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HI-FI CHOICE No 35
Turntables and Compact Disc Units

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by Martin Colloms

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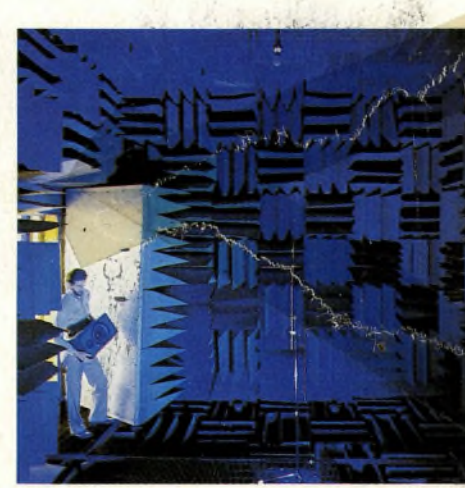

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HOW TO USE THIS BOOK

Each Hi-Fi Choice edition aims to give the most comprehensive examination of models in a given hi-fi product category. This page is a guide to the various chapter headings.

Every *Choice* project involves extensive lab testing and generates a considerable amount of data. The introductory sections are arranged so as to make the tests and conclusions accessible to the generalk reader, and at the same time informative to the more technicalloy-inclined.

The **Consumer Introduction** (written by Paul Messenger) is an attempt to deal with the essential considerations of disc replay and record deck design in strictly non-technical language, also providing guidance for those who would like to make the best possible use of the book 'starting from scatch'.

The **Technical Introduction** describes the tests which were undertaken and explains why particular measurement techniques have been used. Many of the traditional measurement techniques used to assess turntables do not give fine discrimination between models, and may not reflect the differences which can be heard under controlled 'typical use' listening-test conditions, and consequently we have striven to develop more sophisticated techniques to give more meaningful results. This in itself has pitfalls, as there are still no 'standard' test conditions for some aspects of performance — such as the turntables sensitivity to the environment in which it is used, which can dramatically affect the performance of a system in ways which are often unpredictable.

In this chapter the author also details the tests carried out on Compact Disc players, in comparison with each other and with analogue disc systems.

Reviews of course make up the biggest section of the book and in each case include description, test data and interpretation thereof in sufficient detail to allow necessary qualifications to be made. While we attempt to assist buyers by using a 'recommended' flash and summarising our results elsewhere in the book, it must be stressed that this does involve a degree of over-simplification.

Although we have covered as many turntables and arms as possible in the main review section, we have also included a short section of **Summary Reviews,** allowing brief coverage of models tested in earlier editions which should still be available but which for space reasons could not be reprinted in full.

Conclusions is an important section which discusses the findings of the project in general terms, and amplifies on some of the crucial aspects of the test programme in view of the results obtained from the different designs.

Best Buys and Recommendations picks out designs in different price brackets which appear to use to offer a good overall performance for the price asked. In the lower price categories, we have suggested 'Best Buys' which in our view offer exceptional value — but we have also offered many 'Recommended' products of fine performance, which will certainly be very good buys. Naturally our recommendations are based on our interpretation of the relative importance of different aspects of performance and the reader should decide how these coincide or conflict with his own requirement and assess our 'value for money' conclusions in this light. Our findings are based on the prices available as we go to press, and of course any variation in price subsequently must be taken into account.

Separate tonearms and motor units are necessarily assessed in combination with the best ancilliaries and will clearly attain the performance as assessed only when used under such conditions. We have tried to give as much information as possible on the technical and subjective matching of components to produce complete player systems, and have included a selection of suggested player combinations too.

The **Overall Comparison Chart** gives an 'instant' comparison of the main points made in the review. It should be useful when seeking to shortlist models with particular features or characteristics.

A short feature on **Platter Mats** investigates the often obscure effects which different mats can produce when used on many turntables — the audible results can be quite significant.

Finally, we come to **Compact Disc.** After a brief introduction, the test report on Compact Disc players looks at the performance of all the models available to us by the time of going to press, including some very new 'second generation models'.

At the back of the book will be found a **Glossary** which we hope will save the reader from being baffled by the inevitable technical terms used in the books!

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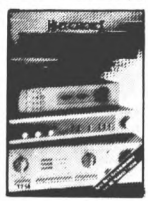
Each issue is authored by one of Britain's finest audio technicians. We pit machine against machine under controlled laboratory conditions manufacturers claims against reality.

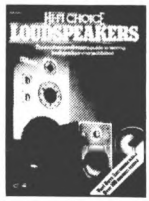
We conducted 'blind' listening tests using a panel of listeners. We print the reviews, warts and all. These are preceded by a 'Consumer Introduction and a 'Technical Introduction', usually many pages in length. Each issue has a quick reference 'Overall Comparison Chart' and, of course, a 'Best Buys and Recommended Section'. Photographs of all models are included. Lastly, we award those little tags to a selection of the models tested.

We usually publish five *HI-FI CHOICE* editions a year. They cost £2.50 per copy. Each one dedicated to a particular theme. We laminate the covers to make them last for years and supply quality binders to keep them in for permanent reference. We also maintain stocks of back issues for people to buy through the mail (using the coupon below) or you can visit our new Back Issues Centre in the West End of London. This is located at 14 Rathbone Place, London W1P 1DE, five minutes walk from Tottenham Court Road tube station.

Any new issue of *HI-FI CHOICE* is usually to be found at W. H. Smiths or other good newsagents. Some hi-fi dealers carry a stock of back issues, too, but in case of difficulty, contact us at the above address.

Ours is not a very economic way of producing a hi-fi publication. We could probably cut a few corners on obtaining the information we publish and make a lot more money. But our Series Editor, **Steve Harris**, just wouldn't stand for it. And he stands for what is printed on the front cover of every *HI-FI CHOICE* — 'The most comprehensive Guide to Buying Hi-Fi Ever Published.'





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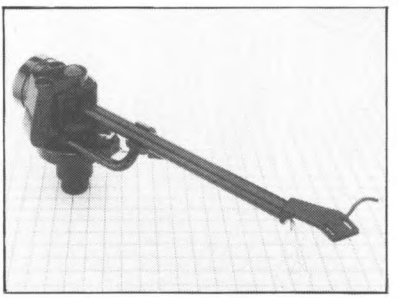

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EDITORIAL INTRODUCTION

For this sixth 'Turntables' issue, we have aimed to cover the current turntable market from the most esoteric of separate components down to quite basic integrated players.

With this edition we have continued our policy of trying to cover all the most refined and innovative products of the 'specialist' hi-fi manufacturers. It is very significant that many of these manufacturers now offer products which can give the 'specialist' virtues of improved sound quality at a much lower price than previously.

While there has been no shortage of exciting new product from the UK manufacturers, quite a few of the Japanese corporations have now bowed out of hi-fi separates altogether, and supply turntables only as an obligatory ingredient of their packaged audio systems; but it is interesting that of those Japanese products which do remain on the separate turntable market, one or two proved to be much better than expected.

Apart from the crop of completely new models, there are many established products which have been improved or modified since the last edition, and these have been reassessed where appropriate. We have certainly seen continued progress from such manufacturers as Heybrook, Pink Triangle and Michell, who have all offered improved versions of an already well-regarded product. Sometimes the process of development and improvement is almost continuous, which is beneficial to the consumer but frustrating for the reviewer. As always, we can only comment on the samples we receive, and although we have done our best to be flexible in accommodating subsequent changes during the course of preparing the book, the purchaser is advised to try to confirm our findings rather than do assume that this sample will necessarily be identical to ours! We cannot stress too strongly the importance of going to a good dealer and listening for yourself.

With separate motor units and arms, mechanical subleties can make or mar a product's ultimate sonic performance, and hence affect its acceptance in the extremely competitive hi-fi market of today. By the same token, turntables probably sill arouse more controversy and debate than any other part of the hi-fi chain, and the irreconcilable differences of opinion among manufacturers, dealers and reviewers, arguing on both theoretical and subjective grounds, are enough to make consumers (let alone editors!) despair. In this situation the *Choice* approach to turntable reviewing can claim the advantage of consistency at least, for all models are tested in a controlled manner under the same conditions. While we would concede that there is still plenty of room for debate on the relevance and viability of certain aspects of turntable testing, the techniques used in *Choice* are the result of many years of experience and experiment — and that experience, gained in the examination of multitude of designs, hopefully has enabled us to avoid misinterpretations of turntable or arm behaviour and to give every product the fairest possible hearing.

Hi-fi by definition demands a striving after 'perfect' reproduction of recorded sound, and how far away the best (or the worst) products now are from that goal may well be regarded as a matter of individual perspective. In *Hi-Fi Choice* the references for performance standards have always been created by the products available rather than by some imaginary absolute — and in the specialist field at least the general standard is improving all the time. This means that we have had to effectively downgrade our recommendations on some models previously tested, as they have become less attractive in the light of recent competition. On the other hand, while the very low priced 'rack system' type turntables appeared for some years to be getting worse every season — cost-cutting by manufacturers tending to produce flimsy plinths and unsatisfactory arms — the rot seem to have stopped here in some quarters at least.

It is this which has led us to reintroduce 'Best Buy' category for turntables of very moderate price only, but it should be stressed that in the medium-to-high price bracket, a recommendation still carries its full weight. These ratings *must* be taken in the context of the review.

While nobody pretends that the analogue LP is going to become obsolete without a very long swansong, if ever, digital audio has at last come upon us in finalised and reviewable form. For this we looked at the latest Compact Disc players and have, we hope, made a useful assessment of this new sound carrier.

Steve Harris

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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 33⅓ 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 33⅓ rpm and hanging the cartridge on the end of a beam that allows horizontal and vertical motion!

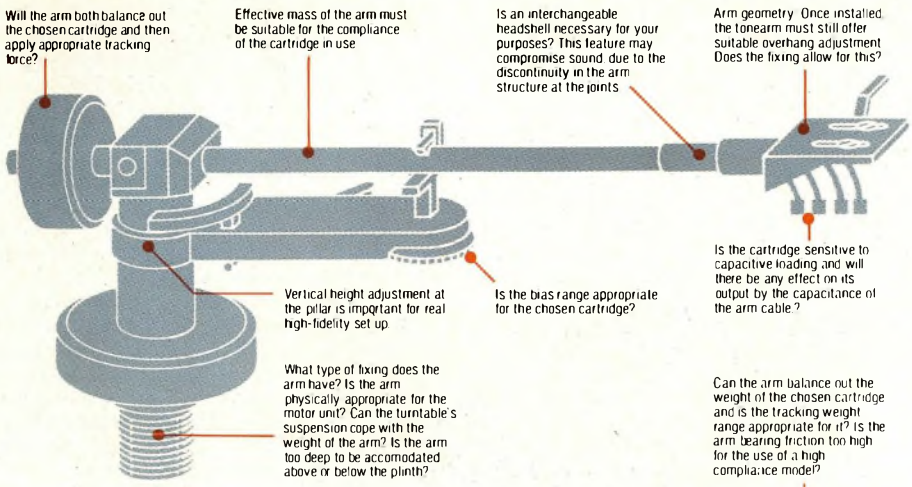
In order to further emphasise the inherent mechanical problems that the system has to try and overcome, it is both instructive and disturbing to examine the different magnitudes involved. This was poignantly portrayed by E. B. Meyer in the Boston Audio Society's magazine *The Speaker,* so I will draw 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

TURNTABLE & TONEARM BUYER'S CHECKLIST



Will the arm both balance out the chosen cartridge and then apply appropriate tracking force?

Effective mass of the arm must be suitable for the compliance of the cartridge in use

Is an interchangeable headshell necessary for your purposes? This feature may compromise sound due to the discontinuity in the arm structure at the joints

Arm geometry. Once installed, the tonearm must still offer suitable overhang adjustment. Does the fixing allow for this?

