league.

GENERAL DATA	Integrated Player
Motor Section	
Type	direct drive
Platter mass/damping	1.4kg/adequate
Finish and engineering	good
Type of mains/connecting leads	two core/combined earth/phonos
Speed options/variable?	33⅓, 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.1%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.12%/0.16%
Speed accuracy/drift/variation under load	≤0.2%/≤0.2%/2.0%
Rumble (av DIN B wtd L/R)	63/64dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	5.5g
Type of headshell	Fixed
Headshell mass (inc screws)	N/A
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	adequate
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	190mg (inc bias)/20mg
Bias comp: type/force rim/centre (1.5 ell set)	spring/350mg/300mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/3.5secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	37(w) x 32(d) x 14(h)/7cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	poor
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	average
Ease of use	good
Estimated typical purchase price	£50



Arm resonances (compared to cartridge resonances, dotted).

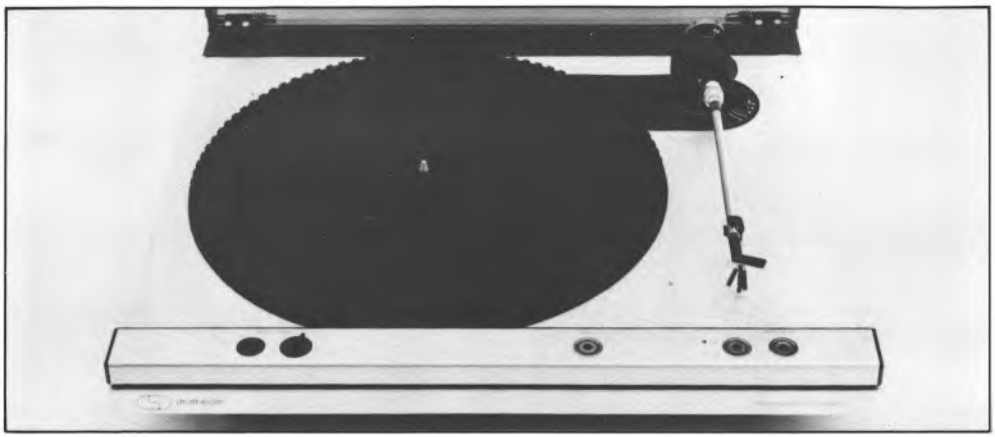


Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Strathearn SM2000

Strathearn, Strathearn Audio Ltd., Kennedy Way, Belfast B12 0232 623231



Features facilities setting up and use

Strathearn have been working hard to improve standards in recent months, and the *SM2000* represents part of the outcome of that effort. A direct drive turntable with fine speed adjustment, the *SM2000* is a development of the previous *SMA2,* now discontinued. A low profile design, it includes the characteristic Strathearn 'bubble' in the lid, which is required to accomodate the arm's arc of travel. The controls were in an accessible position on the upper front section of the plinth outside the lid, and include power operated cueing.

A notable change has been the replacement of the rather flexible plastic headshell of the *SMA2* by an aluminium casting. The turntable is available in two formats, with and without an Ortofon *VMS20ED* cartridge, which was ready fitted and properly aligned. The arm was sufficiently light to accommodate low mass, high compliance cartridges, and the model fitted proved compatible by producing a 10-12Hz subsonic resonance with optimum tracking stability. The deck was fitted with carefully designed flexible anti-shock feet, which were found to impart two distinct resonances to the assembly, one in the lateral plane at 5Hz and the other at 12Hz in the vertical plane — the latter too high but better than nothing.

Lab performance

True to the manufacturer's claims, the *SM2000* delivered very good wow and rumble results; while load stability was fair, overshoot was minimal thus obviating the possibility of dynamic wow. Using the electronic strobe for adjustment, the speed accuracy was only satisfactory at +1.2%, and drift was also a little high (fortunately in the reverse direction!) Including an occasional hiccough, the start up was reasonable at 3 seconds, while measured acoustic breakthrough was about average with quite even distribution. Shock resistance was very good but hum only adequate using a moving coil cartridge, although it proved fine with the less susceptible model supplied. Feedback rated as good, with the lid either up or down.

On charted resonances, the arm was none too promising — perhaps not surprising in view of its very low mass construction. The first break — possibly the counterweight bush — appeared at a low 75Hz, and the grouping from 280Hz to 500Hz was quite severe. Things settled down thereafter and a favourable even energy spread appeared right up to the 20kHz limit (18kHz on the scale). Friction was moderate and cue operation excellent, with biasing close to the correct values and downforce very accurate.

Sound quality

This model achieved an 'average' rating, exhibiting inaudible wow and rumble and a moderate muddling of midband detail. Slight treble brittleness was apparent but with no 'splash'; a degree of softening of bass definition as well as reduced stereo depth were also noted, but the overall effect was pleasant enough.

Conclusion

As one of the very few direct drive models with a genuine low mass arm and generally good per-

RECOMMENDED

formance, the *SM2000* can be recommended. If you like the cartridge offered, so much the better, as the combined package is then also fairly competitively priced; perhaps even more important, the assembly was both compatible and properly aligned.

GENERAL DATA Integrated Player

Motor Section

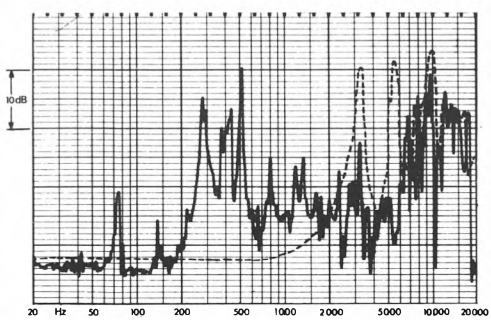
Type	direct drive
Platter mass/damping	1.0kg/very good
Finish and engineering	good
Type of mains/connecting leads	2 core/phonos integral earth
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.06/0.1
Speed accuracy/drift/variation under load	+1.2%/–0.3%/–0.025%
Start up time to audible stabilisation	3secs
Rumble (av DIN B wtd L/R)	72dB

Arm Section

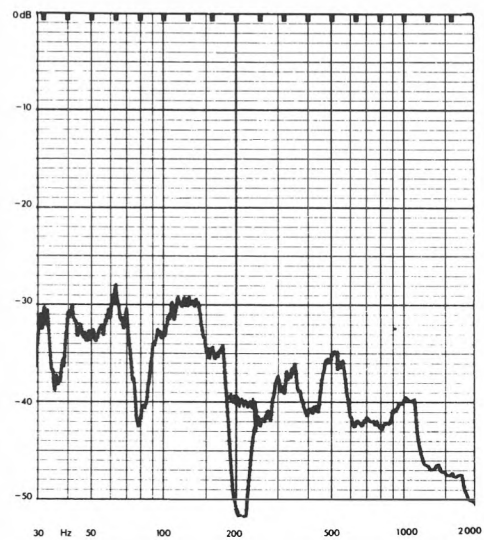
Approximate effective moving mass (excl cart, inc screws)	5.0g
Type of headshell	fixed, detachable arm tube
Headshell mass (inc screws)	N/A
Geometric accuracy	good
Facilities for acjustment	overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	20mg/40mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/250mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.25secs/2.5secs
Downforce calibration error 1g/2g	–0.05g/–0.5g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42(w) x 38.3(d) x 11(h)/3cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	adequate/good
Vibration or shock sensitivity	very good
Ease of use	good
Estimated typical purchase price	£130(exc cart)



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Technics SL220

Technics, National Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR
0753 34522

Features facilities setting up and use

Placed at the budget end of the Technics range, the *SL220* demonstrates that a good performance is still obtainable at a sensible price. The deck shared several features in common with the *SL1400*, namely its angled control panel on the front section of the plinth, as well as its auto return option and variable speed, the latter monitored by means of a mains derived neon strobe. The essential difference between the two decks was in their internal construction and more particularly their drive, which is the case of the *220* is via a belt from a DC motor, with an integral tacho-generator feeding an ic servo control system. The *SL230* is the fully automatic version.

Despite its rather light construction, this model was favoured on test. It was found to be both well engineered and adjusted, and attention had been paid to such aspects as minimising play in the arm bearings, while all facilities operated easily and smoothly. The headshell closely resembled that fitted to the *SL1700*, but in this instance was a plastic rather than an aluminium casting.

Lab performance

Very good rumble and wow results were obtained, together with an acceptably rapid start up, fine speed stability and accuracy, plus negligible overshoot. All in all, this was a very good combination. The light construction and poor environmental isolation were shown by the charted acoustic breakthrough curve, this only fair and deteriorating down to the 30Hz measurement limit. Lower frequency shock resistance was very good and feedback margins reasonable, particularly with the lid down (the recommended play position). Very low hum levels were obtained with all cartridge types.

A pretty average characteristic was shown by the arm resonance curve, the first break occuring at 250Hz with a fairly dissected midrange and a reasonably well maintained energy spread to the highest frequencies. Friction was excellent, bias compensation spot on, and cue fine, except for the slow ascent, while downforce was acceptably accurate. Arm alignment was set using an accessory protractor, although only overhang adjustment was provided by the manufacturers — the cartridge height requirement should therefore comply with that offered by this arm.

Sound quality

The noted acoustic breakthrough results undoubtedly affected sound quality which was rated as 'average' — a nonetheless promising result at this price level, and no worse than that pertaining to its more expensive brothers. This deck was described as a little 'two dimensional' with weakened low bass and lumpy upper bass, while the balance was rather light, with a 'feathery' effect in the treble. Some 'tube' coloration was audible in the mid region, although this was not severe.

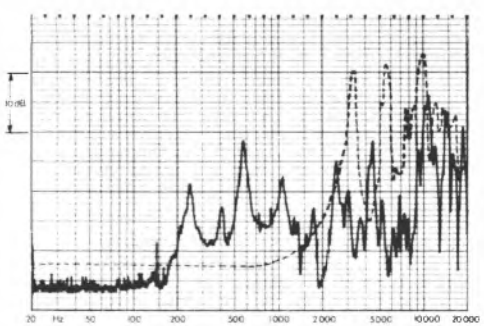
Conclusion

The overall performance undoubtedly qualifies the *SL220* for a recommendation, but as usual, the best results were to be had using low compliance

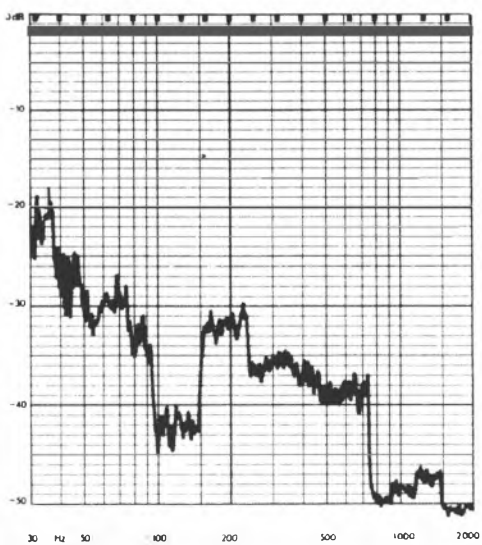
RECOMMENDED

cartridges and a rigid shelf location, well away from the speakers.

GENERAL DATA	Integrated Player
Motor Section	
Type	belt drive
Platter mass/damping	0.7kg/adequate
Finish and engineering	good
Type of mains/connecting leads	2 core/earth + phones
Speed options/variable?	33⅓, 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.08%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.085/0.095
Speed accuracy/drift/variation under load	variable/≤0.05%/≤0.05%
Rumble (av DIN B wtd L/R)	72/74dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	9g
Geometric accuracy	fairly good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	15mg/10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/140mg/200mg
Cueing: drift/8mm ascent/8mm descent	negligible/4secs/3.5secs
Downforce calibration error 1g/2g	-0.05g/-0.05g
amount of damping	none
System as a whole	
Size/rear clearance for lid	42.9(w) x 37.5(d) x 13.0(h)/4.6cm
Typical acoustic breakthrough and resonances	fair
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	excellent/fairly good
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£80



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Technics SL 3200

Features facilities setting up and use

Once again, this Technics product review actually does double duty, with the semi auto *SL3200* here tested identical in all other respects to its fully automatic brother, the *SL3300*. Brand similarity was also demonstrated in the styling, the basic appearance of the *3200* closely resembling that of the cheaper *SL220*, with the same front access control panel. The arm fitted to both models was also virtually identical, save for the fact that the *SL3200* was equipped with an aluminium headshell.

A relatively inexpensive direct drive model, certain steps have clearly been taken to increase total mass and thus improve feedback, notably by the inclusion of a heavy mineral loaded bottom cover (the plinth moulding itself being plastic rather than metal.) Fairly soft rubber feet were fitted, giving a rather high 8Hz resonance in the horizontal plane, but little freedom of movement was exhibited in the vertical plane. Engineering was fairly good, and the finish was to a high standard with all of the controls working well and proving easy to operate. Two speeds were provided, with individual fine control and a mains energised strobe for speed checking against mains frequency; this system is usually highly accurate — often better than 0.1% — its performance only degraded by unusual peak load demands, or in the small hours of the morning when the frequency timing 'catches up' with any unavoidable losses.

Lab performance

Unfortunately, in marked contrast to the cheaper *SL220*, the overall results for the *3200* were actually worse, with rumble only managing a 'good' rating. Indications of possible dynamic wow were present namely an 0.5% overshoot with off-load speed recovery (see sound quality), and although the intrinsic main bearing rumble checked out at −75dB with power disconnected, the driven figure deteriorated to −68dB on the left channel due to pole noise vibration in the motor. Breakthrough was fair except for a strong coupling at 63Hz, while vibration and shock rejection were adequate and feedback suprisingly good.

The arm resonant behaviour was pretty average with the first break at 300Hz and the second at 800Hz, fairly good control exhibited thereafter right up to 20kHz. Friction was very low with negligible bearing play while downforce was accurate and biasing about right in degree, but wrong in ratio. One wonders about bias consistency if these results are compared with those for the *220*. However, cue proved satisfactory in all modes.

Sound quality

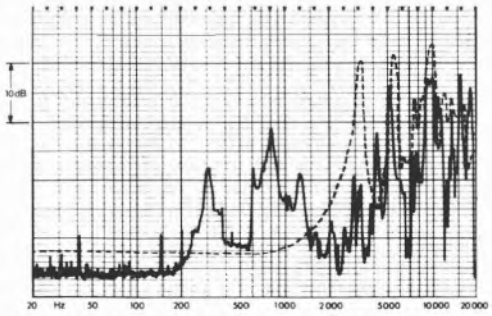
Rated as only 'adequate', in practice the rumble level proved inaudible and dynamic wow was virtually absent, at least to our ears, the high torque undoubtedly proving an asset here. The sound was considered to be rather cold in balance with some mid coloration, nasal and boxy comments were also applied to a slight degree. The upper range was coarsened, stereo a little vague and low bass

deficient.

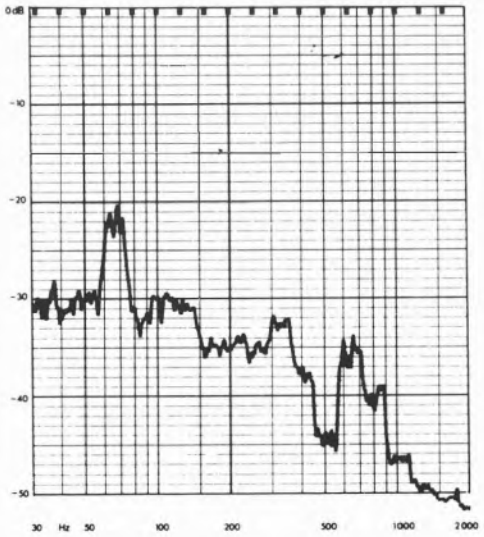
Conclusion

The sound quality was not sufficient to merit a recommendation at the price; however this is certainly not a 'bad' turntable as such, and will benefit from a sensible location.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto return direct drive
Platter mass/damping	1.6kg/good
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.08%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/0.10%
Speed accuracy/drift/variation under load	adjustable/<0.05%/-0.05%
Start up time to audible stabilisation	2.0secs
Rumble (av DIN B wtd L/R)	68/74dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	17.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.0g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	<10mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/185mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.0secs/2.5secs
Downforce calibration error 1g/2g	-0.025g/0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	42.9(w) x 37.5(d) x 13(h)cm/5.0cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	very good/very good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£[illegible]



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Technics SL1700

Technics, National Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR
0753 34522

Features facilities setting up and use

While the inclusion of the auto return *SL1700* represents a retest, its performance is in fact also applicable to three other units in the Technics range, namely the manual *SL1800,* the fully automatic *SL1600* and the *150* motor, the latter permitting the purchaser to fit an arm of his own choice.

Employing an ingenious variation on the basic suspended sub-chassis theme, the advantages of a low suspension frequency were absent as the assembly was too stiff and limited in travel. Excellently engineered, the main plinth consisted of an immaculate metal die-casting, while the motor was an advanced direct drive type controlled from a second order servo incorporated in a single integrated circuit. The apparently inevitable cartridge alignment by overhang measurement was again specified in the instructions; Sony's example should be followed by the other Japanese manufacturers, and card protractors supplied with all decks.

The arm was a conventional type with no damping, geometrical alignment proving quite good, although no tilt or height adjustment was provided. The headshell mass at 10g or so gave this arm a fairly high effective mass, and thus low compliance cartridges are suggested for the best results.

Lab performance

Excellent wow and flutter was recorded, with the rumble almost to the same high standard. Dynamic wow is impossible to generate due to the high torque (1 second start up) and negligible speed overshoot, plus excellent results on loaded and reference speed stability. Acoustic breakthrough was better than average with shock resistance and feedback very good, while hum induction proved more than satisfactory even using a sensitive moving-coil model.

The arm resonances rated a little above average, with the upper range fairly even and the more important lower range showing firm control. The first break occurred at a moderately high 300Hz, while friction levels were low, downforce quite accurate, and cue operation excellent, with biasing fairly close to the required value, at about 25% high.

Sound quality

Rated as 'average', the *SL1700* was described as moderately 'loud' and coloured in the midband, and low on extreme bass energy, with stereo depth and locational precision a little muddled and veiled. The overall balance was a trifle on the dull side and in addition a little coarseness or 'splash' was noted.

Conclusion

As found in the previous issue, the *SL1700 (1600, 1800* and *150)* has done well enough to merit a recommendation, even though the price is a little on the high side. Technics' expertise in motor technology helps it to win through, but nevertheless a rigid shelf is recommended for the best results.

Technics SL1700

RECOMMENDED

GENERAL DATA Integrated Player

Motor Section

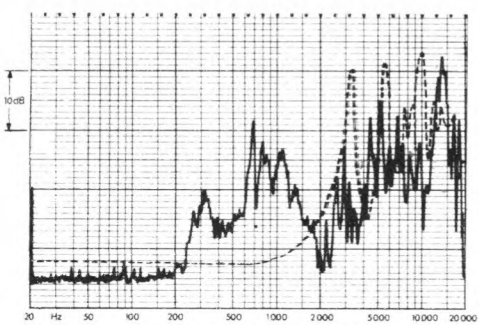
Type	auto return direct drive
Platter mass/damping	1.55kg/good
Finish and engineering	very good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓: 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	<0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.08%/<0.06%
Speed accuracy/drift/variation under load	adjustable/ 0.1%/0
Start up time to audible stabilisation	1 sec
Rumble (av DIN B wtd L/R)	74/73 dB

Arm Section

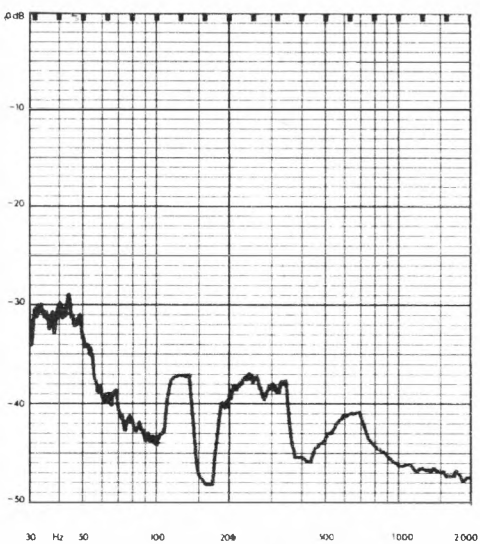
Approximate effective moving mass (excl cart, inc screws)	16g
Type of headshell	universal detachable
Headshell mass (inc screws)	10g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Friction lateral/vertical	20mg/30mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200m /230mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/3.5secs
Downforce calibration error 1g/2g	0.025g/–0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	45.7(w) x 35.6(d) x 12.6(h)/5.2cm
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/excellent
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£155



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Technics SL1400 II

Technics, National Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR
0753 34522

Features facilities setting up and use

Like the *1700*, the *SL1400 II* included here also represents several other models, namely the *150 II* motor unit, the *1500 II* manual player and the *1300 II* fully automatic deck with memo repeat. The *SL1400 II* is an auto return version, and in common with the *1700*, had an inbuilt, limited freedom, spring suspended sub-chassis. The latter comprised a substantial deadened structure in a mineral loaded plastic, but the plinth was formed from a substantial metal pressure die casting.

The arm was similar to that in the *1700*, but came supplied with the same damped headshell as was used in the *EPA100*, possessing an integral sliding overhang scale. Located on the angled front section of the plinth, outside of the lid perimeter, the exquisite metal touch button controls were readily accessible, and in addition to a digital speed display, a second window showed the speed deviation in %. An inbuilt digital frequency synthesiser also permitted selection of a +/−10% variation in 0.1% steps, with quartz lock stability. The speed variation could be reset to zero by a touch control, or alternatively this happened automatically when the deck was switched on.

The overall quality of the engineering was quite excellent, but once more the clumsy overhang method for cartridge alignment was specified, and significant play was also evident in the horiontal arm bearing.

Lab performance

The rumble plus wow and flutter results were exemplary, while start up was rapid at 1.5 seconds (slower than specified), overshoot negligible, and torque high. Quartz precision was observed in terms of the load stability, drift, and accuracy, and measured acoustic breakthrough was fairly good, although the hump at 400Hz was worrying. Hum levels proved fine, this including moving-coil examples, and feedback margins were quite good in the domestic test location, being slightly better with the lid raised. Shock resistance was barely satisfactory, which is a little disappointing at this price.

Some lateral friction was noted — not disastrous though, and possibly a sample fault. Downforce was quite accurate and biasing in the correct ratio if slightly low in amount. Cue was satisfactory, geometry quite good and effective mass on the heavy side at 16g.

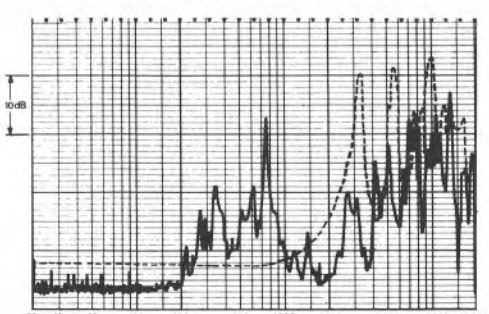
Sound quality

Rated as 'average', wow and rumble were inaudible but a loss of bass definition was noticed, together with an upper bass lift and a corresponding reduction in the lower registers. Some widening of the stereo image was present with a loss of depth — a feeling of imprecision somewhere — but no annoying or unpleasant effects.

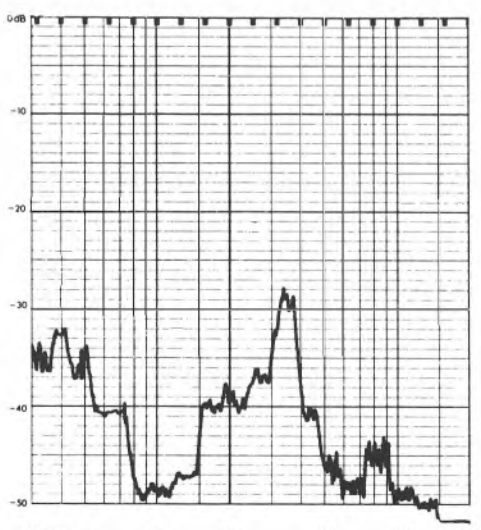
Conclusion

Despite quartz accuracy and fine engineering, the price was high for the resulting sound quality. Rigid shelf mounting will undoubtedly help matters, and the *150 II* motor unit is worthy of recommendation under these circumstances.

GENERAL DATA	Integrated Player
Motor Section	
Type	quartz direct drive
Platter mass/damping	2.55kg/good
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45 rpm/yes, digital display
Wow and flutter (DIN pk wtd $\sigma 2$)	<0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	<0.07/<0.07
Speed accuracy/drift/variation under load	quartz/quartz/0
Start up time to audible stabilisation	1.5secs
Rumble (av DIN B wtd **L/R**)	76/77dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	16g
Geometric accuracy	satisfactory (see text)
Adjustments provided	height, overhang
Finish and engineering	good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	80mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/125mg/165mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/2secs/4secs
Downforce calibration error 1g/2g	0g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45.3(w) x 38.7(d) x 14.5(h)/5cm
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	satisfactory
Ease of use	very good
Estimated typical purchase price	£240



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Technics SL1000 II

Technics, National Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks, SL1 3DR
0753 34522

Features facilities setting up and use

Three separate components are covered by this report, namely the *SH10B3** plinth: the *SP10 II** motor chassis plus power supply; and finally the *EPA100* pickup arm. Supplied as a complete ensemble, the whole is designated *SL1000 II,* its inclusion here representing a retest, as this system was in fact covered in the previous issue of *Choice*. Considering the price level it was a little disappointing to find some minor finish blemishes on the motor top plate as well as significant play in the vertical ruby ball race on the arm; a degree of headshell tilt was also apparent which could not be corrected. Technics were informed of these problems at an early stage in our test procedure, but in fact did not follow up our comments by the time the edition had gone to press. Fortunately at least the bearing play could be cured by adjusting the appropriate setting screws.

The quartz-locked direct drive motor was clearly built to professional standards, and in fact large numbers are in use in broadcasting and recording studios. The heavy plinth, which alone weighed 12g, consisted of a low resonance laminated structure suspended on rubber feet which offered a desirably low 5Hz resonance. The arm employed a damped headshell, with a titanium double layer tube and variable damping. Three speeds were offered, namely 78, 33⅓ and 45 rpm. The unit as a whole was superbly engineered and came provided with comprehensive instructions, although once again, cartridge alignment was by the inaccurate overhang measurement system.

Lab performance

As one should expect at this price, the motor results proved to be at the threshold of measurement, and simply consist of a list of 'excellents' for wow and flutter, rumble, stability, loading, overshoot, start up (¼ second) and torque. However, while acoustic breakthrough was rated as above average it was not outstandiing, particularly at higher frequencies. Thanks to the separate power supply, the hum levels proved very good using all types of cartridge. Feedback was similarly rated, but vibration sensitivity was only just 'good'.

Judged to be above average the response was quite even above 1.5kHz. However early minor breaks occurred at 150Hz and 200Hz, with a further series at 350, 700 and 1200Hz. The 2° odd headshell socket list has already been mentioned and will undoubtedly have affected the subjective performance, particularly with regards to stereo depth and clarity. The other arm parameters were fine with effective mass on the heavy side; even with the damping control, compliances no higher than 20cu are indicated. Bias compensation was about 30% high.