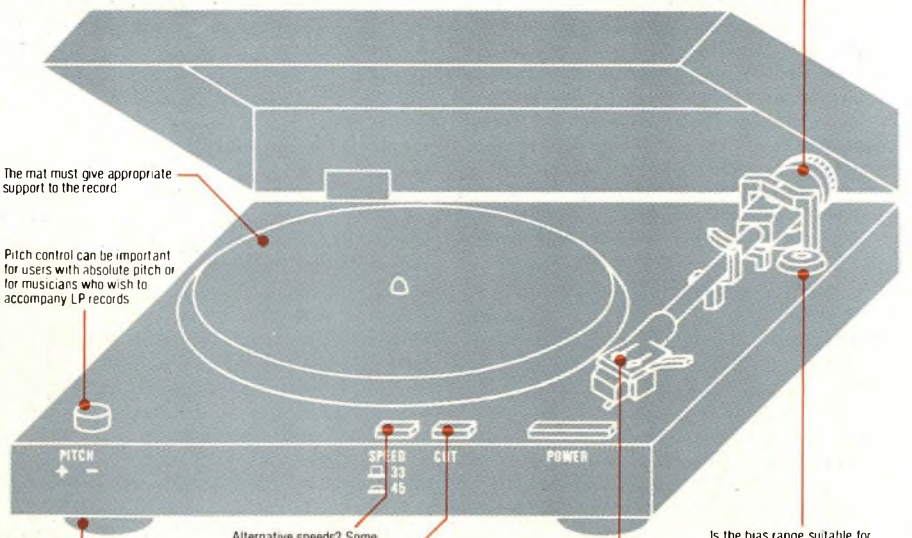
Is the cartridge sensitive to capacitive loading and will there be any effect on its output by the capacitance of the arm cable?

Vertical height adjustment at the pillar is important for real high-fidelity set up

Is the bias range appropriate for the chosen cartridge?

What type of fixing does the arm have? Is the arm physically appropriate for the motor unit? Can the turntable's suspension cope with the weight of the arm? Is the arm too deep to be accomodated above or below the plinth?

Can the arm balance out the weight of the chosen cartridge and is the tracking weight range appropriate for it? Is the arm bearing friction too high for the use of a high compliance model?



The mat must give appropriate support to the record

Pitch control can be important for users with absolute pitch or for musicians who wish to accompany LP records

Suspension should be adequate for the environment in which the turntable will be used. A model which relies on sprung feet will not be suited for use on a sideboard, for instance. Correct mounting and location for feedback free results is essential

Alternative speeds? Some motor units feature only 33⅓rpm.

Semi-automatic decks may just lift off at the end of side or may return the arm to its rest. Fully automatic turntables will play without any manual cueing

The cartridge for an integrated player must be mechanically compatible. Its weight and compliance must be matched to the tonearm's effective mass to produce a mechanically stable combination. If there is no height adjustment in the integrated arm, is the cartridge body too deep or too shallow without packing for correct vertical tracking?

Is the bias range suitable for the cartridge? The bias dial sets a small force to counteract the arm's tendency to pull inwards when the stylus is placed on a moving record (this is due to arm geometry and does not occur with radial tracking). Bias is necessary to centralise the moving parts of the cartridge — if bias is inappropriately set, the effects will be heard as vague stereo imaging and poor tracking

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

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.

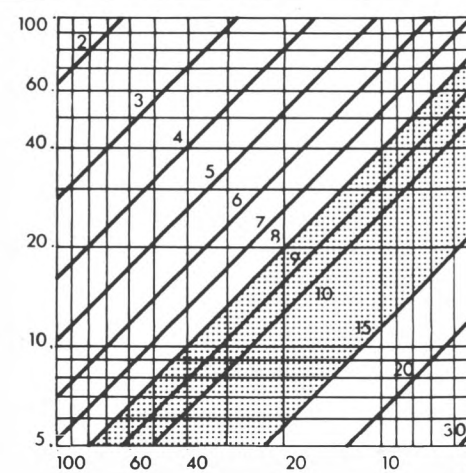
Getting back to the real position of the cartridge, stylus, and groove, we should get little relative movement and hence output below resonance, subtantial output and possible tracking problems at resonance, and 'normal' output corresponding to the groove modulations above resonance. Now we are obviously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

MASS/COMPLIANCE/RESONANCE RELATIONSHIPS.

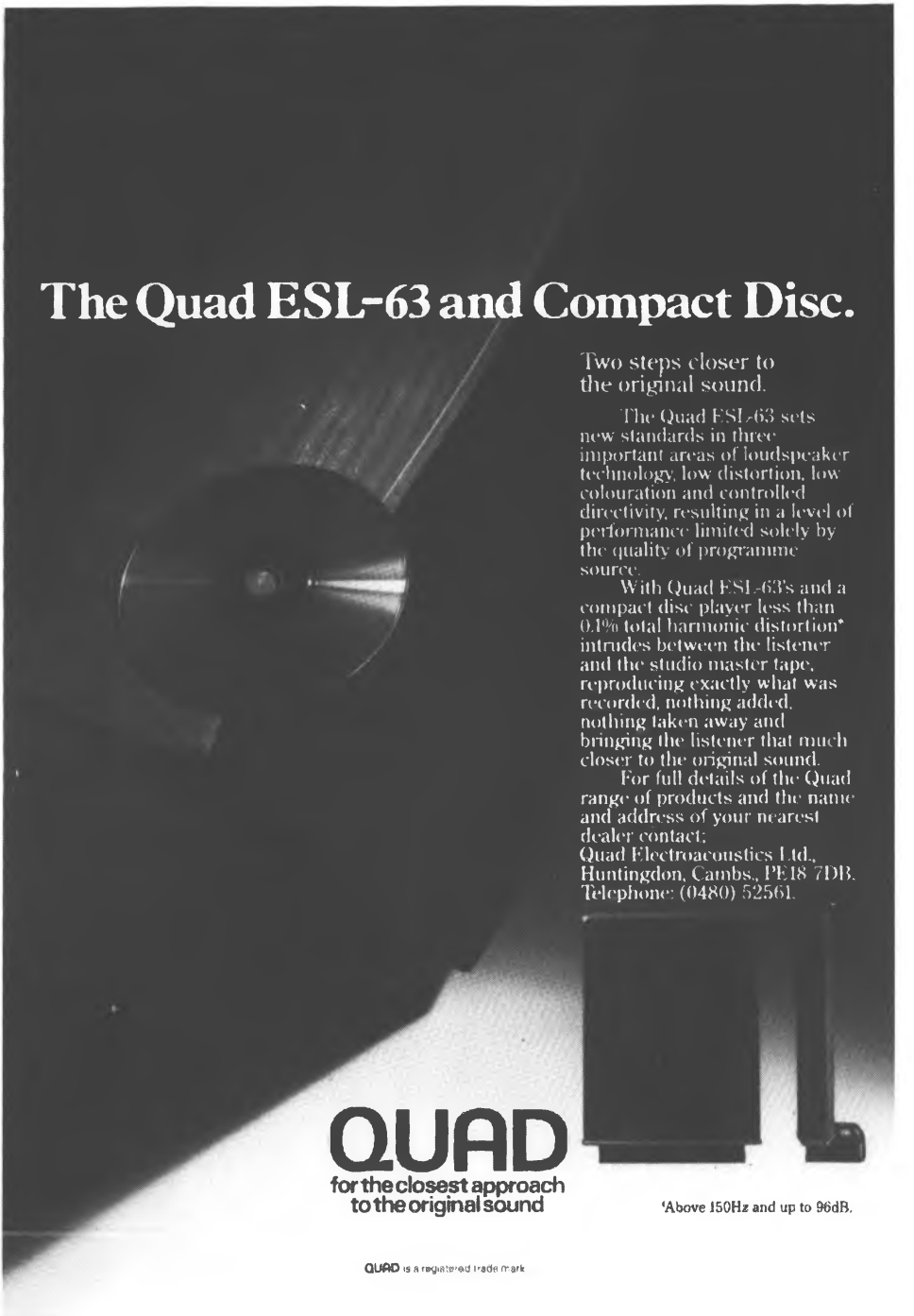
Calculating the main arm/cartridge resonance is relatively simple if one knows the following details; arm effective mass; cartridge mass; cartridge compliance.

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.



The Quad ESL-63 and Compact Disc.



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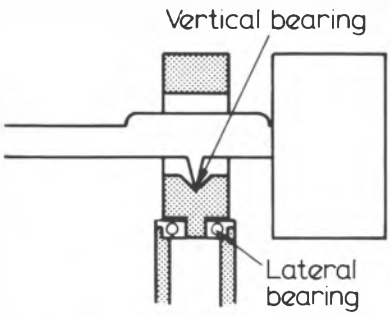
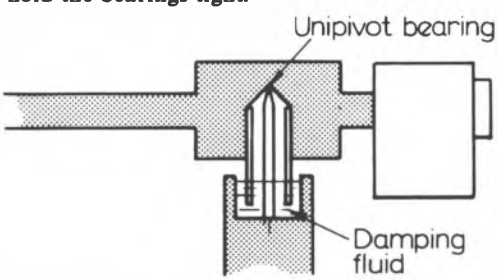
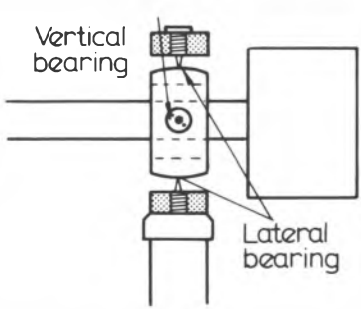
THREE TYPICAL ARM BEARING TYPES



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'.

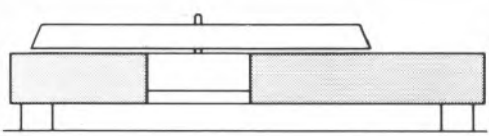
One cannot at this stage make definite assertions about the 'correct' approach to these situations, but evidence does suggest that systems resolving the most musical detail couple the cartridge closely to the arm tube, avoiding resonances as much as possible, and provide the finest bearings to transmit 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

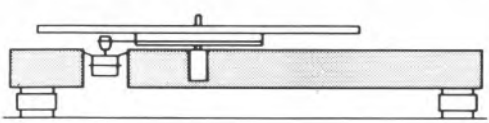
Pickup arms tend to use a limited number of engineering principles, and designers or their advertising agencies can be fiercely partisan about their chosen approach. It is true that some outstanding no-compromise systems can work extremely well for some people, but others may not find them to their taste 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.

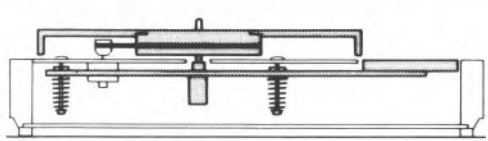
THREE TYPICAL TURNTABLE DESIGNS



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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TECHNICAL INTRODUCTION

Our test programme for turntables, tonearms and Compact Disc players combines comprehensive laboratory analysis with careful auditioning. This Technical Introduction covers the methods and relevance of the technical tests, and the approach used for listening.

With this sixth *Turntables* edition, the review coverage again reflects a changing hi-fi marketplace; and we have been able to test and compare many new models from the more 'specialist' manufacturers, who now compete strongly to produce good-sounding turntables at several price levels. Many products which were included last time have undergone revision or improvement over the last year or so, and these have been either extensively re-assessed or are covered in completely new reviews.

With CD now well on stream, it is clear that most Japanese manufacturers have heavily downgraded their analogue turntable commitment, and of what little is left, most appears wedded to the mid-fi 'rack' system. (A number of these models were covered in the recent *Complete Systems* issue, *HFC* No 34, by Alvin Gold.) This trend explains the absence of a number of previously well-represented brands such as Sharp, Sony and Akai to name but a few.

As is usual, our review schedule inevitably coincided with several turntable model deletions and replacements, and for the same reason some CD player manufacturers are also missing. For example, B&O have decided to wait another year or so before launching their *5000* series player, and Akai did not have their second generation player ready in time. On the other hand, Sony's latest low cost CD model, already selling on the Japanese home market, is not now scheduled to appear in the UK, and the *CD-P101* will therefore continue as the prime model.

At present UK manufacturers are showing little interest in CD, not specifically because its quality is suspect, but on the grounds of the prohibitive investment that is required, and its current lack of profitability. I suspect however that if CD becomes something of a formula product whose performance is dictated by a set of universal integrated circuits, then there may be little scope left for the more inventive of audio designers. As with the present generation of push-button synthesiser tuners, specifications and performance are usually quite similar from model to model.