Sound quality

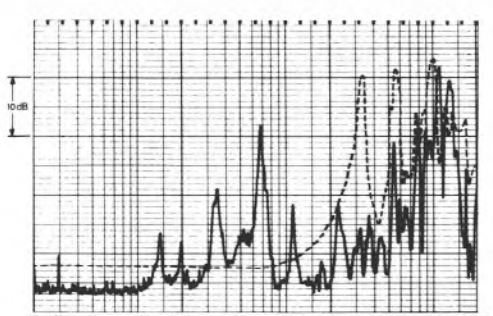
The more critical standards employed in this issue have resulted in a marginal downgrading by comparison with last time; however the 'good' performance rating achieved was still well above average. The arm was considered very good allowing for the shell misalignment, the system as a whole characterised by low coloration, some

'shyness' in the low bass and a 'feathery' quality verging on 'fizz' in the high treble. Marginal stereo positioning and depth loss were also apparent.

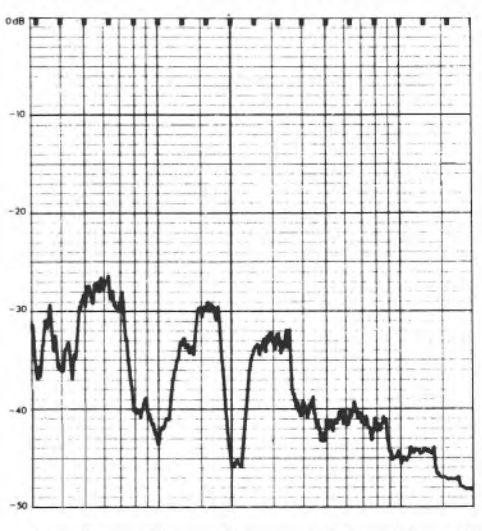
Conclusion

The *SL1000 II* remains a top class turntable despite the odd defect or two, but on the basis of sound quality-versus-price, it does not merit a recommendation. However, used appropriately, the motor section is outstanding in terms of its technical performance.

GENERAL DATA	Integrated Player
Motor Section	
Type	manual quartz direct drive
Platter mass/damping	3.0kg/very good
Finish and engineering	very good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓; 45; 78rpm/no
Wow and flutter (DIN pk wtd σ2)	< 0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.1%/ 0.06%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	0.25secs
Rumble (av DIN B wtd L/R)	78/77dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	16g
Type of headshell	universal detachable
Headshell mass (inc screws)	11g
Geometric accuracy	good
Facilities for adjustment	damping,height,overhang
Finish and engineering	very good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	< 10mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/200mg/280mg
Cueing: drift/8mm ascent/8mm descent	negligible/0.5secs/5secs
Downforce calibration error 1g/2g	-0.025g/-0.1g
Amount of damping	moderate
System as a whole	
Size/rear clearance for lid	56(w) x 46.5(d) x 17(h)/6cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/very good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£1000



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

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Leeds. Tel: 0532 449075

A.T. Labs
191 Chase Side
Enfield, Middx. Tel: 01-363 7981

Thorens TD160BC

Thorens, Metrosound Audio Products Ltd., 4-10 North Road, Islington N.7. 01-507 5141

RECOMMENDED

The *TD160* is currently available in two versions: the standard Thorens motor unit, and an integrated player known as the ATR, which uses a modified motor unit fitted with Hadcock or Maywarearms as standard.This deck is fully set up by the dealer, who will also fit and align a separately purchased cartridge as part of the service. The parallel with the Linn LP12/Grace combination is an interesting one; parity is certainly not claimed, but in both cases, comparable value is offered in respect of the potential sound quality.

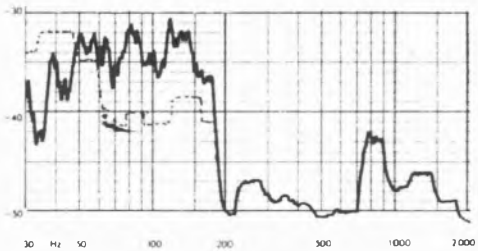
In mechanical terms, the *TD160BC* is a synchronous motor two speed belt drive turntable, with massive main bearing and a die cast balanced outer platter mounted on an effective, low working resonance, suspended sub-chassis. Engineering was to a high standard as the measured data confirmed, and even 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.

GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	2.5kg/good
Finish and engineering	very good
Type of mains leads	2 core
Speed options/variable?	33⅓, 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.11%/0.08%
Speed accuracy/drift/variation under load	+0.6%/none/–0.4%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	73/74dB
Size/rear clearance for lid	43(w) x 34(d) x 15(h)/9.5cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/very good
Vibration of shock sensitivity	very good
Ease of use	straight forward
Estimated typical purchase price	£90



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Thorens TD115

Thorens, Metrosound Audio Products Ltd., 4-10 North Road, Islington N.7. 01-507 5141

Features facilities setting up and use

Replacing the *TD160* and *145* players at an increased cost, the *TD115* represents the auto stop version, with the *TD110* being a manual only model. The coil springs of the now discontinued decks have been supplanted by a new method involving a beryllium-copper flat spring for the vertical sub-chassis freedom, supplemented by a saucer-shaped well accepting a round-ended rubber post, which in conjunction with the spring provides lateral rocking. The design was such that the two suspensions complemented each other and did not interact. However, while the lateral rock frequency was fine at around 5Hz, the system proved to be too stiff vertically, thus resulting in a poor 12Hz resonance which intersected that of the arm/cartridge combination.

The dependable synchronous motor has been replaced by a DC type under servo control, thus facilitating the incorporation of variable speeds and a stroboscope. The mat had been restyled (previously criticised for minimal record contact) but had not been significantly improved. In addition, the integral strobe/die-cast platter was less than half the mass of the previous models, the main bearing also scaled down in proportion. A new version of the *Isotrack* arm had been incorporated, possessing a higher rigidity tube socket with threaded takeup, and an improved cartridge mounting facility.

Lab performance

Speed drift was rather high at +0.5% over 30 minutes, but accuracy, load variation, and steady state wow and flutter were all very good. Start up was definitely slow at 5 seconds, this partly due to a slow delayed servo overshoot as correct speed was attained; this also occurred on load recovery and might generate an audible effect (see sound quality). Rumble was excellent — better than the master acetate test disc used for the previous issue, while acoustic breakthrough was above average, but not as good as for the *160*, which was some 5dB superior at all frequencies. Feedback was rated as good, but shock resistance and hum induction were both a step improved, being classed as very good.

The counterweight calibration was faulty on the two samples tried, due to poor plastic threading (no comment has yet been received from the importers.) Arm friction was very low, but the deliberately sprung shock protected pivots raised doubts about overall rigidity. The frictionless magnetic bias was close to the optimum, the cueing worked well bar a mild lateral drift, and geometrical accuracy was fine despite the absence of an alignment protractor. However, in apparent contradiction of the manufacturer's claims, arm resonances were not particularly good, with the first (albeit well-controlled) appearing at a typical 210Hz, followed rapidly by 2 more at 400 and 500Hz. Subsequently the behavior was improved up to 5kHz, above which point the rather severe sequence of large amplitude resonances appeared. Effective mass was low at 7g and is thus suited to medium-high compliance cartridges.

RECOMMENDED

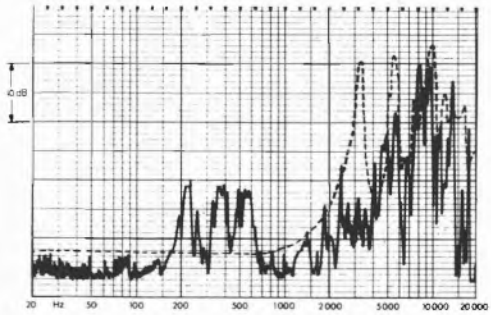
Sound quality

Somewhat disappointing at 'average' overall, an indication of slow pitch wavering rather than true wow was audible on critical programme, and a trace of motor whine could also be heard if the deck was located close to the listener. A loss of low frequency definition was apparent, together with some mid veiling and reduced depth impression. The high frequency range exhibited a slurring of transients and emphasis of tracing distortion, and this is almost certainly linked to the dissected treble range visible on the graph.

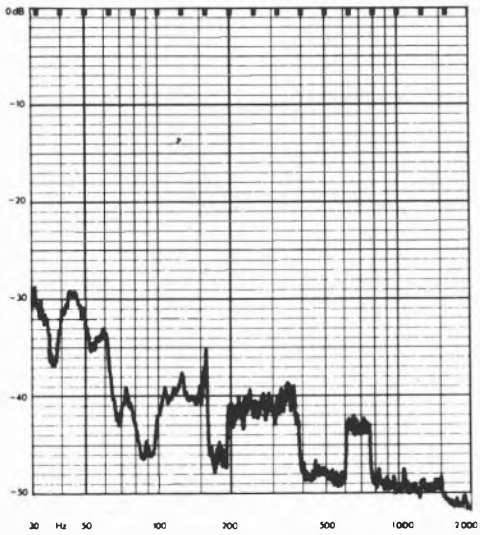
Conclusion

Despite the various problems noted, the overall level of performance attained at the price was sufficient for a recommendation to be made.

GENERAL DATA	Integrated Player
Motor Section	
Type	auto return, belt drive
Platter mass/damping	1.3kg/good
Finish and engineering	good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.055%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.12%/0.08%
Speed accuracy/drift/variation under load	+0.1%/+0.5%/0%
Start up time to audible stabilisation	5secs
Rumble (av DIN B wtd L/R)	75/74dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	7g
Type of headshell	special detachable arm 'wand'
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	overhang, tilt, height (by spacers)
Finish and engineering	good
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	<10mg/15mg
Bias comp: type/force rim/centre (1.5g ell set)	magnetic/ 190mg/220mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1sec/3.5secs
Downforce calibration error 1g/2g	random error to 30%
Amount of damping	none
System as a whole	
Size/rear clearance for lid	44.5(w) x 35.8(d) x 13.3(h)/none required
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good
Vibration or shock sensitivity	very good
Ease of use	very good
Estimated typical purchase price	£135



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Thorens TD126 III

Thorens, Metrosound Audio Ltd., 4-10 North Road, Islington N.7. 01-507 5141

Features facilities setting up and use

The *Mark II* version of this large turntable was tested in the last issue, but the deck has been redesigned since then. It is perhaps strange that the new arm used for the *TD115* has not been fitted here, the *126* instead employs a modified version of the established *TP16 Isotrack* detachable tube (unfortunately the fittings are not interchangeable). This *TP16* is actually designated a *TP63,* as there have been changes made to the earlier clumsy cartridge mounting procedure, but in our opinion, this still leaves a lot to be desired, with a pile of spacers and washers needed to install many cartridge models.

The original massive die-cast sub-chassis has been retained, together with the effective coil spring support which offers sufficient freedom in all planes with a 3-4Hz vibration rate. The deck used the same tacho-generator servo motor found in the *115*, with a just audible whine and a slow 1-2 second speed overshoot characteristic. I would have thought that for this class of player a 2nd order servo was essential; 33⅓, 45 and 78 rpm were all provided, with the original reflection-derived mains strobe for checking. The arm board was easily removed from the chassis to aid installation, but the auto stop and isolated touch button cueing facilities of the complete *126* are of course absent on the motor only version, the latter simply possessing an on/off control.

Lab performance

Rumble was exemplary — one of the best in the whole report, thus confirming Thorens claims. Wow and flutter on steady state measured very well, but there still remains some doubt over the servo response under transient conditions, for example, when responding to changes in dynamics, particularly using higher tracking weight cartridges. Drift, as with the *115*, was on the high side for the 30 minute test period, but shock immunity was superb, and feedback and hum levels excellent. Acoustic breakthrough was above average — in fact better than the *115*, especially at low frequencies.

The arm response graph was certainly different from that of the *TP70* arm fitted to the *115*, the first resonance being beneficially higher at 350Hz, although some 10-12dB more severe in amplitude. Similar characteristics were demonstrated to 5kHz, but above this point the *TP63* possessed considerably less high frequency energy. Friction was excellent, bias compensation about right but with the ratio reversed, and downforce excellent, cue operation was fine, and geometry very good.

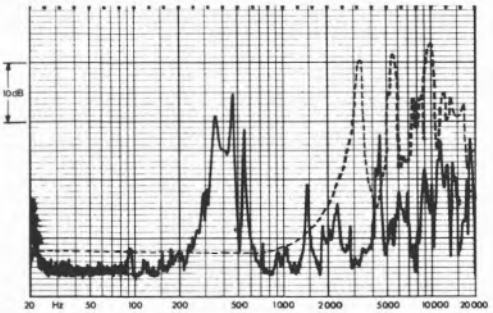
Sound quality

Rated as 'good' overall for both the complete *126* system as well as the separate motor unit, the former sounded quite well balanced with reasonable stereo stability and depth. Bass quality was undoubtedly good, but some hardened forwardness was apparent on female vocal passages. The motor unit alone could well partner more expensive arms.

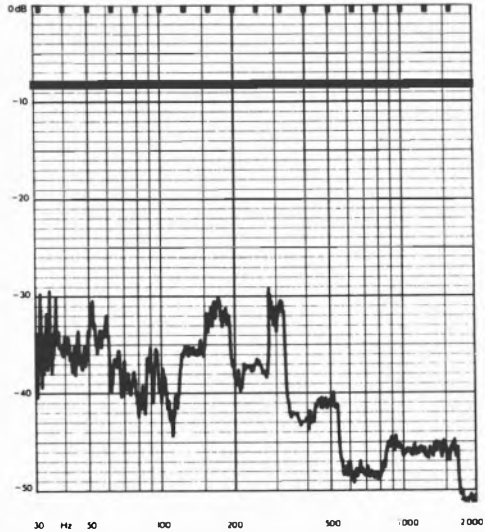
Conclusion

A good mat would provide a significant improvement at minimal extra cost. This matter aside, the *126* nonetheless demonstrated a good standard but with minor reservations still remaining about the servo overshoot — personally I was happier with the older *Mk II* performance in this respect.

GENERAL DATA	Integrated Player
Motor Section	
Type	belt stop belt drive
Platter mass/damping	2.3kg/good
Finish and engineering	good
Type of mains/connecting leads	two core/earth + phonos
Speed options/variable?	33⅓, 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	< 0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-30Hz)	<0.07/<0.06
Speed accuracy/drift/variation under load	adjustable/+0.3%/-0.1%
Start up time to audible stabilisation	2 to 5secs
Rumble (av DIN B wtd L/R)	77/78dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	8g
Type of headshell	special arm detachable
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	height, tilt, overhang
Finish and engineering	very good
Ease of assembly/setting up	fair
Friction lateral/vertical (typical)	< 15mg/< 10mg
Bias comp: type/force rim/centre (1.5g ell set)	magnetic/ 190mg/180mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/1.0secs
Downforce calibration error 1g/2g	0g/0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	50.3(w) x 38.8(d) x 17(h)/none required
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	excellent/excellent
Vibration or shock sensitivity	excellent
Ease of use	very good
Estimated typical purchase price	£260



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Toshiba SRF225

Toshiba (UK) Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey.
0276 62222

Features facilities setting up and use

The least expensive in this line of related Toshiba models, the *225* was a fully automatic belt drive deck costing around £90, supplied ready fitted with a Toshiba *C-290* cartridge. Rather lightweight, the die-cast aluminium platter was powered by a four pole mains synchronous induction motor, with moderately effective flexible decoupling from the main mounting board. The internal mechanics were built to a good standard with the quality of the overall engineering higher than usual for this price level.

Easy to use, the *225* was designed with an array of front-mounted controls which allowed operation with the lid down. These all worked well although the cue lever was a little stiff in action. Toshiba have tried to isolate the deck from the environment using a form of coil spring in the feet, but the total mass suspended was rather low for the spring rate, and the resulting resonance at around 11Hz was too high in frequency. The 0.5m signal leads proved rather short, which restricts the flexibility of location relative to the amplifier. Poorer than average record surface contact resulted from the mat and platter design, which left little plane surface for the record to rest on.

Lab performance

While the high torque ensured a rapid 0.8 second start up and a freedom from speed overshoot, the wow and flutter readings were none too promising and may well be audible on music by many listeners. On measurement, rumble was fairly good, but motor breakthrough was audible on the listening tests. Speed accuracy was very good, as was stability under load, while acoustic breakthrough was considered typically 'average'. Shock immunity was just adequate but both hum and feedback margins were rather better.

Effective mass was estimated in the medium range at 14g, suited to 10-20cu cartridges, although the highish lateral friction measured suggests that tracking below 2g is inadvisable. Bias compensation carried the right ratio but was some 50% higher than required, while the cue and downforce were satisfactory. The arm resonance curve was about average; little comment can be made except to indicate the ubiquitous headshell/socket breakup at 240Hz, and the generally dissected appearance at higher frequencies.

Sound quality

Rated as 'below average', the basically reasonable musical balance was marred by the audible drive defects, namely rumble and wow. If the latter were cured, an upgrading to an 'average' rating would probably result.

Conclusion

Despite offering good facilities and a potentially good sound quality, the measured performance of this model was insufficient for a recommendation.

GENERAL DATA Integrated Player

Motor Section

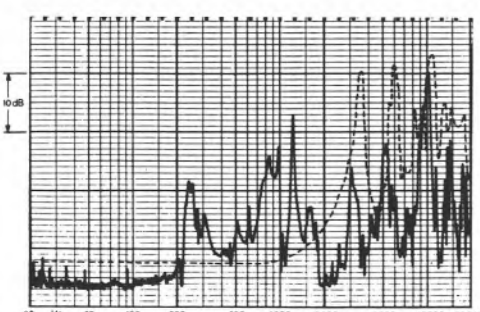
Type	automatic belt drive
Platter mass/damping	0.85kg/poor
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd $\sigma 2$)	0.14%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.22%/0.12%
Speed accuracy/drift/variation under load	synchronous/-0.20%/0.80%
Start up time to audible stabilisation	0.08secs
Rumble (av DIN B wtd L/R)	66/68dB

Arm Section

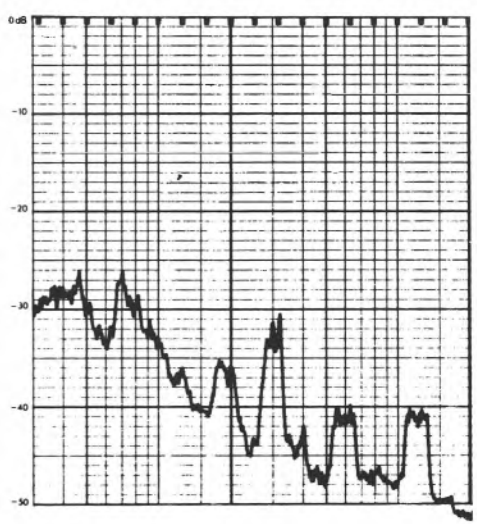
Approximate effective moving mass (excl cart, inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for acjustment	overhang
Finish and engineering	adequate
Ease of assembly	very good
Friction lateral/vertical (typical)	180mg/25mg
Bias comp: type/force rim/centre 1.5g ell set)	spring/230mg/275mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1.5secs/4.0secs
Downforce calibration error 1g/2g	-0.075g/-0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42.2(w) x 35.9(d) x 13.9(h)cm/5.5cm
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£90



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Toshiba SRF 325

Toshiba, Toshiba (U.K.) Ltd., Toshiba House, Frimley Road Frimley, Camberley, Surrey, 0276 62222

Features facilities setting up and use

A slightly more expensive version of the *225*, the *325* incorporated a strobe and fine speed control, this made possible by the replacement of the *225* AC motor by an electronically controlled DC type having a tacho-generator servo system to maintain constant speed.

Again a fully automatic deck, in common with the other two Toshibas, the *325* incorporated an infinite repeat function, whereby the deck will continue replaying the same record indefinitely until either the disc wears out, or the user disengages it! Coil spring feet were fitted, but in this case the resonance was rather high and overlapped that of the arm/cartridge subsonic range. The same Toshiba cartridge as was fitted to both the *225* and *530* was also installed here, but this sample was unfortunately supplied 2° out of alignment in the lateral plane. In addition, the headshell socket tilted the assembly by 1-2° in the vertical plane, and no provision for tilt readjustment was provided.

Lab performance

Start up was reasonable at 2.3 seconds, the torque available together with the absence of speed overshoot proving quite sufficient to negate the possibility of dynamic wow. The DIN wow and flutter reading was fine at 0.09%, although somewhat high 0.14% linear wow was recorded — poorer than average. Rumble levels were satisfactorily low, but marred by residual motor vibration breakthrough into the plinth, and thence to the arm. Speed stability and accuracy were to a good standard with acoustic breakthrough about average, shock resistance just adequate, and feedback quite good, and as found with the *530*, better with the lid down. Hum levels were not really sufficient to permit the use of a moving-coil cartridge, however.

Arm performance in general parallels that obtained from the *225* and *530*, particularly as regards resonances. On this sample lateral friction proved to be rather high, and biasing some 80% excessive at the 1.5g setting.

Sound quality

Despite mildly audible motor drone breakthrough at realistically high listening levels, the sound quality was judged quite pleasant and thus warranted an 'average' rating — quite good for the price level.

Conclusion

Missing a recommendation by only a small margin, attention to the motor breakthrough plus tighter quality control on the arm friction and bias compensation could improve this model significantly. As with the other Toshibas, best subjective results will accrue from installation on a strong rigid wall-mounted shelf as far distant from the speakers as possible, but preferrably not in a corner.

GENERAL DATA Integrated Player

Motor Section

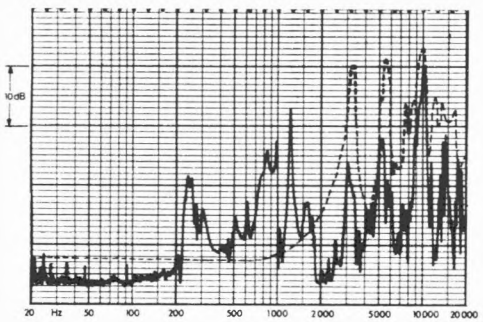
Type	automatic, belt drive
Platter mass/damping	1.25kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.09%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.14%/0.08%
Speed accuracy/drift/variation under load	-0.2% (adjustable) -0.1%/-0.2%
Start up time to audible stabilisation	2.3secs
Rumble (av DIN B wtd L/R)	72/68dB

Arm Section

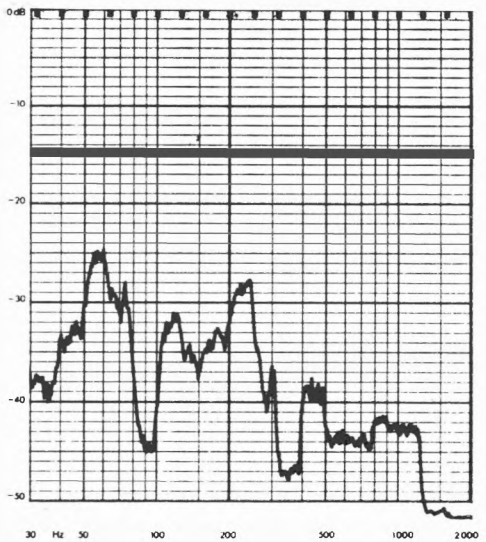
Approximate effective moving mass (excl cart, inc screws)	14g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.0g
Geometric accuracy	adequate
Facilities for adjustment	overhang
Finish and engineering	fair
Ease of assembly	very good
Friction lateral/vertical (typical)	160mg/25mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/270mg/300mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1.0secs/3.5secs
Downforce calibration error 1g/2g	-0.075g/-0.1g
Amount of damping	none

System as a whole

Size/rear clearance for lid	42.2(w) x 36(d) x 14(h)cm/4.6cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	adequate
Ease of use	very good
Estimated typical purchase price	£100



Arm resonances (compared to cartridge resonances, dotted).

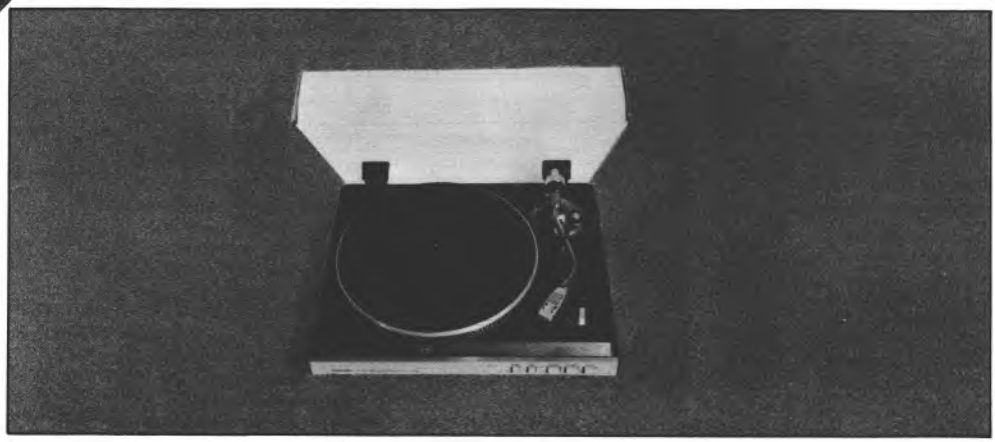


Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

RECOMMENDED

Toshiba SRF 530

Toshiba (UK) Ltd., Toshiba House, Frimley Road, Frimley, Camberley, Surrey.
0276 62222



Features facilities setting up and use

While the *530* was the most expensive of the Toshiba models reviewed, its price of around £120.00 is in fact quite low for a fully automatic direct drive model with cartridge included. In this model range, total mass appeared to increase in proportion to the rising price, thus tending to impart the better feedback properties to the *530*, the heaviest Toshiba of the three decks reviewed. Concealed coil spring feet were fitted to the plinth, giving fair vertical plane freedom albeit with a rather high 11Hz vibration frequency. Lateral freedom of movement was however restricted and hence shock isolation was not optimised.

The general configuration of the front-mounted controls was similar to that for the other two models, with engineering quality to quite a high standard. The motor is of the Toshiba's own design — a low profile type with a flat ceramic magnet rotor, and self-supporting flat overlapping windings with a clear adhesive binding. The headshell proved to be of average weight at 8g inclusive, resulting in a medium rating for effective mass which is best suited to cartridge compliances in the 10-20cu range. The friction was low enough to consider 1.25-2g tracking forces, if the cartridge will permit this.

Lab performance

While the loaded speed stability was just adequate, the low level of overshoot generated on recovery should ensure an absence of dynamic wow (see sound quality). Both wow and flutter and rumble measurements gave very good results, while start up was fairly quick at 1.8 seconds, but hum levels were barely satisfactory using a moving-coil cartridge, and conventional types are thus recommended. Feedback and shock resistance were quite good, the former some 10dB worse with the lid raised. As mentioned above, acoustic feedback proved superior to its smaller brothers, and is probably a little better than average in this respect.

Friction was reasonable in both planes, and cue operation excellent, with downforce quite accurate and bias compensation in the right ratio, if some 40% high. Geometrical alignment was good, although only adjustment for overhang was available via a gauge rather than the preferred protractor. Arm resonance behaviour was classed as 'average' and closely paralleled that of the other two models — essentially the same arm was fitted to all three.

Sound quality

With inaudible wow and rumble, and a pleasant overall quality (lid down), the *SRF530* was rated as 'above average'. The usual slight loss of low bass was noted while the midrange was both a trifle 'loud' and forward, with some veiling of depth and detail. Nevertheless a satisfactory balance was achieved.