Instead, the UK industry has concentrated its efforts upon continued analogue player improvement, to a point where even modestly-priced players show a distinct advantage when compared with imported price-equivalents. Both the empirical and theoretical understanding of the total balance of acoustic and subjective performance of a good LP player are growing apace, resulting in sonic refinement at quite modest prices. Such products are helping the UK industry to hold its own against what many designers and shops regard as an alien invasion.

LABORATORY TESTS

Once again we can claim improvements in laboratory technique which continue to provide greater discrimination between products, and bring us a trifle closer to understanding and perhaps predicting the sonic performance from the technical data. It must be stressed however that the total performance and operating interaction that occurs in a turntable is very complex and not amenable to simple analysis, and listening tests will continue to play a vital part in product assessment. It is easy to hear turntable faults despite the poor quality of some discs, because the player faults are distinctly different. The failings of a weak turntable will pervade all the pressings it reproduces; a characteristic which will soon fatigue the listener.

We are at an early stage in the testing of digital systems, particularly CD. In contrast to our previous *Turntables* issue, the first to catch the CD launch, this time test discs were available from several sources and provided quite a comprehensive array. The performance of a CD player in a technical sense, transcends that of an analogue player and the tests and their results resemble those pertaining to a fine hi-fi preamplifier. The interpretation of those results and their relationship to sound quality is however less certain at present.

On the face of it the measured results are often excellent, so good in fact to make it possible to remove all doubts concerning CD's technical quality. Yet subjective tests have shown that CD players continue to exhibit subtle subjective differences, these uncorrellated as yet with even quite searching measurements. For example I can show harmonic distortion for a particular CD player

TECHNICAL INTRODUCTION

Polygram have publically stated 'the CD player reproduction is *identical* (my italics) with the master.' For those of us in the hi-fi business, the word 'identical' is much too strong a description to apply here. In practice, few experienced recording engineers would be prepared to guarantee identicality between CD replay and the original master; differences in the D/A convertors and their output filters between the studio equipment and the, domestic player would almost certainly rule this out. In addition there is the question of editing and transcoding. Some digital masters are not to the 48kHz professional standard, while CD in any case samples at a different 44.1kHz rate. A digital translator or number-cruncher has to change the frequency and in effect a re-quantisation takes place. No one can yet guarantee that such processes are inaudible. Perhaps if the pro standard was 18 bit rather than the present 16, and the signal rounded down to 16 after transcoding, the correspondence would be closer.

In the long run, it is a general objective for the recording industry to operate a mastering standard that is higher than domestic replay to allow some margin for the necessary editing and transcoding processes. The new Neve studio console and mixing system operates in 20 bit to provide just such an operating margin.

Over the first year of CD launch the total number of issued titles has been approximately 1,000, and a sufficient number of demonstration discs are now available for comfortable subjective testing of the players.

Turntable systems

Returning to analogue turntable systems, tests have been devised to bring out, as much as possible, aspects relevant to sound quality. Only in the most simple and obvious cases do conventional measurements such as those for wow and flutter and rumble etc have much relevance to subjective quality. For example, peruse the figures for any modern turntable with pretensions to quality: rumble and wow figures are quoted which surpass even our test methods, and which are below audibility thresholds; yet in practice these tell nothing about sound quality of the deck in question if experienced and perceptive listeners are involved.

Assuming that a turntable's sound quality *does* matter, we can then consider a number of subtle parameters which are notably difficult to qualify. For example, stereo imaging can be flawed in terms of both clarity and the ability to reproduce depth, due to instability in subchassis systems, excessive stored energy or coloration in the subchassis system and unwanted vibrational excitation arriving at the cartridge stylus. The bass may be weakened in both power and definition due to incipient acoustic feedback, also to counterweight resonances in arms, or to weak platter main bearings, which can encourage platter rocking at low frequencies. Sound quality in the midrange may be coloured and masked by structural resonances, plus coupled feedback in turntable lids or plinths, and if poorly isolated, also the shelf on which the deck is placed. Such middle range resonances may also be attributed to structural weaknesses in tonearms, and their mounting board or platform. The platter and subchassis themselves can also 'ring' or resonate in the mid register. The proportionality of plinth and platter mass can also be significant. A light platter on a strong heavy plinth will resonate more than when fitted to a lighter plinth where some mutual damping may be encouraged. Thin platters tend to ring like gongs, their damping partially controlled by choice of mat.

For the best sound quality the platter mass should be sufficient to provide a useful rotational inertia, providing a flywheel energy store, helping the platter resist small speed changes induced by variation in drive power, and the stylus drag which alters with music modulation. If the power is low and the platter light, then dynamic wow can occur as an audible pitch instability following loud programme transients.

Weak main bearings (including the support) can allow rocking modes in the platter to the detriment of coloration levels. Conversely, controlled stiffness and mechanical losses in the subchassis/arm mounting can help to trap and absorb unwanted energy which could otherwise be transmitted or reflected back into the platter or tonearm.

to be – 100dB on the fundamental, or 0.001%! Yet this is no guarantee of perfect sound.

In general, CD designers appear to have got their specification numbers in very good order. But they need to devote more attention to sound quality differences as a whole, if the claimed consistent accuracy of CD is to be achieved. In theory, the digital replication process for CD is nearly perfect, with full correction of system errors.

The execution of the springing associated with a suspended subchassis design is almost an art in itself, and is crucial in determining the operational stability as well as the isolation performance of the whole. The Linn *Sondek* exemplifies a model which may outwardly appear a trifle primitive in design, but which nonetheless incorporates many 'hidden' aspects which enhance its performance: there is hardly any detail of its construction which does not contribute to the whole. For example, the belt is critical in dimensional tolerance, surface finish, elasticity and internal loss factor. Any deterioration can affect speed accuracy, load tolerance, torque, wow and flutter, drive motor breakthrough rumble, as well as subchassis instability and behaviour. The audible repercussions are legion; for example excessive belt tension will mean the motor coupling will be too tight, resulting in worsened rumble and energy coupling to the platter, the subchassis will also be under excess lateral drag, impairing isolation and worsening vibration rejection; finally the belt-subchassis mass resonance may become involved — a factor usually kept at bay due to a minimal belt tension consistent with good drive.

In an earlier issue the 'flexibility' of the *Sondek* arm mounting facility was mentioned, but we now recognise that in practice this flexibility is an advantage rather than a weakness in the case of the *Ittok* arm series (the latest *Ittok* has undergone further revisions, see review). It is now apparent that an important terminating and absorbing function is provided by the 'composition' arm board and its apparently superficial fixing to the subchassis. Energy propagating from the cartridge down to the arm pillar is absorbed here, rather than being reflected back to the cartridge by a misterminated board/arm pillar interface (see Lux *PD300* review).

However we have found it dangerous to use the *Sondek* as a reference turntable for comparative auditioning, due to its unique character and sonic balance; but it does remain useful as a long term reference in view of its musically-balanced and satisfying performance. So far no other turntable has provided the same balance and combination of qualities and weaknesses which would allow an easier A/B comparison test. Good disc players increasingly represent a 'system', where motor unit, arm, cartridge and mat offer an optimised combination. Alter any single part and one's view of the whole can be altered too.

Acoustic and vibration isolation

Returning to the more general discussion of factors affecting subjective performance, we classify energy arriving at the working cartridge from the outside under the heading of 'acoustic and vibration isolation', this including energy emanating from the music reproduced by the loudspeakers. The latter is a feedback-promoting effect which rapidly worsens sound quality with increasing gain, well before the point at which 'howl-round' is reached. The energy enters the turntable *via* two routes, both acting together. Vibration in the room structure is transmitted by the floor and excited in the support cabinet or shelf, entering *via* the turntable feet and base; airborne acoustic energy is intercepted by the entire turntable structure — the lid, the armboard, the plinth, platter, disc and the subchassis.

The isolation performance of a turntable affects other subjective factors as well, these classically described as signal to noise ratio, and more recently noted as dynamic range or more simply still, 'dynamics'. The important distinction here is that traditionally the noise part of the signal to noise measurement was judged in the absence of the signal, this being the easiest way to do it. Take rumble as an example. Conversely, subjective dynamics concern how much unwanted noise is present in the reproduction while the music is also playing through a complete hi-fi system; that is, a judgement of the noise in the presence of a signal. This is much harder and requires some practice. Subjectively, one can learn to recognise the spurious noise which hangs like a coloured (acoustically that is) veil over the sound stage, masking fine musical detail and blurring the definition of sharp sounds or transients, resulting in a flat, two-dimensional image that lack true space, depth and ambience. In addition the dynamic relationship between soft and loud passages appears compressed, detracting from their liveliness and 'attack'. A system with a poor dynamic signal-to-noise ratio sounds as if the subjective volume is more constant, and is usually on the loud side at that.

In the lab it has proved possible to investigate some of those factors which affect

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this dynamic quality, mainly via wide-band isolation tests. The vibration and acoustic isolation performances are assessed separately, and presented on one display where their joint effect may be judged.

For vibration purposes, the turntable was mounted on a reinforced wooden panel, flexibly mounted and driven in the horizontal plane by a small vibration exciter. The flexible mounting was provided by polyurethane foam, which gave an overall lateral resonance at around 3.5Hz. The accelleration at the centre of the tasble was monitored by a B&K accellerometer, and adjusted by an equaliser to show a fairly unform value measured in constant bandwidth analysis over the important isolation range of 10Hz to 500Hz. Above this frequency range, even the worst rubber feet on primitive players are very effective. Below 10Hz questions of subchassis and cartridge resonance excitation arise, and these were dealt with separately.

The printed vibration graph represents the RIAA equalised output from a pickup cartridge on a record and demonstrates the isolation achieved between the vibrating test board and the stylus.

The second factor, acoustic isolation, was analysed in a similar manner, but here the excitation was a uniform pink-noise soundfield generated by a powerful loudspeaker, 1m distant. A B&K microphone system was used to help define a uniform frequency response at the record position over the useful range, 30Hz to 500Hz. A parametric equaliser aided this calibration. The sound pressure was set at 90dB while the measured result was scaled against standard rumble reference level of 10cm/sec lateral at 1kHz. The baseline is equivalent to – 80dB.

Inevitably, both the turntable and the baseboard on which the turntable was mounted were jointly excited by this soundfield, and some contribution from the baseboard thus appears in the measurement depending on the vibration isolation characteristic of the turntable under test.

A turntable with excellent vibration and acoustic isolation performance has the potential for good subjective dynamics, though the resonant behaviour of the subchassis/platter arm combination will also play a part here.

For the printed graphs, as already noted, a split display is used. The upper half is a 60dB (six division) section showing acoustic breakthrough with the mid screen representing a baseline of – 80dB. The lower 60dB or six divisions are allocated to the vibration isolation, again with a – 80dB baseline. The frequency axis is linear 10Hz to 500Hz; note that most other graphs use the usual logarithmic audio frequency scaling.

Suspension modes

Using the spectrum analyser and via selective frequency sweeps into the vibrator exciter, the various subchassis and suspension modes may be explored and noted. In particular, modes which overlap the critical area of arm cartridge resonance 9-12Hz are judged severely, in view of their potential interaction with the cartridge. Rotational modes are important in that scrub flutter may be easily induced, while the effect of general chassis movement on audible wow was also noted.

Disc impulse response

Following Moncrieff's lead on disc impulse response, a 4g plastic rod was allowed to fall at an angle of 45° onto the edge of a record, in position on the platter. The cartridge sensed the transmitted mechanical impulse as it arrived at the other side of the disc and its output was captured for analysis both as an impulse response (reproduced in the reviews) and also for Fourier processing.

This deceptively simple impulse test can produce much information about the whole suspended disc playing unit. The shock is applied to the disc, and how it is attenuated in its path across to the cartridge stylus tells us about the absorption and damping characteristics of the disc support. In addition, part of this excitation is transmitted to the platter, exposing any self resonances here. Via the platter, test energy also arrives at the subchassis via the main bearing. Flexure between platter and chassis can be revealed in addition to intrinsic chassis resonances, including harmonic ringing in the suspension springs.