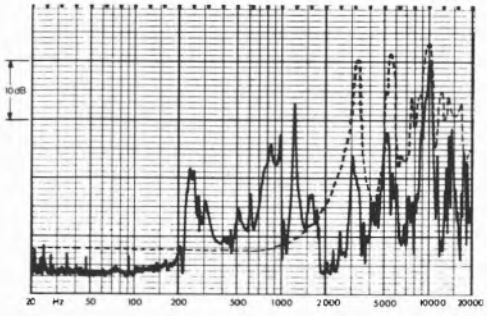
Conclusion

With its fully auto facilities, pleasant sound quality and supplied cartridge (the latter not to be taken too seriously at this price level by a hi fi

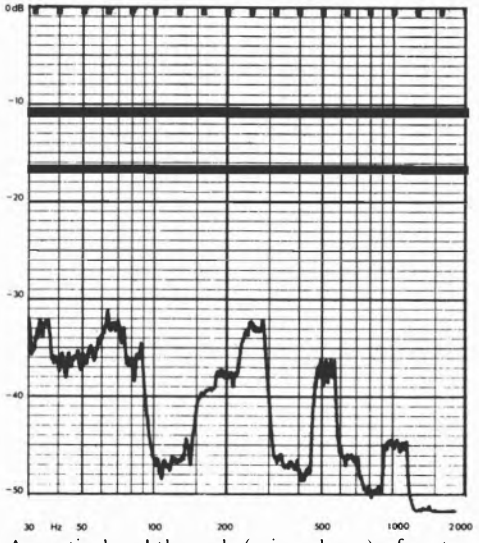
RECOMMENDED

enthusiast), the *SR-F530* can be recommended.

GENERAL DATA	Integrated Player
Motor Section	
Type	automatic direct drive
Platter mass/damping	1.25kg/fairly good
Finish and engineering	very good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.065%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.082%/0.09%
Speed accuracy/drift/variation under load	adjustable/< 0.05%/-0.5%
Start up time to audible stabilisation	1.8secs
Rumble (av DIN B wtd L/R)	70/75dB
Arm Section	
Approximate effective moving mass (excl cart. inc screws)	14.0g
Type of headshell	universal detachable
Headshell mass (inc screws)	8.0g
Geometric accuracy	good
Facilities for adjustment	overhang
Finish and engineering	good
Ease of assembly/setting up	very good
Friction lateral/vertical (typical)	50mg/10mg
Bias comp: type/force rim/centre	spring/210mg/230mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.0secs/2.5secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	42.2(w) x 36(d) x 13.8(h)/5.3cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	satisfactory/good
Vibration or shock sensitivity	good
Ease of use	very good
Estimated typical purchase price	£120



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Trio KD 1033 B

Trio, B. H. Morris & Co. (Radio) Ltd., Precision Centre, Heather Park Drive, Wembley, Middx. HA0 1SU. 01-902 9422

Features facilities setting up and use

The *1033B* in an inexpensive manual belt drive turntable, expected to sell for under £60.00. In their sales literature, Trio have made much of certain features claimed to improve sound quality as well as measured performance; and the following points are specifically cited; a heavy platter; special low friction arm bearings; a pulley bias compensator; special staggered tension springs for superior vibration isolation. Unfortunately the cumulative benefits of these features were not verifiable, although under test the following points did emerge. The platter was in fact relatively light in weight; lateral arm friction was high (possibly a sample fault), and no pulley was present on the bias compensator — rather the weighted thread hangs directly on a small diameter guide wire. Shock isolation was rated as adequate and acoustic breakthrough a little below average — rather conflicting with the claims made for the suspension isolation.

Such carping aside, the unit employed a four pole synchronous/induction motor coupled by a precision belt to the pressure die-cast platter. The arm was a conventional detachable headshell version of 15g effective mass, best suited to low 8-15cu compliance cartridges tracking at 1.5-3g. A poor cartridge alignment gauge was supplied — a protractor is to be preferred.

Lab performance

Wow and flutter was classed as only adequate mainly due to the close on 0.2% of linear peak wow, the DIN peak weighted figure alone being quite reasonable at 0.1%. The player ran a significant 1% fast as well as slowing 0.4% on load, the latter potentially just audible with large program dynamic changes using a high tracking-force cartridge. Rumble was classed as satisfactory, the relatively good DIN B figure marred by some motor vibration breakthrough heard on the subjective test. Acoustic feedback was quite good, but shock resistance only just adequate.

150mg of lateral arm friction was noted, which if typical makes it inadvisable to track at much below a 2g downforce. Vertical friction was however fine, downforce accurate, and cue operation good. The correct ratio of bias compensation existed although some 40% higher than required, with some additional lateral friction generated by thread/guide stiction. The arm resonance curve rated as average with the first serious mode present at 300Hz, while from 1-5kHz the behaviour was fairly stable, becoming more erratic above this point. Energy levels were however maintained to 20kHz.

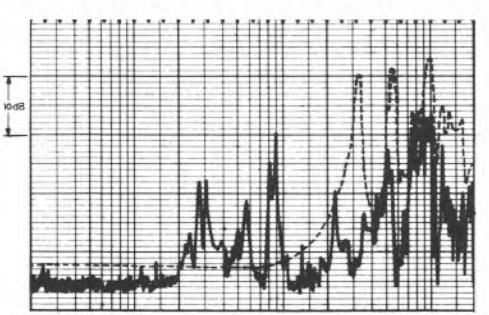
Sound quality

Rated as 'adequate', a 200Hz or so motor drone was audible at high listening levels. The midrange showed some coloration, notably a hardened nasal quality with a coarsening of higher frequencies, while mid detail and stereo depth were veiled, and the bass register also appeared less even than average.

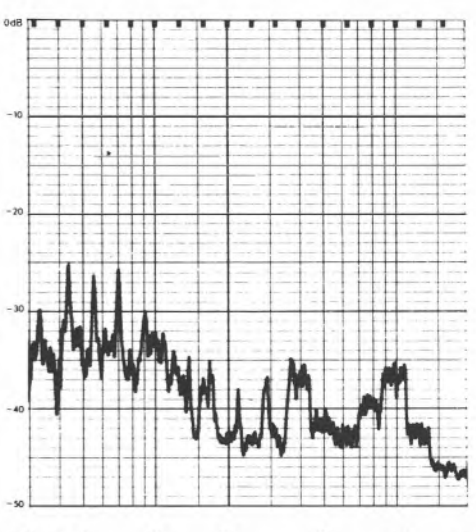
Conclusion

Despite the low price, the sound quality of this model does not really warrant a recommendation.

GENERAL DATA	Integrated Player
Motor Section	
Type	manual belt drive
Platter mass/damping	1.25kg/good
Finish and engineering	fairly good
Type of mains/connecting leads	three core/earth + phonos
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	0.1%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.18%/0.08%
Speed accuracy/drift/variation under load	+1%/synchronous/-0.4%
Start up time to audible stabilisation	0.75secs
Rumble (av DIN B wtd L/R)	68/69dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	8g
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	satisfactory
Ease of assembly	fairly good
Friction lateral/vertical (typical)	150mg/10-15mg
Bias comp: type/force rim/centre (1.5g ell set)	thread and weight 220mg/280mg
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/3secs
Downforce calibration error 1g/2g	-0.025g/0g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45.9(w) x 36(d) x 14.5(h)/5.4cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	adequate
Hum level/Acoustic feedback	adequate/good
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£55



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Trio KD 750

Trio, B. H. Morris & Co. (Radio) Ltd., Precision Centre, Heather Park Drive, Wembley, Middx. HA0 1SU. 01-902 9422

Features facilities setting up and use

The massively built *KD550* assessed in the previous issue has been largely superceded by the new *KD750.* Priced at around £500, one would expect an exemplary performance and perhaps numerous facilities; certainly the latter was not the case, as this is essentially a manual direct drive deck with two fixed speeds, quartz controlled. A redundant frequency-locked strobe was also included, with electronic brake which aids the change from 45 to 33⅓ rpm and reduces the stopping time.

Substantially constructed, the unit exhibited a superb dark walnut mirror-finish veneer and weighted a considerable 17.5kg, but it was strange to find that very little attention had been paid to environmental isolation. The fairly rigid so-called insular feet gave little freedom of movement to the plinth structure, with an estimated suspension resonance as high as 20Hz. The arm was packed separately — a simple matter to install it, although the overhang method of cartridge alignment was again specified.

Despite the use of magnesium for the headshell, it weighed a considerable 11g with the fixing screws and including the Litz type connecting wires. While height and overhang adjustments were present, headshell tilt was omitted, suprising at this price level. Two minor faults were present — moderately high horizontal arm friction and an intermittent servo fault on 45 rpm, when the phase lock failed and the servo 'hunted' for the correct speed (this condition could continue until the motor was switched off; the importers have yet to comment.)

Lab performance

Wow and flutter was excellent, as was rumble except when the servo fault was present on 45rpm. Superb quartz accuracy holds, while start up was reasonably quick and speed overshoot negligible. Measured acoustic breakthrough was somewhat better than average at low frequencies, but deteriorated significantly above 500Hz which is in the sensitive midrange region. Shock resistance, feedback and hum levels were just 'good'.

The highish lateral friction has already been noted — not really disastrous though. Downforce was reasonably accurate, biasing about right but with no rim/centre variation, and the cueing was quite satisfactory accounting for a fairly slow ascent. Effective mass at 15g suggests that low to medium compliance cartridges are thus recommended (ie 10-20cu). The arm resonance curve was rated as 'average', the whole frequency range being rather dissected above 2.5kHz. The reasonably controlled first break appeared at 330Hz (ignore the spike at 32Hz, this is a noise effect).

Sound quality

It was disappointing to find that the sound quality for such a costly player rated as only just 'above average'. Low bass was supressed a little, whilst the midrange showed some nasal coloration noticeable on vocal passages. A veiling of stereo depth and detail was also apparent with the higher frequency range considered somewhat hard.

Conclusion

Price-v-performance as described above prevents inclusion in the recommended category despite the system's good overall performance.

GENERAL DATA Integrated Player

Motor Section

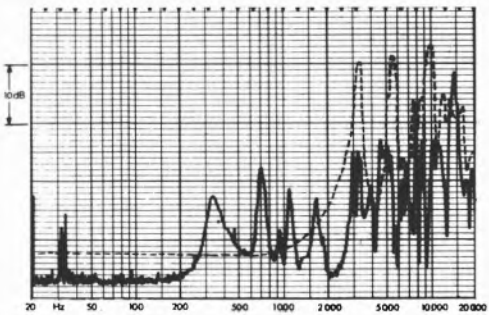
Type	manual quartz direct drive
Platter mass/damping	3.2kg/very good
Finish and engineering	excellent
Type of mains/connecting leads	2 core/earth + phono
Speed options/variable?	33⅓; 45rpm/no
Wow and flutter (DIN pk wtd σ2)	<0.05%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	<0.06%/<0.07%
Speed accuracy/drift/variation under load	quartz/0/0
Start up time to audible stabilisation	2.0secs
Rumble (av DIN B wtd L/R)	76/75dB

Arm Section

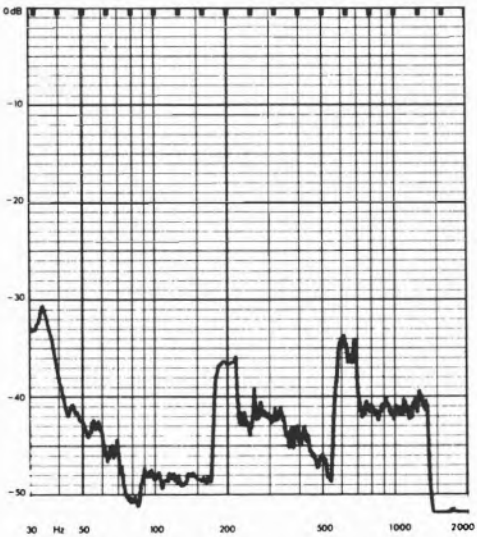
Approximate effective moving mass (excl cart, inc screws)	15g
Type of headshell	universal detachable
Headshell mass (inc screws)	10.0g
Geometric accuracy	very good
Facilities for adjustment	height, overhang
Finish and engineering	good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	80mg/<10mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/185mg/185mg
Cueing: drift/8mm ascent/8mm descent	negligible/2.5secs/3.5secs
Downforce calibration error 1g/2g	+0.10g/+0.15g
Amount of damping	none

System as a whole

Size/rear clearance for lid	49.4(w) x 42(d) x 16.9(h)/4.2cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	above average
Hum level/Acoustic feedback	good/good
Vibration or shock sensitivity	good
Ease of use	good
Estimated typical purchase price	£500



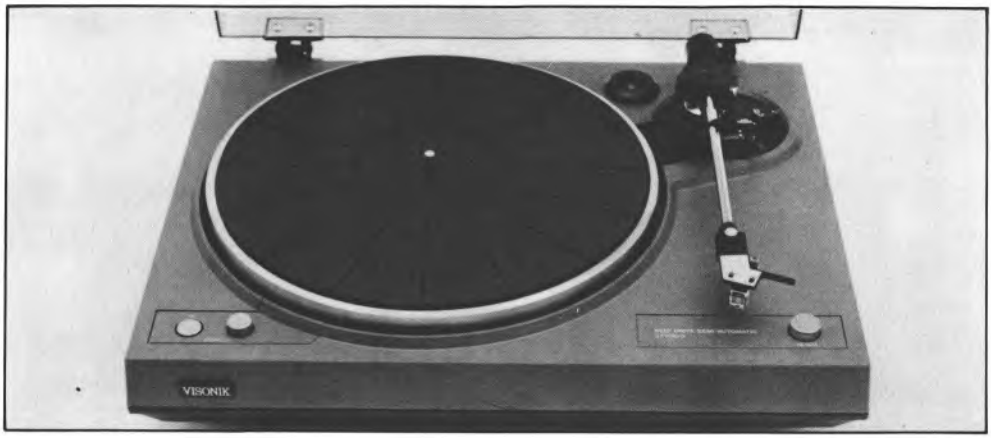
Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Visonik VT 3300

Visonik, Uher Ltd., 28 Spencer Street, St. Albans, Herts, AL3 5EG. 0727 30236



Features facilities setting up and use

The two German designed Visonik decks reviewed are distributed in this country by a division of the company responsible for Uher products. Examination reveals that the manufacturer is C.E.C. of Japan. Essentially, both decks possessed a similar basic form and appearance with the same low mass arm, but mechanical differences were apparent.