Tonearm resonances

Tonearms possess an ability to flex and resonate in the audio bandwidth, and are therefore a potential source of coloration, due to their close coupling with the cartridge. Less severe with high compliance models, these resonant effects are most marked using a

close-coupled, less compliant moving-coil cartridge, the Osawa *60L*, used to illustrate resonant interactions with the tonearms we tested, being an example. Its compliance measured 18×10^{-6}cm/dyne (18cu), and the acceleration in the side of its body resulting from a lateral sweep 20Hz-20kHz (*TRS1007*) was sensed by an ultra low mass wide-band accelerometer (*B&K 8307*) which records both bending and rotational modes in fair proportion.

Depending on the tonearm involved, it became apparent that severe resonances at the cartridge could be induced from as low as 30Hz right up to 20kHz, and that major differences in broad-band energy were also observable up to 20kHz. These resonances are akin to be delayed 'decay' energy responsible for the majority of loudspeaker colorations, and may be perceived in much the same way.

Ideally the arm should be infinitely rigid, to perform the task of supporting the cartridge accurately with respect to the record groove throughout the frequency range. At the same time the bearings, while free of slackness, must be of sufficiently low friction not to impede the progress of the stylus across the record, or affect its ability to ride warps and other related imperfections. Play and lack of rigidity in a tonearm not only colours the sound through audible resonance, but this very imprecision also upsets the cartridge/groove relationship, adding spurious intermodulation interference over the whole frequency range, and detracting from clarity and the quality of the stereo image.

We therefore examined arms for quality of headshell fixing, bearing play and friction, as well as for geometrical accuracy, effective mass and resonant properties. The resonance graph is not a linear function of acceleration, due to imperfection in the test cartridge (non-uniform mechanical impedance variation with frequency), and to the pre-emphasis used on the test disc. A theoretical approximation is however given for the ideal tonearm — a uniform acceleration from 20Hz to around 1.5kHz, the trend then rising at 6dB/octave in the 2kHz to 20kHz range.

To gain an idea of a single tonearm's relative performance, a study of several resonance graphs is essential; this allows recognition of common patterns, as well as some of unavoidable test cartridge/arm interactions.

In the case of 'super rigid' designs, the coupling factor from cartridge body to the arm board is sufficiently firm to allow the cartridge to read the terminating absorption properties of the arm mounting itself, which has a noticeable effect on the resonance graph: this effect may be associated with the sound quality differences that occur when an *Ittok* is fitted to different turntables, for example.

Breaks or resonances occuring below 100Hz are usually generated by seismic modes in the counterweight assembly — the rubber decoupling bushes often employed frequently being the cause. From 100Hz to 2KHz, some of the lower level disturbances may result from arm pillar mounting effects, the subchassis structure etc, while from 150Hz to 250Hz flexure at the socket in detachable headshell arms is generally apparent, often as a severe mode with a strong step or 'platform' in relative energy level. Fixed head arms show a smoother energy trend, though bending or torsional resonances in the main tube are still apparent, with the more flexible types breaking up at 250Hz, and the 'ultra rigid' examples deferring this to a high 800Hz or so. Arm designers continue to attach odd appendages which are clearly detrimental to sound quality; these include springy finger lifts and the like. In one example the cue platform was also found to resonate in the mid range.

It is also possible to hear resonances in the internal springs used for bias compensation and downforce with certain arms. Tapping the arm gently with a small screwdriver blade while the cartridge is in place on a stationary record can also help expose such phenomena. Monitoring here is best done on headphones.

Arm effective mass and arm/cartridge subsonic resonance

Earlier issues of this series were rightly concerned over the poor compatibility of many tone/arm cartridge combinations then in use. More specifically, heavy 14-20g detachable head arms were being used with high compliance 30-60cu cartridges from such manufacturers as ADC, Empire, Ortofon and Shure (to name but a few). An unstable performance in many areas was the outcome of the resulting poorly-damped 5-7Hz resonances, lying in the worst range of record warp energy.

Matters are however improving now, with the general trend towards moderate stylus compliance plus reduced tonearm and cartridge mass combining to offer much better mechanical

matching than before.

Conversely the design requirements of the modern moving-coil cartridge seem to result in low compliance values suited to higher mass tonearms; indeed these demand the strength and good resonant characteristics of such designs. The medium mass *Ittok* is well suited to such cartridges, and provides an ideal resonance combination in conjunction with the low compliance *Asak*.

With 'difficult' combinations of arm and cartridge, some method of damping the resulting subsonic resonance was considered necessary. Traditionally, this has involved a dashpot of some sort or another, filled with viscous silicone fluid and mounted in or near the arm pivots. However few arms nowadays still incorporate this feature and it is generally recognised that the correct place for a viscous damper is at the headshell, coupling the cartridge body to the disc surface via a sliding part. Rangabe first produced such a device, (sold as the *Z-Track*) but at the highest quality level, this type of device can cause some minor noises as some of the music energy is inevitably transmitted from the damper to the cartridge adding spurious sounds.

Recently, a new version of the arm damper has emerged on the Elite turntable where the fluid bath is placed over the record and engaged with a paddle mounted on the headshell adjacent to the cartridge. By its location it offers normal arm damping at the subsonic resonance and also a transmission path for structural resonances at the headshell end of the arm. In theory arm coloration is thus reduced, and in contrast to other schemes, the Elite is intended to complement an existing well-matched arm cartridge combination, not to rescue an ill-advised arrangement.

Low frequency sound quality

Really clean bass from a turntable is impossible due to the compromises involved in the complete recording/reproducing chain. For example, as mentioned in a previous issue, twelve low frequency filters are typically present between the original sound and the listener. Those we can pinpoint easily are those due to the loudspeaker itself, the amplifier and the cartridge/turntable combination, and to these we can add the disc cutter, the low frequency filter in the cutter amplifier and the magnetic head on the studio recorder. If a multitrack recording is involved, then several tape stages may also be present, while the microphone capsule plus its preamplifier are also 'in line'. So far we have ten or so filters in cascade (or additive condition); now we can include the small audio transformers used for balanced line coupling of the vast majority of studio equipment namely microphones, noise reduction systems such as Dolby *A* and *dbx*, equalisers, echo, mixers etc. At best we can add five roll-offs due to the LF limiting frequencies of these transformers; at worst some recordings have up to 30; after passing through such stages it is a wonder that the bass sounds are worth listening to at all! As these coupling transformers usually have an HF limit at around 30kHz, their effects are present at the high frequency end of the spectrum as well. Further HF problems would include disc cutter resonance, microphone cut off (typically 16kHz), pickup cartridge tip mass resonance and tracing, plus many, many more.

Fortunately with modern transformerless balanced output amplifiers and digital recording systems, the potential now exists for a reduction in the number of sound degrading interfaces. Assuming a direct-coupled amplifier, and a DC coupled recorder, in principle a digital recording chain could be constructed with only two significant LF roll-offs, namely the microphone system and the loudspeaker. This is why the classic Direct Cut records such as the Sheffield series, using a minimum of ancilliary equipment, have such a good bass.

Compact Disc is clearly at an advantage here since the player has a flat frequency response to below 5Hz and does not suffer problems of RIAA equalisation, subsonic resonance and the like. CD is also virtually immune to low frequency feedback, which is a major factor with many analogue turntables. On good recordings the CD bass compares with the original master and comfortably exceeds the present standard obtainable from analogue players.

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.

We have continued where possible to use the precision rumble coupler system which allows a DIN B threshold of measurement of close on −80dB, rather than the −65dB attainable from the best records or the −73dB available on master cut studio lacquers.

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.

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

Wow and flutter

The Matsushita master acetate was used 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 sigma functions. We used 'sigma 2' (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 damper was mainly employed for the flutter tests, in place of the Osawa 60L). The finest example recorded 0.04% DIN peak-weighted (sigma 2), 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%. 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.

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 0.1mm 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 under-sized turntable spindle. For an off-centre record rotating at 33⅓ 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 of 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 6Hz and that of the arm/cartridge above 8Hz. The maximum incidence of record warp 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 allow compression engine is fairly tolerant of poor engine tune, but a higher performance model is utterly dependent on accurately set timing, valve openings and mixtures etc.

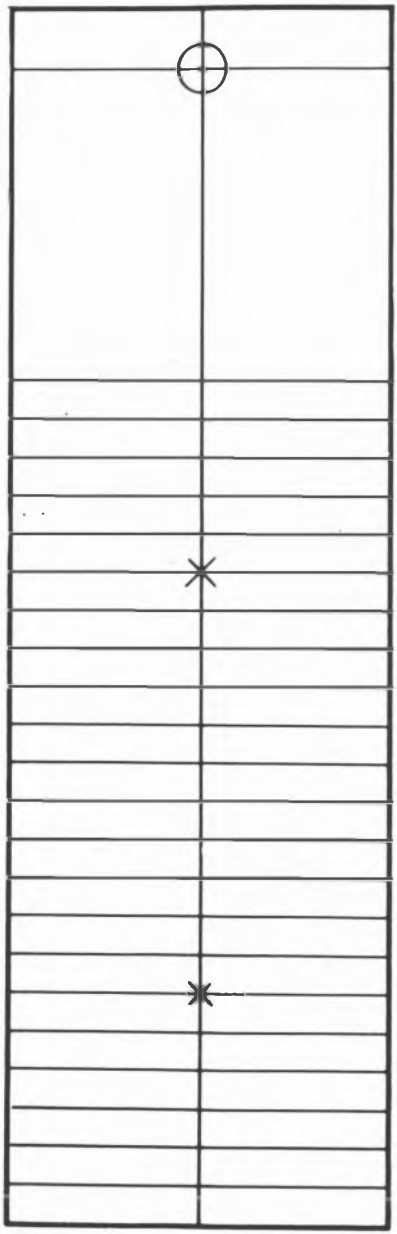
A few degrees of cartridge misalignment will degrade the channel separation of a high class cartridge by a factor of some 15dB, but on the other hand it will produce relatively little impairment of the already moderate separation characteristic of a less expensive pick-up. At present the importance of accurate arm alignment is highly under-rated. 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 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 the protractor cards that are supplied with a number of universal pick-up 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 45rpm 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 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 compatability, 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 line contact and van den Hul tips where a small tilt will cause the long contact walls to miss the intended groove sections, resulting in an unwanted rake angle between the stylus axis and groove axis, with serious consequences for groove wear and tracing.

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 23°, 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



Alignment protractor

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 manufacturer's making, but reflect the inaccuracy of the disc playing system, which is so tolerent of niceties of alignment that despite a compounded-multiplicity of errors the cartridge will nonetheless continue to play records, and many users remain oblivious to the musical information they are missing!

CD PLAYER TESTS

Fortunately a range of test discs are now produced by Philips, Sony, Technics and DHF1 which gives a wide range of computer encoded and hence perfectly accurate signals. As can be seen from the review data, frequency response, separation, linearity, intermodulation, dynamic range and spurious outputs can all be analysed. High grade instrumentation is essential to fully evaluate the best CD players; furthermore the impulse response may be inspected and the error capability of the player evaluated.

Signal to noise ratios of 86dB, distortions at −80 to −100dB and channel separations of 85dB and more are common here. The

frequency responses are so accurate as to required 0.1dB resolution! Despite the lack of absolute correlation with the listening results, these tests are still worth performing since they do prove that each model has been properly designed. Early samples had certain weaknesses which were both measureable and audible; for example the original Hitachi *DA1000* suffered from poor convertor linearity; wide spectrum high-order harmonic distortion was measured at the 0.3% level. This was manifest as a brittle, edgy quality added to the sound.