The *3300* was an auto return belt drive model fitted with a synchronous/induction motor, a light, spring suspended sub-chassis being incorporated with a fair 6Hz vibration resonance. The low arm mass in conjunction with a sensible choice of low-to-medium compliance cartridge should ensure that the arm/cartridge resonant frequency is well above this frequency. Compromises were apparent with respect to rigidity in order to reduce mass, the plastic detachable headshell with special socket system proving to be rather flimsy. Considerable decoupling was used on the counterweight. An Ortofon cartridge comes ready fitted and well aligned; in this instance a *F150 II* spherical-tipped model. Engineering was fairly good although noticeable play existed in the vertical plane arm bearings, and some platter runout was also observed.

Lab performance

Both wow and flutter and rumble were classed as satisfactory which cannot be considered a particularly good achievement in the context of this report; in fact the 0.14% DIN peak wow reading is potentially audible by the more pitch sensitive user. Speed accuracy, stability, and load variation were similarly rated, while acoustic breakthrough was well below average, especially at 300Hz and below 50Hz. Hum induction was not sufficiently low for a moving-coil, but gave no problems with the supplied model, while feedback was rated as fairly good, the dominant frequency at 30-40Hz being visible on the breakthrough graph. Shock immunity was poor.

Just acceptable friction values were recorded, although cue operation was satisfactory, bias compensation pretty good, and downforce reasonably accurate. Effective mass was quite low at 7g, making for a good match with medium compliance cartridges, 12-25 cu. The arm resonances were not considered favourable, with the first break appearing at a rather low frequency and the general characteristic rather uneven and dissected.

Sound quality

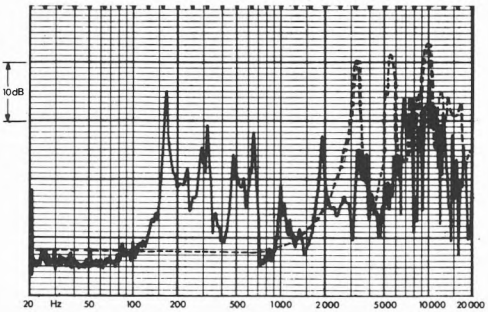
Despite the relatively poor DIN B rumble figure, motor rumble proved virtually inaudible on the listening test, while wow proved only just audible with accurately centred records. The overall effect was not unpleasant, although the treble range sounded dull with slurred sibilants and transients; stereo imaging was a little wide with depth masking, while low bass was reduced in impact, upper bass was softened and not very clear.

Conclusion

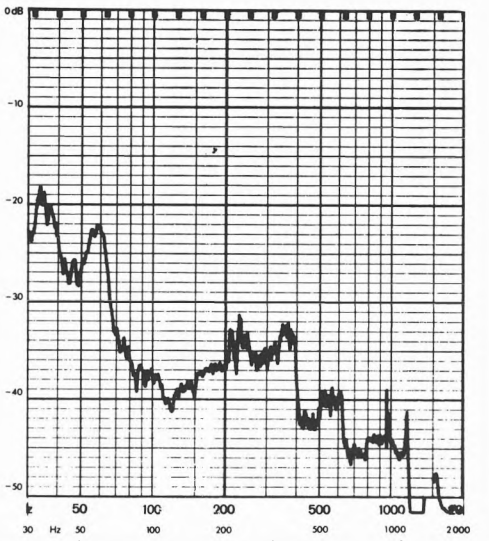
Although reasonable in many respects, the

VT3300's overall performance nevertheless does not merit a recommendation.

GENERAL DATA	Integrated Player
Motor Section	
Type	belt drive
Platter mass/damping	0.75g/adequate
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/none
Wow and flutter (DIN pk wtd σ2)	0.14%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.1/0.08
Speed accuracy/drift/variation under load	+0.5%/N/A/–0.2%
Start up time to audible stabilisation	0.9secs
Rumble (av DIN B wtd L/R)	59/60dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	7.0g
Type of headshell	detachable; special
Headshell mass (inc screws)	5.0g
Geometric accuracy	good
Facilities for adjustment	tilt, overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	100mg/65mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/130mg/200mg
Cueing: drift/8mm ascent/8mm descent	satisfactory/1.5secs/3.5secs
Downforce calibration error 1g/2g	–0.05g/–0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45(w) x 36.2(d) x 13.3(h)/4.2cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	poor
Ease of use	good
Estimated typical purchase price	£80



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Visonik VT 5300

Visonik, Uher Ltd., 28 Spencer Street, St. Albans,
Herts. AL3 5EG. 0727 30236

Features facilities setting up and use

Broadly similar to the *3300*, the synchronous motor of the latter is here replaced by a dc servo type, which allowed the inclusion of a single fine speed control common to both 33⅓ and 45 rpm, as well as a mains frequency illuminated strobe. The platter mass was increased to a nonetheless still light 1kg (that for the 330 weighed only 0.75kg.) The same moderately effective suspended sub-chassis was fitted here as in the *3300*; similarly the auto return mechanism for the arm was common to both models.

The main design weakness concerned the linking of the sub-chassis to the plinth via a fairly rigid acuating rod, the latter coupled to the reject button. Theoretically, this short circuited at least some of the filter decoupling function built into the suspended sub-chassis system. As with the other Visonik, the deck came ready supplied with a fitted Ortofon *F150 II* cartridge.

Lab performance

A mild servo weakness seemed present, producing a rather high linear wow figure of 0.2%, and it was also possible to excite some overshoot. This, together with the only fair loaded speed stability, suggested that dynamic wow was likely to be audible (see sound quality). In contrast, the rumble showed a 10dB improvement over the figure measured for the less expensive model, while start up was fair at 2.5 seconds. Acoustic feedback was fairly good, shock resistance just adequate, and charted acoustic breakthrough below average.

Acceptable friction levels were recorded, with bias compensation of the right order and downforce calibration accurate. Cue operation was entirely satisfactory. Geometrical accuracy was fine, with overhang and tilt adjustment provided; height or 'rake' correction was suggested by the use of packing in the appropriate end of the cartridge. Arm resonances were judged to be poorer than average due to the lack of rigidity, and predictably paralleled those for the *3300*.

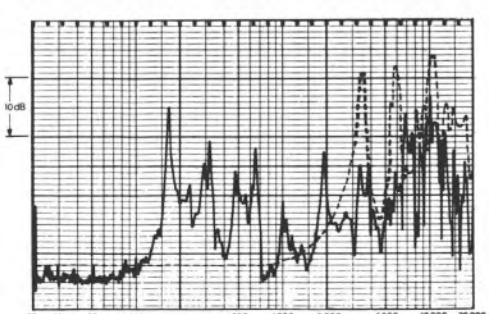
Sound quality

Rated as just 'average', the *5300* was only marginally better than the cheaper *3300*. No rumble could be heard and fortunately the dynamic wow proved almost imperceptible. The two players sounded similar — hardly surprising in view of their comparable construction.

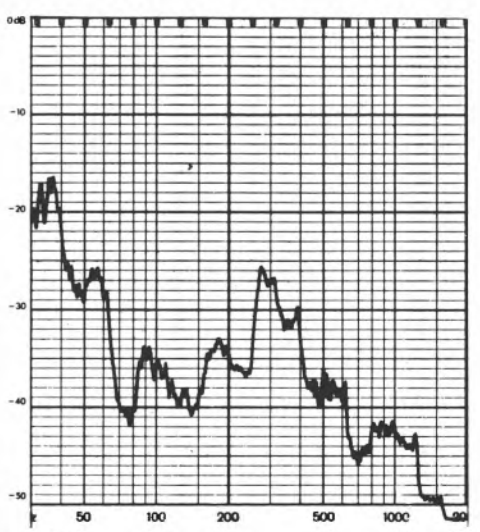
Conclusion

As one of the few integrated turntables with a low effective mass arm, the *VT5300* is a useful market addition which will complement a number of medium and high compliance cartridges. With some tightening of performance and manufacturing standards, a recommendation might well be possible.

GENERAL DATA	Integrated Player
Motor Section	
Type	belt drive
Platter mass/damping	1kg/adequate
Finish and engineering	fairly good
Type of mains/connecting leads	2 core/earth + phonos
Speed options/variable?	33⅓; 45rpm/yes
Wow and flutter (DIN pk wtd σ2)	0.1%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.2/0.09
Speed accuracy/drift/variation under load	0.05%/0/-0.03%
Start up time to audible stabilisation	2.5secs
Rumble (av DIN B wtd L/R)	70dB
Arm Section	
Approximate effective moving mass (excl cart, inc screws)	7.0g
Type of headshell	detachable special
Headshell mass (inc screws)	5.0g
Geometric accuracy	good
Facilities for adjustment	tilt, overhang
Finish and engineering	fairly good
Ease of assembly/setting up	good
Friction lateral/vertical (typical)	80mg/60mg
Bias comp: type/force rim/centre (1.5g ell set)	spring/180mg/250mg
Cueing: drift/8mm ascent/8mm descent	negligible/1sec/4secs
Downforce calibration error 1g/2g	-0.05g/-0.1g
Amount of damping	none
System as a whole	
Size/rear clearance for lid	45(w) x 36.2(d) x 13.3(h)/4.7cm
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/Acoustic feedback	satisfactory/good
Vibration or shock sensitivity	adequate
Ease of use	good
Estimated typical purchase price	£105



Arm resonances (compared to cartridge resonances, dotted).



Acoustic breakthrough (microphony) of system (0dB = approx. 10 cm/s RMS, DIN rumble level, equivalent to loud music output from turntable).

Conclusions

One overwhelming fact to emerge from this report is that although many fairly competant turntables are currently on sale, there are very few 'good' ones. While most work well, play records, and no doubt provide listener satisfaction, the difference between such 'average' players and the really good but not necessarily expensive ones is quite considerable in terms of their sound quality, and would be readily appreciated by most listeners. Compared with a fine SLR camera a turntable seems overpriced, containing as it does only a small fraction of the precision engineering of the former, but at a similar price. It seems a shame that several of the costly features which adorn many decks confer no audible benefit whatsoever — for example quartz lock, automatic facilities, synthesised speed control, pretty strobes, over-engineered dials and expensively finished exteriors. This anomaly is even more striking when it can be shown that an almost first class subjective performance is attainable at quite a modest cost, simply by incorporating the correct engineering features into the design.

There was also some evidence of poor product consistency, particularly in terms of arm bearing quality and adjustment, for example, in product ranges employing essentially the same arm for a number of turntables. Bias compensation, although well documented in the technical press, seemed an almost random or chance factor with many designs, while environmental isolation had been dismally neglected, and cartridge alignment likewise accorded a low priority.

Greater differences were found to exist between high quality pickup arms on ground of coloration than had been previously suspected, these confirmed by the resonance characteristics. It would seem that there is still much work to be done in this field, encompassing the study of complex vibrating structures. One interesting point — in our view, the audible differences apparent between the top class of current flat response moving-coil cartridges are considerably less than those perceived as existing between the various models of top class pickup arm recommended in this report.

While on the subject of arm colorations some interesting observations can be drawn from the 80 or so models tested here. The most significant is simply that the 'universal detachable headshell' is more trouble than it is worth. Its presence inevitably degrades the structural rigidity and resonant behaviour of the arm concerned, and the sooner the *SME III* socket or equivalent is made an industry standard, the better. Even more beneficial would be the widespread abandonment of detachable facilities altogether as there is no real justification for their inclusion, since with the exception of one or two enthusiasts, very few people use more than a single cartridge at any one time. In return, the arm designers might offer full height, tilt and overhang facilities for proper cartridge alignment, at a quite modest cost, together with dramatically increased rigidity and reduced effective mass, a worthwhile improvement in subjective sound quality being in consequence virtually assured.

The previous generation of unnecessarily over-compliant cartridges has left us with a legacy of ultra low mass costly 'component' arms. The pursuit of high compliance for its own sake has been shown to be over-rated, and this is equally true of excessively low mass in tonearms. Clearly if taken to the limit, as has been the case with some manufacturers, rigidity suffers, and in consequence, stereo quality and coloration are impaired. An ideal effective mass for an arm would appear to be around 8g, a figure which would allow great strength to be obtained with the use of modern materials, provided that the detachable shell is eliminated.

This would also permit proper control of resonant modes — torsion, bending, standing waves and the like. In conjunction with a sensible cartridge of say 7g mass and a medium compliance of around 20cu, a near ideal 10Hz subsonic resonance is in fact attainable, taking into account the effect of a modicum of viscous arm damping; (9.2Hz without damping).

Turning to the question of motors, the inclusion of a 'servo' for speed control, including tacho-generators, quartz reference oscillators, and the like, often appears to result in a poorer performance than for an ordinary synchronous motor, particularly with regard to speed overshoot resulting from transient load changes produced either by the tracking cartridge or perhaps a dust collector. While rumble from platter main bearings now appears to be a thing of the past, the rather simpler task of isolating a motor or transformer from the structure to prevent breakthrough still eludes many designers.

It also remains a mystery to my why certain companies should withdraw top line and hence competitive products, and replace them with others that are inferior in several respects. It confirms my belief that a lot of hi-fi design merely follows market

trends and fashion, thereby perpetuating the mistakes already made by others.