SUBJECTIVE TESTS

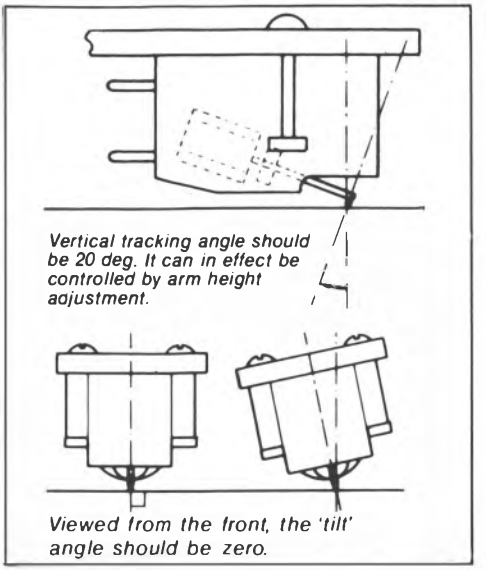
Each turntable was placed on a substantial wooden coffee table, located some 3m from the loudspeakers, on a normal suspended timber floor. The relative performance on acoustic and vibration susceptibility was reliably assessed from physical observation, checking of feedback margins, and auditioning of selected music discs. The assessment of quality for separate component tonearms was undertaken on a rigid wall-mounted platform, well-spaced from the speakers to minimise the turntable colorations.

Two Sound Tables were also used for the testing. Ancillary equipment included Spendor *SP1* and Magneplanar *MGIII* loudspeakers, the Spendors used on heavy sand filled stands with floor bonded adjustable spikes. Amplification comprised Krell *KSA-50* and Burmester *838*, supplemented by an Audiolab *8000A* for moving magnet cartridge work. Test cartridges included the EMT *van den Hul*, Linn *Asak*, Technics *EPC 205 III*, and Shure *V15V MR*.

For CD, the players were mainly used with a passive control unit, the Sondex *PCU*, working straight into the Krell power amplifier. Initial A/B comparison was all too easy, with easily matched levels and their essentially similar tonal characteristics. As auditioning proceeded, we felt committed to evaluating the subtler differences between the CD players, which proved to be much harder work, comparable to exploring the difference between good preamplifiers, for example.

CD was also compared with vinyl, but only after great care had been taken to ensure a close tonal similarity between the sources. In the case of trials against moving coil cartridges, it often proved necessary to employ a passive shelf filter with CD rolling, off above 800Hz and shelving at −2dB at higher frequencies. It was also essential to confirm the pedigree of the masters uses for CD and vinyl as these often did not match at all.

Comparative and sequential auditioning was undertaken, in an effort to explore the differences and similarities between the various models with 'blind' sessions employed on the most critical 'playoffs'. We found that turntable and tonearm auditioning was particularly difficult at the high quality end of the product spectrum due to the interaction between different components. For example, two tonearms of nominally equivalent merit could affect the sound balance of the turntables to which they were fitted to such a degree that sensible assessment was impossible.



Vertical tracking angle should be 20 deg. It can in effect be controlled by arm height adjustment.

Viewed from the front, the 'tilt' angle should be zero.

My own conclusion is that there is no such thing as a universal high performance motor unit, since the consequencies of leaving other matters of disc support, arm and cartridge in someone else's hands usually prejudices the end result. I believe that a very limited number of options exist for each model to provide a top class performance, and we have tried to identify these, albeit in a limited fashion, for as many models as possible.

ACKNOWLEDGEMENTS

Many thanks are due to Paul Crook, my assistant on this issue; to Marianne Colloms for her help in checking and typing copy, and to the listeners involved in auditioning the product in this and the last issue; Paul Messenger, Alan, McGechan, Steve Harris, David Prakel, John Atkinson and Paul Crook. Thanks are also due to the manufacturers who loaned product to aid evaluation and thanks also to Audio T, our local dealer, for the loan of equipment.

BEST BUY

Acoustic Research

Acoustic Research Ltd, High Street, Houghton Regis, Beds LU5 5QJ
Tel (0582) 603151

When it was first designed some 20 years ago, the original AR turntable was the definitive belt-driven subchassis model; this was last reviewed by *HFC* some six years ago in its final *77XB* form, after which it was taken off the market. The deck did suffer from quality control problems then, and it was unfortunate that inconsistencies were also manifest in our samples of the 'revived' version, introduced recently and tested here. This time the main bearing was poor, and did not meet our requirements until a third sample was supplied — dealers and purchasers will need reassuring that this problem has at last been resolved.

The latest version sells for around the same amount, allowing for inflation, as the old *77* model, but this time the £160 does not include a tonearm. AR will supply a 'bought-in' arm at a price of around £60, which can be factory fitted; but as this was not available in time for review, a Linn *LVX* was substituted. The appearance and finish of the deck are both very good, a much improved plinth and cover now being fitted.

AR have retained the original light-alloy cast subchassis, but this is now adapted to give a universal arm mounting, the chassis suspended on three well-placed and selected coil springs. The two-piece aluminium platter is covered by a felt mat, and is belt-driven from a conventional slow-speed synchronous motor. Speed change, as always, is effected manually after removal of the outer platter

Lab report

Platter mass was about average at 1.8kg and edge float during rotation was satisfactory. The final review sample had a fine main bearing tolerance while speed characteristics were also good, with combined wow and flutter on DIN peak weighting at a commendable 0.08%. Separately weighted, the figures for wow and flutter were also fine. Absolute speed was close to standard, the drift negligible due to the synchronous motor, while torque was ample, the speed slowing only 0.2% under the extra loading test. Speed recovery was attained without unwanted overshoot, this combination of results confirming the freedom from dynamic wow.

Good results were obtained for rumble, the DIN B weighted readings averaging −79dB, a subjectively innocuous result. Post spectral analysis revealed the presence of a couple of motor supply related harmonics at 100 and 150Hz, these absent from the upper electrical-

only graph.

On the disc impulse test, the platter/mat response was quite typical for the type and longer term modes were well damped. Both acoustical and vibrational energy were well rejected by the turntable, which was however not quite to the standard of the very best models, and shock resistance as also fairly good.

Sound quality

Auditioned with a Linn LVX, the traditionally high reputation of the AR deck was found to be well justified; in fact it was good enough to justify the use of superior tonearms such as the *RB300* from Rega or the Syrinx *Leone*.

The impression given was of an airy, articulate sound, with good timing and rhythm, plus pleasing rendition of space and ambience. The bass quality was well above average, if a little lightweight, while the mid was clear and well balanced, with the treble in good proportion.

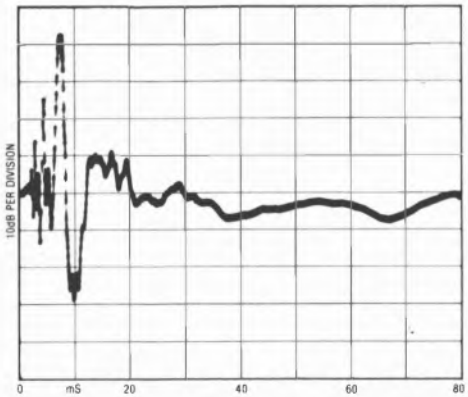
Stereo images were well developed, with a decent level of fine detail resolution in the depth plane.

Conclusion

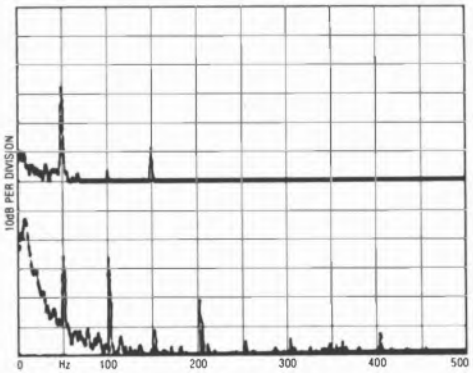
Assuming the bearing tolerance quality is maintained, the current AR turntable provides a fine all round performance with an above average finish. The chassis was well executed and remains well set for extended periods. We liked the sound and it scored high on value for money, indicating Best Buy status.

(Stop Press: We received an arm-equipped sample at last. The arm was of good quality and well adjusted, roughly equivalent to the Mission 774LC. However, the main turntable bearing was once again poorly toleranced, making a 'Recommended' rating only appropriate. 'Best Buy' status must be taken to refer only to latest production which has the improved bearing.)

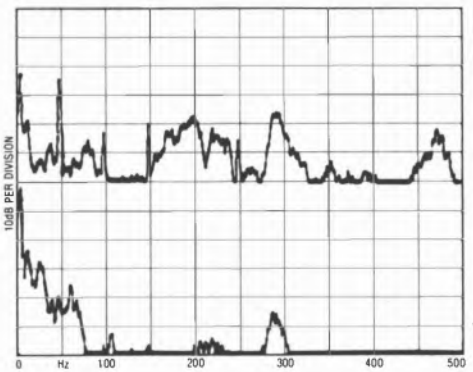
GENERAL DATA	Motor unit (arm available)
Type	belt drive, subchassis
Platter mass/damping	1.8 kg/good
Finish and engineering	both very good
Type of mains lead/connecting lead	3 core/—
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (Iin peak wtd 0.2-6Hz/6-300Hz)	0.08%/<0.05%
Absolute speed error	<0.1%
Speed drift, 1 hour/load variation	<0.1%/–0.2%
Start-up time to audible stabilisation	3.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 78/ – 80 dB
Size (w × d × h)/clearance for lid rear	46 × 39 × 16.5cm/6cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£165



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



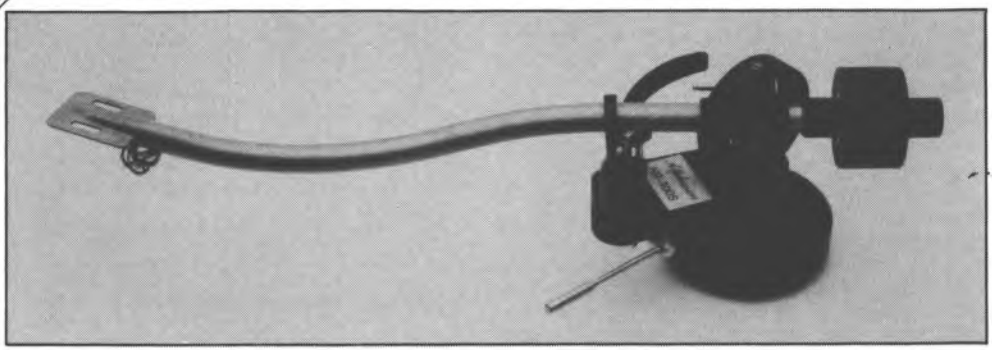
Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Alphason HR100S

Alphason, 31 Shawbrook Close, Euxton, near Chorley, Lancs PR7 6JY
Tel (02572) 76626



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

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

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

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

At present the arm is supplied with a pillar base specified as Linn *Ittok/Basik* compatible, but we did not find this to actually be the case. 6mm rather than the required 4mm bolts are used, and the tracking geometry is optimised for a 58mm radius zero tracking-error point, rather than the accepted 64-65mm. The arm is also slightly longer than the *Ittok* by about 2mm. However we understand that these discrepancies will soon be overcome in production to make the arm fully compatible. The long slotted headplate of the Alphason of course allows any desired overhang/offset angle to be obtained, and in this sense the geometry is already compatible.

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

Lab report

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

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

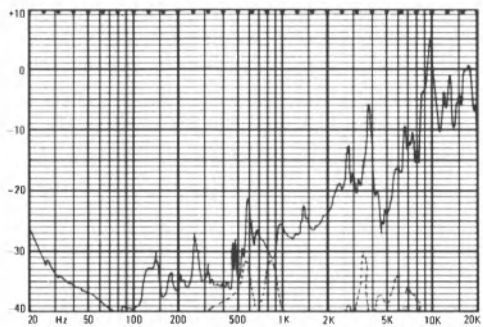
Sound quality

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

Conclusion

While the price is high the technical and more importantly the audible performances are both undoubtedly worth the money. This time round we found the arm still maintained its high standard. It now has full *Ittok* mounting compatibility, and an all-black finish which helps to tidy up its appearance. Full recommendation is continued for this finely-toleranced product.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	10g
Type/mass of headshell	non-detachable
Geometric accuracy	N/A
Adjustments provided	overhang/offset/height
Finish and engineering	good/excellent
Ease of assembly/setting-up/use	very good/good/good
Friction, typical lateral/vertical	10mg/20mg
Bias compensation method	thread, pulley and weight
Bias force, rim/centre (set to 1.5g elliptical)	180mg/150mg
Downforce calibration error, 1g/2g	−0.1g/ −0.1g
Cue drift, 8mm ascent/descent	negligible, 0.5 sec/1.0 sec
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	95pF/none
Estimated typical purchase price	£285



Structural arm resonances, audio band

RECOMMENDED

Ariston RD80SL

Ariston Acoustics Ltd, Unit 176, Brieryside, Prestwick Airport, Ayrshire KA9 2RD
Tel (0292) 76933

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

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

Lab report

Though apparently undamaged externally our review sample suffered motor disintegration in transit, but fortunately survived a rebuild. The supplied *LVX* arm fared less well as the counterweight had been left in position; the result was 'notchy' bearings.