Improved correlation between subjective and measured performance has been established in this issue, notably in relation to the acoustic breakthrough responses. This attempts to quantify the effectiveness, or more hopefully the ineffectiveness of the turntable acting as a microphone and as such, trapping and storing the resonating sound energy incident upon it. However this does not represent the whole picture, since unwanted acoustic energy may also arrive at the cartridge output via conduction of vibration emanating from the speakers, passing through the floor and/or the structure supporting the turntable. This mode of coupling can extend from 100Hz downwards, and hence a useful augmentation of the breakthrough curve would be the superimposition of the transmission response of the turntable from its supporting shelf. This should extend down to the lowest frequencies of floor and structural vibration (2-3Hz for a person walking on a suspended timber floor), and can be readily accomplished by means of a vibration table, a technique we hope to employ in future issues. At present, vibration and shock resistance was comparatively assessed via a repeatable impact applied to the cabinet on which the turntables were auditioned.

It is no exaggeration to say that the moulded clear or smoked dust cover is a considerable menace to sound quality. The dramatically different feedback margins obtained with many lids either up, down, or better still removed altogether, is proof enough of this — a more effective diaphragm fitted to a turntable for catching sound energy is difficult to conceive! Many manufacturers persist in fitting hard, high 'Q' polystyrene or similar plastic lids which can be heard to ring like coloured echo chambers when they are tapped. Heavy and dead PVC or acrylic is preferrable, but one wonders if the lid as have come to know it, is really necessary at all? Ergonomically and functionally all that is required is a form of cover to keep the dust off, and permit access to the top deck surface; ideally such a structure should form an integral part of the plinth itself. The worst offenders are 'solid plinth' designs where the lid-trapped energy is conducted directly to the arm pillar and thence to the cartridge. Suspended sub-chassis models escape this severe interaction by virtue of their isolation from the plinth, but still suffer somewhat from lid proximity.

Last but by no means least, we come to the problem of record mats, which we found to significantly influence feedback margins and acoustic breakthrough characteristics. A vinyl disc is after all relatively light and poorly damped, and if inadequately supported say over less than 40% of its surface area, can effectively trap incident sound energy. While the actual support area matters more than the substance employed for the mat, be it rubber, felt, or whatever, its composition can however affect perceived coloration as the cartridge traces the music on the disc, (this quite a separate matter to the sound breakthrough under discussion). However, it is hoped to examine some of the properties of platter mats and their effect on performance in more detail in the forthcoming issues of Cartridges & Headphones.

Finally, it must of course be said that the turntable cannot be considered in isolation — its intrinsic qualities of coloration, environmental interplay (floor-borne and air-borne acoustic energy) plus cartridge compatibility will all interact with the chosen cartridge and loudspeakers. A degree of unpredictability is thus inevitable as everyone's system and listening room varies. To take an example — a rich, distant cartridge might be poorly matched with a similar sounding tonearm, (eg: ADC *LMF1* or SME*III*) but complemented by something 'brighter' (the Mission or Grace *707*). Conversely a brighter coarser cartridge which perhaps proved unacceptable in the Grace *707* might musically balance well in the SME *III*. A similar degree of interaction with the loudspeakers' inherent characteristics is also inevitable, but a competant dealer can often advise in matters such as these. The problem of the listening environment may also require individual attention; for example, we have specified preferred locations for many of the decks tested.

Finally I should like to thank all those who have helped in the production of this report, either by contributing time and expertise, or by loaning ancillary equipment needed for the listening tests.

Best buys and recommendations

Deciding on the recommendations and best buys in a hi-fi Choice project is possibly the most difficult part of the whole exercise, because it involves making value judgements on behalf of the reader using specific criteria or the weighting thereof according to personal decisions. The situation is made rather more complex by the fact that there are quite obvious grounds for criticism on virtually all the products included, so virtually all the recommendations contain some degree of qualification which can only be properly established by examining the text of the reviews. Further difficulties are encountered because, while an integrated player is a fixed system allowing (normally) only the cartridge to be changed, separate motor units and tonearms must necessarily be assessed with a complementary component, and obviously this must be of the highest quality to avoid limiting the potential of the assessed component. On the other hand a number of the integrated players supplied contain components that are available separately; in such cases where 'part' of a system received a recommendation, this is not identified by the normal corner flag, but will be referred to in the text. While we have done our best to maintain consistency with the reviews that concern 'variable' product options, this is another area where the oversimplification of a recommendation system can have problems, and once again the reader is enjoined to examine the main text.

It is perhaps inevitable when surveying a large group of products that the range to some extent determines its own norm, where many of the products will be grouped, while there will be rather fewer products at each end of the quality spectrum. This spread of products will naturally be to some extent related to price, and our general recommendations are an attempt to assess performance strictly in relation to price. However concepts of 'value-for-money' inevitably fall down when dealing with the better, more expensive products, when one is attempting to achieve value *per se,* and where the 'for money' tag will depend on one's personal valuation of the said commodity! There are a number of the more expensive models therefore which are recommended for their absolute performance alone, and again these have not been 'flagged' on review pages, but are included in this section and mentioned in the text.

When examining a product for recommendation, we naturally take into account all the various test parameters, attempt to weigh up the relative importance of ergonomic considerations such as automatic operation, and take into account good engineering and finish, the low-maintenance bonus of direct drive models, 'environmental sensitivity' as a whole, and sould quality as we found it. Two 'recommended' models of similar price could therefore perform quite differently on certain parameters, yet still balance out in our estimation to give a roughly comparable overall result. Products that perform particularly badly on one particular aspect are naturally excluded from recommendation authomatically, which explains why a number of the cheapest systems, which may have performed reasonably well in most respects, have nevertheless been excluded. In an attempt to avoid being either hyper-critical or too easy-going, the recommendations encompass a broad spectrum of units at all price levels.

Top recommendations with relatively few reservations go to the following models on grounds of absolute performance or good performance at their price level.

Players
ATR £200 with Mayware or Hadcock arm fitted
B & O 2200 £160 (inc cart) (1102, 1902, 1500 equivalents see text)
Dual 504 £100 (521 auto) (inc cart)
Sansui SR222 II £60
Sanyo TP727 £75
Sony PSX4 £120 (PSX6 auto)
Technics SL220 £75 (SL2300 auto)
Toshiba SR-F530 £120

Component arms
ADC LMF1 £65
Connoisseur SAU2, £16
Grace G707 £120
Mission 774 £120
Rega Lustre £35
SME 3009 III £100

Motor units
Linn Sondek LP12 £250
Thorens TD160BC £90 (esp. with substitute mat)

The following motor units also gave good absolute performance, while proving rather sensitive to their location or mounting shelf, and should be mounted on a rigid shelf to give good results.
Denon DP2550 £230
Technics SL150 £130
Technics SL150 II £230

Also recommended for a good all round performance and/or favourable value for money, albeit with rather more reservations.

Players
Acoustic Research AR77XB £80 (inc cart)
Connoisseur BD103 £80
Garrard GT25P £70 (also GT20)
Hitachi PS48 £120
JVC QLA2 £120
Michell Focus £150
Marantz 6170 £100
Philips AF677 £70 (inc cart)
Philips AF777 £80 (inc cart)
Pioneer PL516 £85
Pioneer PL518 £120
Realistic Lab 250 £80
Sanyo TP1100 II £115
Sony PST1 £80 (PS212) (inc cart)
Sony PSX7 £170
Strathearn SM2000£140 (inc cart)
Technics SL1700 £155 (also 1600, 1800)
Thorens TD115 £135 (also TD16, TD110)
Trio KD2055 £95

Components arms
Decca London International £73
Connoisseur SAU4 £45
Hadcock GH228 £60
Mayware Formula 4 Mk III £69
SME 3009 II ND FD200 £70
Michell Focus* £50

Motor units
Connoisseur BD1 kit £20 — heavy (concrete?) plinth.
Michell Focus £100

The following models are subject to the same aforementioned constraints regarding careful location and rigid shelf-mounting, and assume the new motor type*:
Janorhurst JBE Series III £200 slate, £180 acrylic
Monitor Audio ET500 £150

The following models can also be recommended, but their relatively high prices preclude 'value-for-money' endorsement; nevertheless they are all unique and their particular features may override considerations of price for many purchasers.

Offering exceptional system compatibility, ease of use and setting up:
B & O 4002/4004 £330
Revox B790 £390

Subject to the same aforementioned constraints of siting/locational sensitivity:
Micro-Seiki DDX1000 £350
Technics SP10 MkII £650

Overall Comparison Chart

	Type	Drive System	Wow & Flutter (measured & audible)	Rumble	App. Arm Eff. Mass	Arm Damping	Arm Resonances	Friction & Bias Acc.	General alignment (downforce, geometry)	Engineering Qual.	Shock/ Vibration Susceptibility	Overall Sound Quality (including feedback)	Ease of use	Ease of set up	Price (typical inc.) £
Acoustic Research AR77XB	manual	belt	good	v. good	8	none	ave	fair	good	fair	v. good	ave+	poor	fair	80*
ADC LMF1†					4	none	good	good	good	v. good		v. good	v. good	v. good	65*
Aiwa 2200	auto stop	direct	ave–	v. good	15	none	ave	good	good	good	good	ave	v. good	good	115
Aiwa 2500	auto stop	direct	v. good	v. good	14	none	ave	excell	v. good	v. good	fair	ave	v. good	good	170
Akai AP100	auto return	belt	good	fair	15	none	ave	fair	good	good	poor	fair	good	f. good	70
Audio Technica AT 1010					15	negligible	ave+	f. good	v. good	v. good		ave+	v. good	good	100*
Audiotronic AT 100M†	manual	belt	good	fair	14	none	fair	good	good	f. good	poor	poor	good	good	50
B & O 2200†	auto	belt	excell	v. good	4*	none	f. good	f. good	v. good	good	excell	good	excell	excell	160
B & O 1902y†	auto	belt	excell	excell	4*	none	f. good	good	v. good	v. good	excell	good	excell	excell	120
B & O 4002/4y†	auto	belt	excell	excell	3*	none		excell	excell	excell	excell	good	excell	excell	330
Connoisseur BD2A†	auto stop	belt	good	good	8	none	ave	f. good	v. good	good	excell	fair	good	good	55
Connoisseur BD101†	manual	belt	good	good	9	moderate	ave	v. good	v. good	fair	excell	ave	f. good	f. good	73
Connoisseur BD103†	auto stop	belt	v. good	ave	9	moderate	v. good	v. good	fair	excell	ave+	fair	f. good	f. good	92
Decca London International					12	moderate	ave	f. good	v. good	f. good		good	fair	f. good	73
Denon DP2500†	manual	quartz dd	excell	excell	9.5	none	ave	v. good	v. good	excell	fair	ave	good	v. good	320
Denon 307					10	none	ave	good	good	v. good		ave+	v. good	v. good	140
Denon 309					13	none	ave	excell	good	v. good		ave	v. good	v. good	120
Dual 504†	auto stop	belt	v. good	good	10	negligible	ave	v. good	good	good	good	ave+	good	good	100
Dual 621†	automatic	direct	excell	v. good	12	negligible	ave	v. good	good	v. good	v. good	ave	v. good	v. good	171
Dual 721	automatic	direct	good	good	15	negligible	ave	v. good	good	v. good	excell	ave+	v. good	v. good	250
Dynavector					*	moderate	ave	fair	v. good	v. good		ave	good	good	250
Eagle 7500	auto return	belt	ave–	poor	14	none	fair	fair	good	f. good	poor	poor	v. good	good	75
Elac PC831	auto changer	belt/pulley	ave–	fair	10	none	ave–	f. good	fair	f. good	good	fair	good	good	72
Fidelity Research FR54					16	none	ave	f. good	v. good	v. good		ave+	v. good	v. good	90
Garrard GT25P†	auto return	belt	good	good	11	none	ave–	good	f. good	fair	poor	ave–	f. good	v. good	70
Garrard GT35P	auto return	belt	ave–	good	11	none	ave	good	f. good	fair	fair	ave	f. good	good	80
Garrard DD130	manual	direct	v. good	good	12	none	ave	good	fair	fair	fair	fair	good	fair	90
Grace G707					6	none	ave+	good	excell	v. good		v. good	v. good	v. good	125
Hadcock GH228					6	little	good	good	v. good	f. good		good	fair	poor	60
Hitachi 550	auto return	quartz dd	v. good	v. good	14	none	ave	good	v. good	v. good	fair	ave	v. good	v. good	160
Hitachi P548	auto return	direct	v. good	v. good	17	none	ave	f. good	good	f. good	fair	ave	v. good	good	120
Hitachi 350	auto return	direct	ave–	v. good	15	none	ave	good	good	v. good	fair	fair	good	v. good	100
ITT 8011	auto return	direct	ave–	v. good	16	none	ave–	f. good	fair	fair	good	ave–	good	good	96
ITT 8012	automatic	direct	v. good	v. good	17	none	ave	f. good	fair	f. good	fair	ave–	v. good	good	110
Janorhurst JBE Series III†	manual	direct	ave–	v. good						v. good	good	good*	good		200
Jelco DSC					14	none	ave–	f. good	f. good	f. good		ave	good	good	30
JVC QLA7†	auto stop	quartz dd	v. good	v. good	14	moderate	ave	v. good	v. good	v. good	fair	ave+	good	f. good	270
JVC QLF4	automatic	quartz dd	good	v. good	14	moderate	ave	v. good	v. good	good	poor	ave	v. good	f. good	210
JVC QLA2	auto return	quartz dd	excell	v. good	14	moderate	ave	v. good	v. good	good	poor	fair	v. good	f. good	110
Linn Sondek LP12	manual	belt	v. good	v. good						excell	good	v. good	v. good	good	250
Mayware Formula 4 III					5	moderate	ave	good	v. good	v. good		good	good	good	70
Marantz 6170	auto stop	direct	v. good	good	14	none	ave	good	good	good	poor	ave	v. good	good	100
Michell Electronic	manual	belt	good	v. good						good	fair	ave+	good	good	180
Michell Focus					5	moderate	ave	*	v.good	v. good		ave+	good	f. good	60
Michell Focus	manual	belt	v. good	good						good	ave–	ave+	good	good	100
Micro-Seiki DDX 1000	manual	direct	excell	excell						excell	fair	good	good	v. good	350
Micro-Seiki MA505					14.5	none	ave	v. good	excell	excell		good	v. good	v. good	105