Lab performance of the version was much the same as for the earlier model, both being to a respectable standard. Speed, wow and flutter and rumble figures were all good, if marginally poorer than before on our sample, and some mains-related rumble was evident on the drive, though the bearing showed signs of improvement with continued use — Ariston do state that there is a 'running-in' period.

Platter damping was fine, with a clean initial transient but some subchassis/platter flutter in the 'after-shock' (see impulse plots). Vibration isolation proved very good, as did resistance to acoustic breakthrough, with tolerable shock resistance and very good feedback immunity. Some rotational whippiness around 9Hz was observed with the subchassis, the main resonance being at 6Hz — while belt loading with the ridged two-speed pulley could be troublesome if adequate talc dressing had not been previously applied.

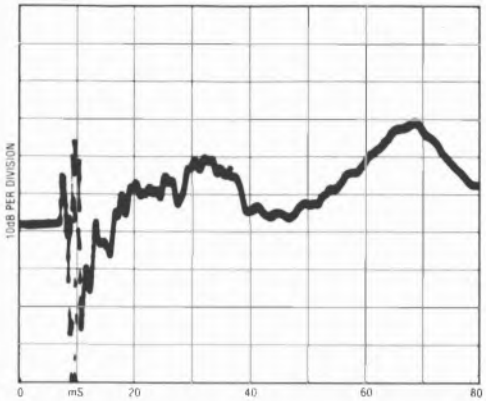
Sound quality

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

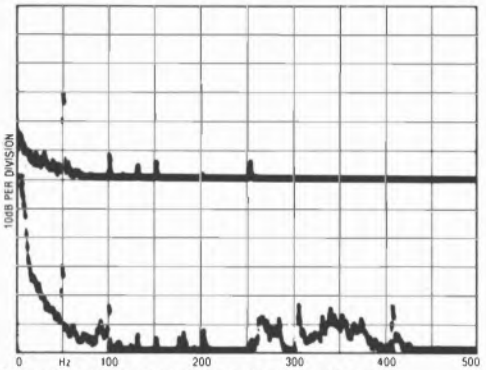
Conclusion

Reassessed for 1984, the *RD80* remains a substantially good turntable at a realistic price, in fact in our view superior to the superficially more attractive *RD40* series which models were not supplied for review. Finish and performance were to a good standard, and despite some recent competition this model continues to merit recommendation.

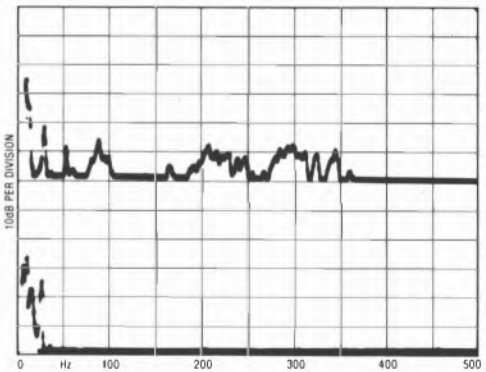
GENERAL DATA	Motor Unit
Type	manual belt drive, synchronous motor, subchassis
Platter mass/damping	2.6kg/very good
Finish and engineering	good/very good
Type of mains	2-core
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.07%
Absolute speed error	+0.08%
Speed drift, 1 hour/load variation	synchronous/−0.25%
Start-up time to audible stabilisation	4.0 sec
Rumble, DIN B wtd L/R average (see Spectrum)	−75 dB
Size/clearance for lid rear	44.5(w) x 36(d) x 17(h)/4.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good+
Hum level/acoustic feedback	very good/very good
Vibration sensivity/shock resistance	very good/fairly good
Estimated typical purchase price	£180



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



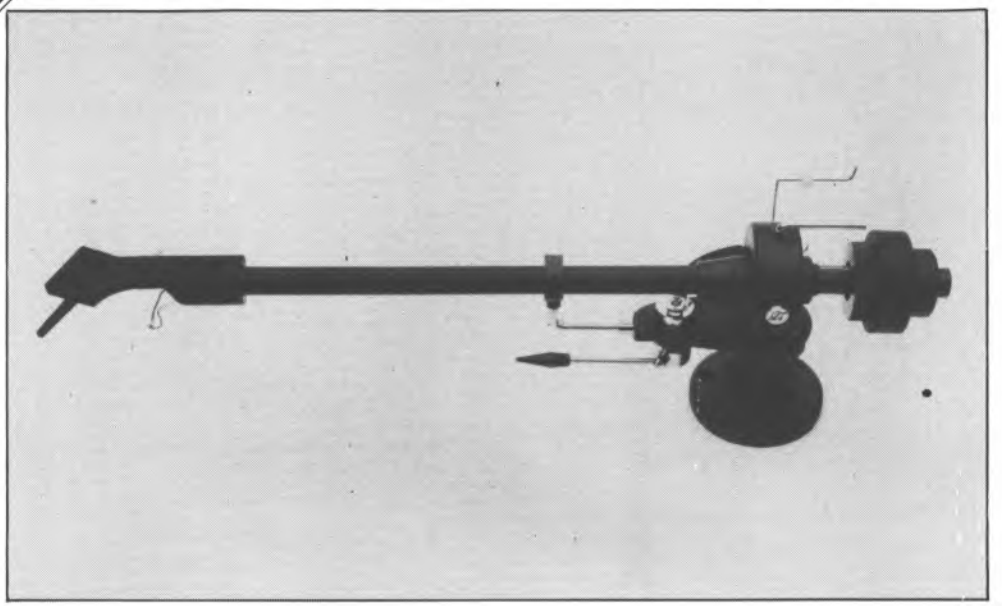
Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Ariston Magnum Opus

Ariston Acoustics Ltd, Unit 176, Brieryside, Prestwick Airport, Ayrshire KA9 2RD
Tel (0292) 76933



Supplied on our latest sample of *RD80* turntable, the *Magnum Opus* was also tested as a separate item; though it is probable that the majority of these arms will be supplied, like the sample we had for review, factory-fitted on an Ariston deck.

This arm is made in the UK; Ariston's lower-cost Japanese built alternative, the Opus, was not submitted for review. The *Magnum Opus* retails at around £80 and has a fixed headshell or cartridge mounting platform, of moderate mass and moulded in a rigid grade of glass reinforced nylon.

A conventional gimbal bearing is fitted, with a full set of four opposed ball races, something that is not always found at this price level. We found that the bearings were well adjusted with satisfactory friction as well as negligible play. Biasing was via thread and weighted lever, while the counterweight was a rotating design, with a pre set downforce calibration scale, the whole somewhat decoupled from the arm by a rubber insert in the rear stem.

The arm is distinguished by unusually flexible leadout wires, chosen to minimise interference with the subchassis. In the case of the *RD80,* the arm is factory-wired to the plinth terminal panel, connection then being made on the outside using a normal phono-to-phono lead, this fitted with an earth wire of course. The arm is well finished in a matt black.

Lab report

Effective mass was moderate at 11.5g inclusive of hardware, this suited to a number of medium compliance cartridges in the 12-22cu range. No problems were encountered with either setting-up or geometry. Bearing friction was fine in the lateral plane, but a little on the high side in the vertical one, where it measured 80mg. Tested at the 1.5g setting, the bias compensation provided compatible values for an elliptical stylus.

Downforce calibration was a little out, applying forces around 10% above calibration, but at least it erred on the safe side! Cue operation was satisfactory.

Charted with an Osawa *60L* cartridge, the structural resonances of the *Magnum Opus* were examined via accelerometer excitation. The result was quite tidy, showing initial breakup at 500Hz to 700Hz, with fair control in the upper frequency range. A pretty rigid, well-damped design is indicated by these results.

Sound quality

The sound quality was considered competitive when judged against the standard set by other

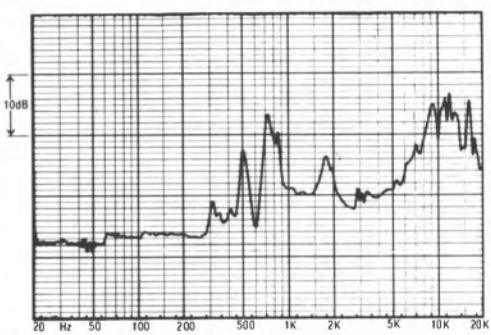
similarly-priced arms. The mid and treble registers showed noticeable restraint, and although this was not too serious, the bass was not so good, showing a loss of both power and definition.

Conclusion

The *Magnum Opus* arm can confidently join the ranks of the new generation under-£80 tonearms. On our sample, admittedly the vertical friction was a trifle high; but, more importantly, the bearings were slack-free. The sound quality also attained a good standard, sufficient for some modest moving coil cartridges. Moreover, it made for a worthwhile combination with the *RD80* player, and recommendation is clearly in order.

GENERAL DATA Tonearm

Approximate effective mass, inc screws, excl cartridge	11.5g
Type/mass of headshell	non-detachable/ –
Geometric accuracy	good
Adjustments provided	rotation/overhang/offset/height
Finish and engineering	good/very good
Ease of assembly/set-up/use	good/good/good
Friction, typical lateral/vertical	<20mg/80mg
Bias compensation method	thread and weight
Bias force, rim/centre (set to 1.5g elliptical)	240mg/270mg
Downforce calibration error, 1g/2g	+ 0.125g/ + 0.2g
Cue drift, 8mm ascent/descent	0.5 secs/3.0 secs
Arm resonances	fairly good
Subjective sound quality	good
Arm damping	moderate counterweight decoupling
Estimated typical purchase price	£80

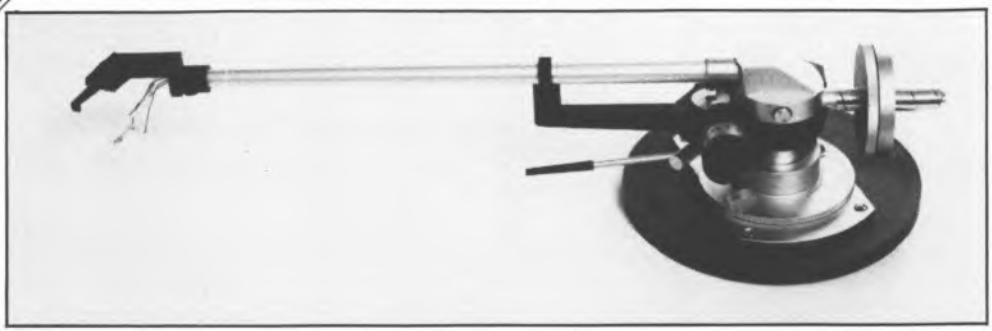


Structural arm resonances, audio band

RECOMMENDED

Audio-Technica AT1120

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



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

The *1100* was characterised by its detachable arm carrier fitted with a rigid low mass fixed headshell, the counterweight an elaborate affair with a lead-screw drive. With the *1120* Audio Technica have in essence simplified the design and taken some steps to improve certain areas, notably the bearings. These changes are in fact sufficient to result in a new arm model and justify a full review here.

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

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

Lab report

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

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

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

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

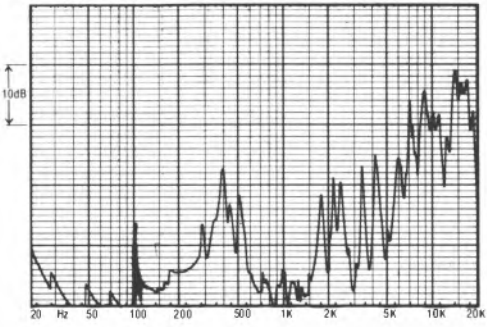
Sound quality

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

Conclusion

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

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	5g
Type/mass of headshell	non-detachable
Geometric accuracy	excellent
Adjustments provided	overhang/offset/height
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	very good/very good/very good
Friction, typical lateral/vertical	5mg/20mg
Bias compensation method	weighted lever
Bias force, rim/centre (set to 1.5g elliptical)	175mg/145mg
Downforce calibration error, 1g/2g	– 0.05g/none
Cue drift, 8mm ascent/descent	none, 0.5 secs/2.6 secs
Arm resonances	average +
Subjective sound quality	good +
Lead capacitance/damping method	85pF/decoupled counterweight and damping pot
Estimated typical purchase price	£110

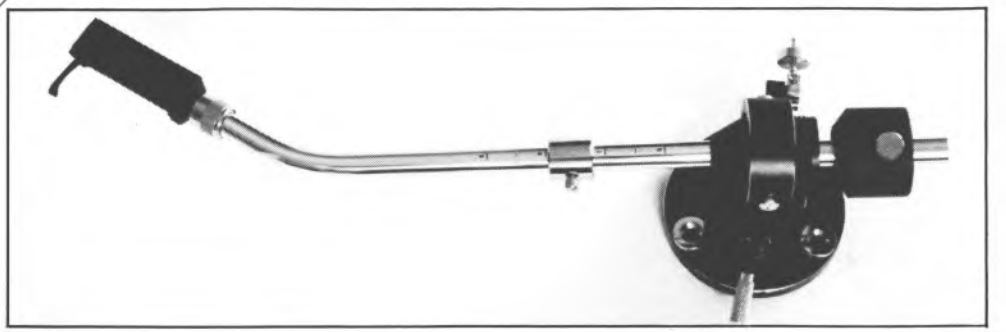


Structural arm resonances, audio band

RECOMMENDED

Audio-Technica AT1503 III

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



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

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

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

Cartridges in the 1 to 20g mass range may be accommodated and in the case of integral-headshell types up to 33g can be accepted. The *1503* may thus be seen as the antithesis of the *AT1120!* The geometry is slightly imperfect in that while a 1 deg 55 sec maximum tracking error is specified, the instructions suggest that an additional ±1mm overhang error is admissable, this due to the headshell fixing intervals – so in fact 1 deg of additional error can then result.

Lab report

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

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

Sound quality

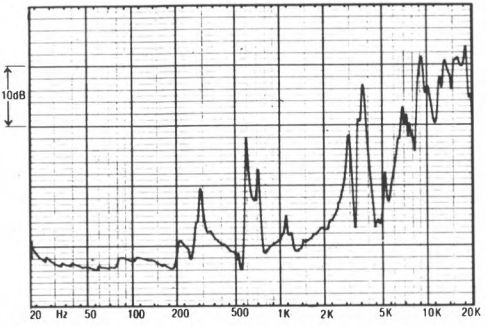
Judged a superior product on auditioning, some mild loss of definition was attributable

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

Conclusion

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

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	20g
Type/mass of headshell	special detachable/13.5g
Geometric accuracy	very good
Adjustments provided	overhang, height
Finish and engineering	excellent/excellent
Ease of assembly/setting-up/use	very good/good/very good
Friction, typical lateral/vertical	50mg/10mg
Bias compensation method	weighted lever
Bias force, rim/centre (set to 1.5g elliptical)	150mg/150mg
Downforce calibration error, 1g/2g	– 0.05g/ – 0.1g
Cue drift, 8mm ascent/descent	N/A
Arm resonances	good
Subjective sound quality	good +
Lead capacitance/damping method	95pF/none
Estimated typical purchasing price	£160

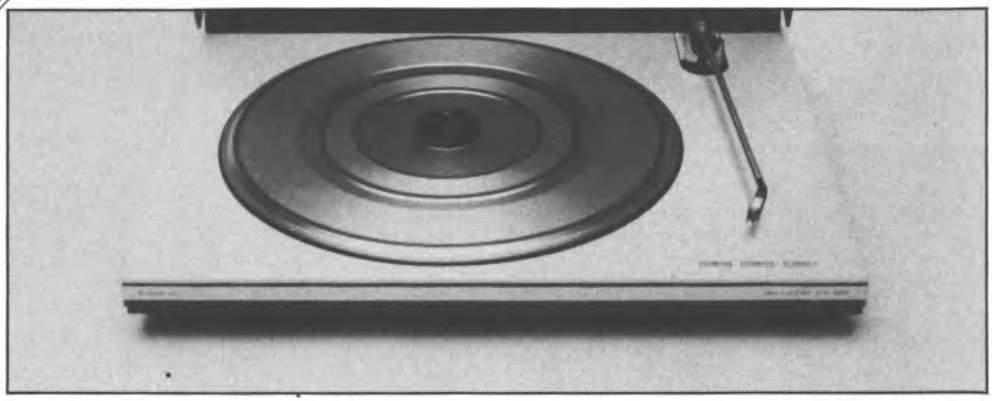


Structural arm resonances, audio band

RECOMMENDED

Bang & Olufsen Beogram 1800

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



Initially supplied for review as a *Beogram 1800* model, this deck is shortly to be introduced in alternative *RX1* form, this version having phono-plug signal wiring and some cosmetic changes.

The *1800* is a development of the *1700* (reviewed in the last *Turntables* issue) and retains B&O's extremely effective suspended subchassis with cantilevered leaf springs.

Demonstrating modern, unfussy styling, the *1800* is excellently finished and offers fully automatic operation. An ultra-low-mass tonearm is fitted, this including a matching integral B&O cartridge. The combination tracks well, and has an ideal subsonic resonance of 12Hz.

In two areas the construction is rather lightweight, namely the thin aluminium platter and the tonearm bearing/pillar assembly; the latter clearly does not follow the current fashion for rigidity with bearings free from slackness.

Lab report

Under test, the motor section performed well. DIN peak-weighted wow and flutter was fine at 0.09%, with good figures also obtained for the separate flutter and wow component. Absolute speed error was low while good torque was shown by the mild 0.22% slowing under load. Some mild speed overshoot was however present on recovery after load removal. Start-up was satisfactory and, more important, the deck's automatic cycles were free from the frustrating dithering and delays so often experienced with other 'auto' players.

Rumble was excellently low for the price, measuring – 80dB, while the spectrum analysis of mechanical noise revealed nothing of significance, with both motor and hum vibration very well suppressed.

Acoustic breakthrough was particularly well-handled by this deck, while the vibration isolation was also good considering the low subchassis mass. The suspension was also well behaved, placing all modes clearly in the 3-5Hz region, well clear of the arm/cartridge resonance frequency.

The arm performed fairly well on measurement, though tests were complicated by the unique cartridge and fixing, and the automatic facilities. For example, arm structural resonances were measured using the supplied cartridge and consequently are not directly comparable with those for the other arms. A lack of rigidity was denoted with modes at 300Hz and 600Hz, which are however satisfactory in this price context, and arm friction was low. Bias levels were on the high side by about 30%, but this again is not too serious.

The cartridge proved to be an able performer, with good channel separation plus a decent frequency response of 30Hz to 20kHz, ±2dB. Overall it is rather better than most cartridges fitted to players at this price level. Close inspection of the graph does again show evidence of the 300 and 700Hz arm modes.

Turning to the disc impulse response, the platter did not appear to offer very good record termination and is no better than average here.

Sound quality

Performing well in its category, the B&O was an eminently civilized and well mannered product. In terms of frequency balance it was fairly neutral, with a sweet, restrained treble register — but overall it lacked some 'bite' and 'attack'.

The bass could also have been firmer, and while the stereo effect was pretty good, more

transparency would not have gone amiss. Nonetheless, the overall impression was good, and furthermore, both shock and acoustic feedback were well handled.

Conclusion

With its basically good sonic performance, plus a fine set of lab results, the *1800* also offers comprehensive automatic facilities. Further benefits accrue from the inclusion of a worthwhile, properly-integrated cartridge, plus the superb slimline styling and finish. It has got to be a good £100 worth, but with a recent increase putting the price up to around £110, we feel that the *1800* now just misses a 'Best Buy' rating, though of course is still warmly recommended.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

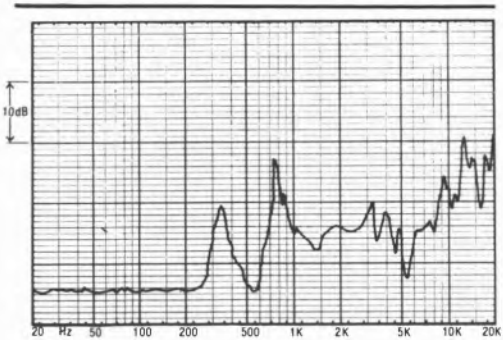
Type	auto belt-drive, subchassis
Platter mass/damping	0.6kg/fairly good
Finish and engineering	very good/good
Type of mains lead/connecting lead	2-core/DIN
Speed options	auto, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.09%
Wow and flutter (Iin peak wtd 0.2-6Hz/6-300Hz)	0.11%/0.14%
Absolute speed error	– 0.15%
Speed drift, 1 hour/load variation	+ 0.08%/ – 0.22%
Start-up time to audible stabilisation	approx. 3 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 80dB

Arm section

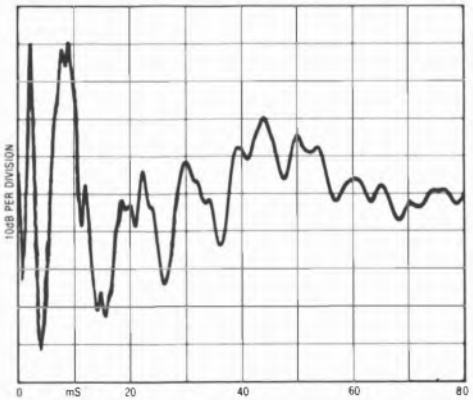
Approximate effective mass, inc screws and cartridge	6.0g
Type/mass of headshell	integrated cartridge
Geometric accuracy	very good
Adjustments provided	downforce
Finish and engineering	very good, good
Ease of assembly/set-up/use	very good/very good/excellent
Friction, typical lateral/vertical	35mg/20mg
Bias compensation method	internal fixed spring
Bias force, rim/centre (set to 1.5g elliptical)	400mg/420mg
Downforce calibration error, 1g/2g	±0.06g/±0.06g
Cue drift, 8mm ascent/descent	low, 1.2 secs/0.8 secs
Arm resonances	see graph
Subjective sound quality	—
Arm damping	none

System as a whole

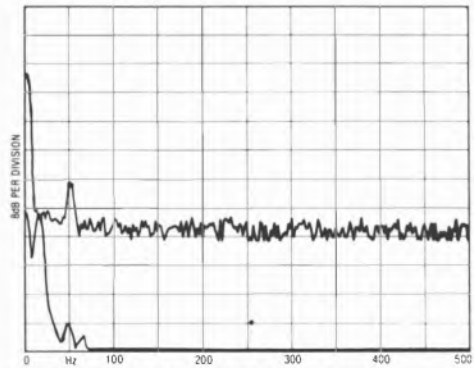
Size (w x d x h)/clearance for lid rear	44 x 33 x 9.5cm/none
Ease of use	excellent
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	average +
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	very good/very good
Estimated typical purchase price	£110



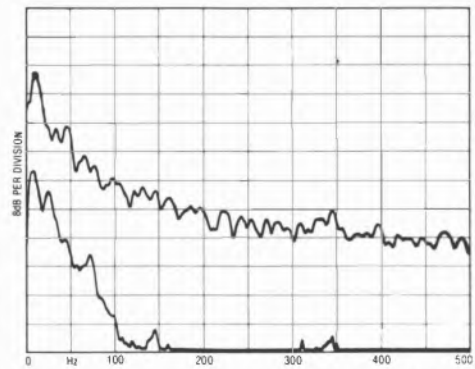
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

Dais 'Heavy'

Audiophile Products Ltd, 5 Crown Terrace, Hyndland, Glasgow G12 9HA
Tel 041-221 5079

An early version of this design was assessed in the previous edition when it carried the Image name. Still made in the UK by Newline Engineering, the Dais, in addition to its new name, also has a new distributor. Two versions of this substantial subchassis turntable are available — the standard model which carries the original 4.4kg platter and the 'Heavy,' where the platter mass rises to 7.0kg. The heavier platter may in fact be retrofitted to the standard version on an exchange basis on payment of the price difference of around £80. The 'Heavy' version is the main subject of this review but we are reliably informed that though the context of a £1000-plus player system the larger platter is worthwhile, the nonetheless substantial 4.4kg 'standard' version represents only a small compromise in performance.