Mission 774					5	variable	v. good	v. good	excell	excell		excell*	v. good	good	110
Monitor Audio ET500	auto lift	direct	fair*	v. good						good	f. good	good*	good	good	150
Philips AF677	auto return	belt	v. good	good	9	none	ave	fair	f. good	good	good	ave–	v. good	v. good	70
Philips AF777	auto return	belt	good	v. good	9	none	ave	good	good	good	good	ave	v. good	v. good	90
Philips AF877	auto return	belt	v. good	v. good	9	none	ave	good	good	good	v. good	ave–	v. good	v. good	130
Pioneer PL514†	auto return	belt	v. good	fair	15	none	ave	ave	good	f. good	poor	ave	v. good	good	65
Pioneer PL516	auto return	belt	v. good	good	14	none	ave	good	fair	fair	good	ave	v. good	f. good	85
Pioneer PL518†	auto return	direct	v. good	v. good	14	none	ave	good	good	good	good	ave+	v. good	good	120
Realistic (Tandy) Lab250	auto return	belt	ave–	good	15	none	fair	good	fair	f. good	good	ave	good	good	80
Realistic (Tandy) Lab500	automatic	quartz dd	v. good	v. good	15*	none	ave	v. good	f. good	f. good	fair	ave	v. good	v. good	170
Rega Lustre					16	none	ave	v. good	good	v. good		good*	v. good	v. good	35
Revox B790	auto stop	quartz dd	excell	excell	3*	none	ave+	excell	excell	v. good	excell	good	v. good	excell	388
Rotel RP3300γ	manual	belt	good	ave–	12	none	fair	good	v. good	v. good	poor	fair	good	v. good	70
Rotel RP5300γ	manual	direct	fair*	good	12	none	fair	good	v. good	v. good	fair	fair	good	v. good	90
Sansui SR222 II	manual	belt	v. good	v. good	11	none	ave	good	v. good	good	fair	ave+	good	good	60
Sansui SR636	manual	direct	excellent	v. good	17	none	ave	excell	v. good	v. good	poor	ave+	good	good	220
Sansui SR838	manual	quartz dd	excell	v. good	16	none	ave	good	v. good	v. good	poor	ave+	good	good	260
Sanyo TP727	auto stop	belt	v. good	v. good	15	none	ave	fair	good	f. good	good	ave	v. good	good	75
Sanyo TP1020 II	auto return	direct	good	excell	18	none	ave	good	good	f. good	good	ave–	v. good	f. good	90
Sanyo TP1100 II	auto return	direct	excell	excell	18	none	ave	v. good	f. good	good	good	ave	v. good	good	115
SME 3009 II ND/FD200†					6*	variable	ave	good	excell	excell		good*	v. good	good	70
SME 3009 III					4.5	variable	good	good	v. good	v. good		v. good	v. good	good	100
Sony PST1†	auto return	direct	v. good	v. good	14	none	ave	fair	good	good	fair	fair	v. good	v. good	80
Sony PSX4†	auto return	quartz dd	v. good	v. good	14	none	ave+	f. good	good	v. good	v. good	ave+	v. good	v. good	120
Sony PSX7	automatic	quartz dd	v. good	v. good	14	none	ave+	good	good	v. good	v. good	good	v. good	v. good	170
Stax UA7 CF†					16	none	ave	v. good	v. good	excell		good	ave+	f. good	160
STD 305D	manual	belt	ave–	good						good	v. good	good*	good	f. good	250
Strathearn SM2000	auto stop	direct	v. good	v. good	5	none	fair	good	good	good	v. good	ave	good	good	150
Strathearn ST400	manual	direct	poor	ave–	5.5	none	fair	fair	f. good	f. good	fair	poor	good	good	50
Technics SL1000 II†	manual	quartz dd	excell	excell	16	variable	ave+	v. good	good	v. good	good	good	good	good	1000
Technics SL1700†	auto return	direct	excell	v. good	16	none	ave	v. good	v. good	v. good	v. good	ave	v. good	v. good	155
Technics SL1400 II†	auto return	quartz dd	excell	excell	16	none	ave+	good	f. good	v. good	ave–	ave	v. good	good	240
Technics SL220	auto return	belt	v. good	v. good	15	none	ave	excell	good	good	v. good	ave	v. good	good	80
Technics SL3200†	auto return	direct	good	good	17	none	ave	good	good	v. good	fair	fair	v. good	v. good	110
Thorens TD115†	auto stop	belt	good	excell	7	none	ave	excell	fair	good	v. good	ave	v. good	fair	135
Thorens TD160BC	manual	belt	v. good	v. good						v. good	v. good	good	v. good	v. good	90
Thorens TD126 III†	auto stop	belt	v. good	excell	8	none	ave	v. good	v. good	v. good	excell	good	v. good	fair	260
Toshiba SRF325	automatic	belt	good	good	14	none	ave	fair	fair	f. good	fair	ave	v. good	v. good	100
Toshiba SRF225	automatic	belt	ave–	ave–	14	none	ave	fair	good	fair	fair	ave–	good	v. good	90
Toshiba SRF 530	automatic	direct	v. good	v. good	14	none	ave	good	good	good	good	ave+	v. good	v. good	120
Trio KD750	manual	quartz dd	excell	excell	15	none	ave	good	good	v. good	good	ave+	good	good	500
Trio KD2055γ	auto return	belt	v. good	v. good	9	little	ave	good	good	good	good	ave+	v. good	good	100
Trio KD1033B	manual	belt	fair	ave–	15	none	ave–	fair	good	f. good	fair	fair	good	f. good	55
Visonik VT5300	auto return	belt	good	good	7	none	ave–	good	good	good	fair	ave	good	good	105
Visonik VT3300	auto return	belt	ave–	ave–	7	none	ave–	good	good	good	poor	ave–	good	good	80
Yamaha YP511γ	manual	direct	ave–	v. good	17	none	ave	v. good	v. good	v. good	fair	ave	good	good	110

* See Text † For separate model and option/variant characteristics, see main review γ adapted from previous issue; not strictly comparable.

NOTE: Tonearms and motor units when assessed for sound quality are perforce used with the best available ancillaries, and may not achieve this potential under less optimum conditions.

The following 'value judgement' characterisations have been used, in descending order of 'goodness' with text equivalents mentioned: excellent; v. good; good; f. good; above average = ave +, average, below average = ave – = satisfactory, fair = adequate; poor.

Glossary

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.

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. See 'resonance'.

Belt drive: The motor has its rotational speed geared down to the required platter speed (33⅓ 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.

Bias: 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. This can be applied in a number of different ways, for instance by weights on the end of miniature thread-and-arm pulley systems, magnetic loading and springs. Bias compensators are usually adjustable, and produce forces of around 10-15% of the tracking downforce.

Coloration: If an item of audio equipment reproduces one frequency or band of frequencies more efficiently than others, then the reproduced sound will be coloured by the imbalance. Undamped resonances in record decks can produce coloration.

Compliance: The stylus of a cartridge is mounted on a tiny cantilever arm which itself must be resiliently mounted to enable the stylus tip to follow the groove wall undulations. Compliance denotes the degree of cantilever resiliance. Static compliance (ability of the cantilever to move against a fixed force) is in practice less significant than dynamic compliance (when the cantilever is tracking a groove in a resonant condition) and the two can differ noticeably.

Crosstalk: In a stereo system, sound from the left channel should not encroach on sound from the right channel, and *vice versa* (unless intended). Unwanted encroachment is called crosstalk, and in the context of the present report, we are concerned with crosstalk in the cartridge.

Damping: Resonances (see separate entry) can be reduced by careful use of additional material to absorb and damp down the resonant energy. But resonances can never be one hundred per cent damped, and damping may create fresh problems, for instance fresh resonances at other frequencies and excessive friction or weight.

Decibel (dB): A logarithmic unit of comparative measurement used in audio. Decibels are thus not positive units of measurement (like lbs, kilos, or litres) but function in the manner of ratios. A doubling of power (watts) is denoted by an increase in 3dB and a doubling of pressure (sound volume level or electrical voltage) is denoted by an increase of 6dB.

DIN B weighted: Measurements related to turntable rumble are measured in rms (a conventional means of averaging audio signals), and doctored according the the DIN B curve, to bring the results on paper into better correlation with what the human ear actually hears. This is necessary because the ear hears various frequencies differently according to their volume level.

DIN, peak weighted: Wow and flutter measurements are measured by their peaks, and these doctored according to another correlation curve.

Direct drive: This type of motor has one moving part, the platter/centre spindle. The other part of the motor is fixed to the chassis or plinth.

Downforce calibration: Equivalent to tracking weight calibration, and related to any controls provided to adjust the force with which the stylus acts down on the record groove.

Gimbal: A pair of concentric bearings used in pick-up arms to give freedom of movement in the vertical and horizontal planes.

Headshell: On some arms the cartridge is securely mounted in a light casing or headshell, which is itself mounted at the end of a pick-up arm, and is generally detachable.

Hertz (Hz): Also kiloHertz (kHz) — The modern manner of denoting cycles-per-second. 1 Hz = 1 cycle-per-second, and 1kHz = 1000 cycles-per-second.

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.

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. Usually, such adjustment is provided for in a headshell (see separate entry). Overhang adjustment effectively controls the lateral angle at which the stylus tracks the groove.

Resonance: Any article 'rings' or 'sounds' at a natural resonant frequency when vibrated. So, all parts of a record

deck may exhibit resonance. The main resonance of an arm is the low frequency at which it resonates when the cartridge stylus is resting in a record groove supporting a compliant cantilever.

Rumble: The low or medium frequency sound produced mechanically by any moving parts in a turntable, mainly the motor and platter bearings.

Speed accuracy (absolute): The ability of a record deck to rotate the turntable at a speed which conforms with the required speed (e.g. 33⅓ rpm for LP disc). Error is expressed in percentage. The ear is relatively insensitive to absolute speed errors, as long as they are constant.

Speed drift: Any temporary variation up and down from the required rotation speed of the platter will create wow and flutter in the reproduced programme (depending on the frequency of the up and down variation). The ear is very sensitive to such changes.

S-type arm: A pick-up arm which is bent into a loose S-shape to minimise tracking error. (Alternatively the arm is straight and the cartridge or headshell is attached to its end at an angle).

Template: A plan or pattern to assist in correctly locating the pivot of a pick-up arm with respect to the platter centre.

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.

Vibration/Shock sensitivity: A purely *ad hoc* assessment of the susceptibility of the system to disturbance at very low frequencies; ie. jolting, springy floorboards etc.

Summary Reviews

B & O Beogram 1902

The *1902* was highly favoured as a package in the previous book, and is very similar to the somewhat more expensive *2200* reviewed elsewhere in this book. Both the *1902* and its close relative the even cheaper *1102* are currently being rationalised into a single model, the *1500*. It is almost certain that these models will perform very similarly to the reviewed *2200*, differing predominately in ergonomics, which ensures that they can again be strongly recommended, possessing good sound quality at a fairly modest price. The package is outstandingly easy to set up and use, although the restriction to B & O's own cartridges (an essential ingredient in the overall system design) may not be to everyone's taste. See B & O *2200* for further general information.

B & O Beogram 4002

The *4002* shares the principles of an optimised cartridge-inclusive package, suspended sub-chassis isolation, and automatic operation, with its cheaper brethren, but unusually also includes a parallel tracking arm under photo-electric control. A *4004* model is also available which can be operated by remote control, but only when used with the Beomaster *2400* receiver. The overall sound quality was considered 'good', if similar to the cheaper models, and would perhaps have benefitted from a mat which offered greater record support. With similar overall performance and price as the other parallel-tracker in this survey from Revox — albeit offering an alternative set of design compromises and greater cartridge choice — the *4000* series can be similarly recommended, but its price precludes a high 'value-for-money' rating.

Rotel RP3300

This manual belt-driven player gave reasonable results for its price on all normal engineering parameters, but sound quality was rated below average, feedback, acoustic breakthrough and vibration/shock resistance were all fairly poor, so the overall performance was not as good as some models at a similar price. The effective arm mass of 12g implies suitability to cartridges in the 10-20 cu range.

Rotel RP5300

Employing a similar solid plinth to the *3300*, Rotel's *5300* uses a direct drive motor which unfortunately gave some dynamic wow problems. Although rating good on feedback, this model was also fairly poor on acoustic breakthrough and vibration/shock resistance with an overall sound quality 'below average'. Arm compatibility was similar to the *3300*.

Trio KD550/KD500

The tested *550* uses a similar plinth to the *2055* but employs a good quality direct drive motor. Sound quality was considered slightly inferior to the *2055*, but the supplied arm was of higher effective mass and lacked the damping of the one on the cheaper model; the *KD500* at some £20 less has no arm and may therefore prove the more attractive alternative, with some elements in common with the Janorhurst and Monitor Audio designs. As the integrated model did not compare too favourably on sound quality with the cheaper *2055*, this model was not recommended, but as it is also due for replacement soon, there may be end-of-range bargains to be had.

Trio KD2055

The *2055* was recommended in the last issue, offering 'good' sound quality at a below average price. This belt drive model provides auto-return and is constructed in a heavy plastic/aggregate plinth. The arm effective mass is lower than average (7-9g) and the counterweight decoupling offers a degree of subsonic damping, so despite the detachable headshell, fairly high compliance cartridges may be used successfully. Although this model will soon cease to be available, it can nevertheless be recommended.

Yamaha YP511

This manual direct drive player is somewhat unusual in that the price has come down some 20% since the last report (in spite of inflation and the soaring yen!) The heavy plinth gave quite good feedback and breakthrough results, but vibration/shock resistance was poor and some dynamic wow effects were noted. The arm behaviour was quite good, but the heavy effective mass suggests cartridges in the 8-15 cu range are the most suitable. A marginally above average sound quality rating at the new price places this model close to a recommendation.

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