With a distinctive cylindrical shape, and now finished in superb black gloss, the Dais has an arm mounting consisting of and outrigger extension of the exposed subchassis. A conventional three-point spring suspension is used with one spring arranged as a rotational mode canceller by virtue of its asymetry and its contra-spiral winding.

As before, a slow speed synchronous mains motor provides power via a white silicone-rubber cord, end-joined and of round section, the grooved pulley having two diameters for 33⅓ and 45 rpm. The base 'plinth' is of gravity-cast aluminium, the interior including an 11-ply wood reinforcement for damping. Top surface access to the alignment bolts (massive socket-head screws) is convenient although there is no provision for base levelling (this is also true of the Linn). The turntable is also very awkward to move once set up, and is best assembled on site, then left alone thereafter. The main subchassis resonance is rather low at 3-3.5Hz and after-shock recovery is consequently rather slow. The original Image sample showed a distinct tendency to rotate about the platter's centre of mass at around 8Hz, inducing scrub flutter and exciting the cartridge subsonic resonance — but this problem is certainly cured with the Dais.

The platter comes with a felt mat which may be discarded allowing direct record contact with the well finished platter surface. No recess is however provided for label or rim, so this suggestion is not as sound as it might be. An acrylic disc is provided to prevent dust from accumulating on the mat, but the arm is left to the elements, unless an additional £100 is spent on a custom acrylic box cover for the entire unit.

Lab report

Large rubber inserts on the massive platter result in a rather dead assembly, which despite the felt mat produced a well damped impulse response. Wow and flutter was good at 0.08% DIN weighted. Flutter readings were low, but the pure wow residual was poorer than expected from this class of turntable — 0.14% was

recorded, and observation of the absolute speed indicator revealed cyclic wow probably associated with belt join, a point noted with the previous version. Absolute speed was fine, with only a 0.1% error, and load variation satisfactory at – 0.25%. Start-up was slow at 5 seconds.

Rumble remains a problem with this model, the right channel proving fine at 78dB but with the left only resolving – 70dB. Subjectively, this is good enough, but not in the superfi class. Motor harmonic breakthrough is the cause and would justify further attention. Rated excellent on acoustic breakthrough and vibration coupling, the Dais was very good on feedback and satisfactory as regards shock immunity.

Sound quality

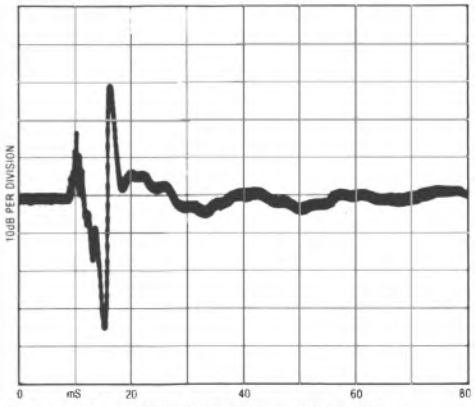
Auditioned with the Zeta arm, which made a handsome combination, the Dais met top-class standards. Bass was notably clean, even and deep with excellent tonal differentiation; while stereo images were well focused and spacious, with an impression of a strong foundation. Feedback was not detectable in our set up. Two very slight reservations were expressed, one concerning a feeling of slight midband congestion and the other a marginal loss of absolute security of pitch on transient programme — the mild cyclic wow perhaps? The measured motor breakthrough apparently passed unnoticed.

Conclusion

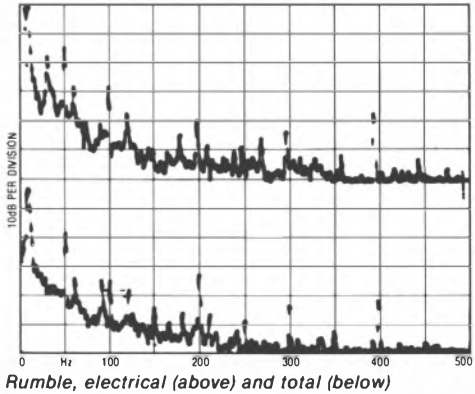
I am still left with the feeling that the Dais has further potential waiting to be realised. When the dust cover is taken into account, both versions are very costly and hence would need to be virtually perfect to ensure a *Choice* recommendation. This might come with a little further development. The Dais can undeniably produce a very good sound with first-rate bass, but as it stands it suffers slightly by virtue of some minor flaws.

GENERAL DATA	Motor unit
Type	belt-drive, subchassis
Platter mass/damping	7.0kg (*4.4kg)/very good
Finish and engineering	excellent/excellent
Type of mains/connecting leads	3-core
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.14%/0.06%
Absolute speed error	– 0.1%
Speed drift, 1 hour/load variation	synchronous – 0.25%
Start-up time to audible stabilisation	5.5 secs
Rumble, DIN B wtd L/R average (see spectrum)	– 70/ – 78 dB
Size/clearance for lid rear	46(w) x 33(d) x 13(h)/none
Ease of use	fairly good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	good/very good
Vibration sensivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£480 (*£399)

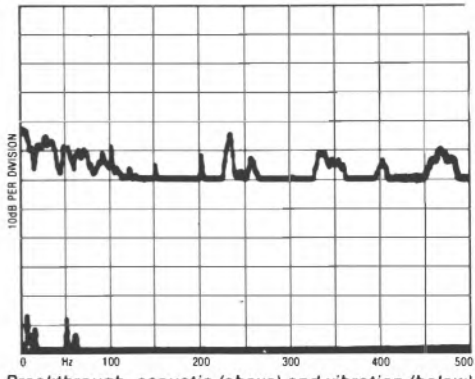
**'Standard' version – all tests on 'Heavy' version*



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

Dual CS514

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks
Tel (0753) 888447

Both *514* and *515* models were supplied for review, the two being very similar in many respects. The *515* sports a touch of mass loading inside the platter rim, plus a slightly more expensive cartridge, but of the two, the *514* would seem to be better value for money, and provided the main subject of this review.

Based on a rather lightweight plastic moulded plinth mounted on small rubber feet, the *514* series uses a sort of steel plate sub-chassis, crudely isolated on rubber grommets. This acts rather more as an anti-feedback (or 'anti-howlround') device than a proper isolation method. A dc motor is used, coupled by belt to the inner drum beneath the ultra-light 0.63kg platter; the latter is a thin pressing of sheet alloy, though the mat is of reasonable quality.

The resonant lid is joined to the plinth and inevitably this arrangement communicates unwanted energy to the cartridge. Front panel controls are provided for speed change and cueing, and appearance and finish are good.

A standard Dual tonearm is fitted, with a nicely-made pivot assembly and good alignment. The bearings did show some play, though.

Lab report

Platter damping was considered to be fairly good, but the disc impulse response illustrated a serious lack of rigidity. The initial pulse was well handled but was followed by a severe platter rock identified at 20Hz, which in fact overloaded the analyser display. Wow and flutter, DIN peak, was fine at 0.09%, with well balanced flutter and wow contributions. Absolute speed was very close to standard but torque was poor; it slowed a serious 0.85% under load, a result not helped by the low-inertia platter. Rumble was more than satisfactory at around – 75dB, DIN B.

Vibration isolation was pretty poor, break-through peaking at around 35-40Hz, which is rather close to typical room modes. On the printed graph the acoustic isolation is dropped by 10dB, and given this visual advantage, the player can be seen to reject acoustic energy rather poorly, especially above 300Hz, again a consequence of the light platter.

The spectrum analysis of the rumble showed a chain of mains related harmonics, which were later improved by better test system earthing. The rumble components were pretty harmless.

Turning to the tonearm, the effective mass was moderate at 9.5g. Lateral angle and overhang adjustment were possible though some play and 'clicking' could be detected from the bearings when the arm was stressed. In view of the type of cartridge likely to be used, the measured arm friction was acceptable, and the bias compensation proved effective, as always with Dual arms. Downforce calibration was well within tolerance and the cue also worked well.

Structural arm resonances were charted with the Dual *DN239* moving magnet cartridge and showed fairly severe break-up at 220 and 400Hz, although this result was fair enough for the price. The cartridge was quite a smooth performer measuring, ±2dB from 30Hz to 20kHz, and its sound should not give offence.

Sound quality

Compared with its bigger brother the *505,* the *514* appears somewhat sub hi-fi. The bass was found weak, but free at least from serious boom, and while it was unreasonably tidy and controlled overall, it seriously lacked depth and

dynamics. Rumble was OK, the programme wow was unmistakeable, a consequence of the poor torque. Stereo focus was satisfactory.

Conclusion

It has been pointed out to me that £20 or £30 is a big difference when considering the quality of players at this lower price level. However, if at £65 the *514* was adequate, then the *515* actually sounded worse, and the *505* was so much better that I would strongly recommend that buyers move up to it. All I can say is that the *514* is perhaps worth considering for the least expensive systems.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

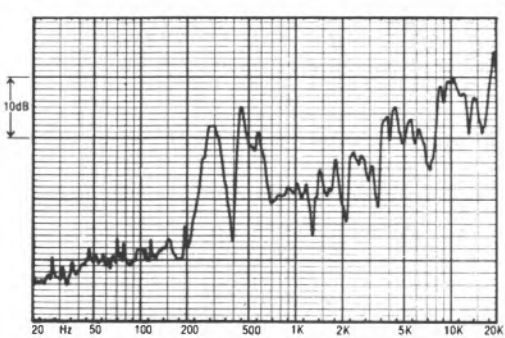
Type.....semi-auto belt-drive
Platter mass/damping.....0.625kg/good
Finish and engineering.....very good/good
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.09%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.018%/0.05%
Absolute speed error.....<0.1
Speed drift, 1 hour/load variation.....synchronous/ – 0.85%
Start-up time to audible stabilisation.....1.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 75/74dB

Arm section

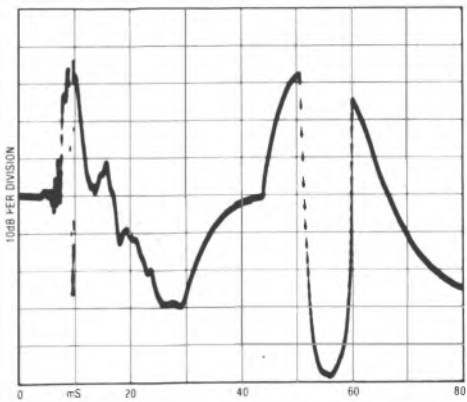
Approximate effective mass, inc screws, excl cartridge.....9.5g
Type/mass of headshell.....non-detachable
Geometric accuracy.....good
Adjustments provided.....overhang/offset
Finish and engineering.....very good/average –
Ease of assembly/set-up/use.....very good/very good/very good
Friction, typical lateral/vertical.....70mg/45mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....225mg/300mg
Downforce calibration error, 1g/2g.....0.05%/ – 0.1%
Cue drift, 8mm ascent/descent.....fairly good, 3.5 secs/2.5 secs
Arm resonances.....average –
Subjective sound quality.....acceptable
Arm damping.....none

System as a whole

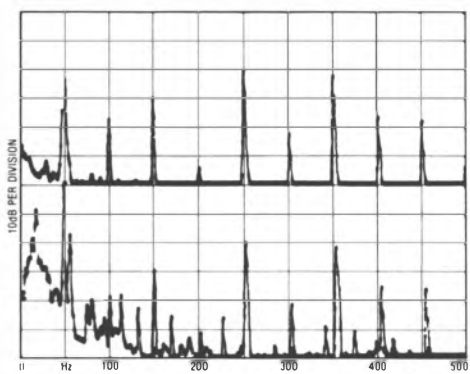
Size (w x d x h)/clearance for lid rear.....44 x 36 x 11.5cm/3cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....poor
Subjective sound quality of complete system.....adequate
Hum level/acoustic feedback.....average – /poor
Vibration sensitivity/shock resistance.....poor/fair
Estimated typical purchase price.....£65



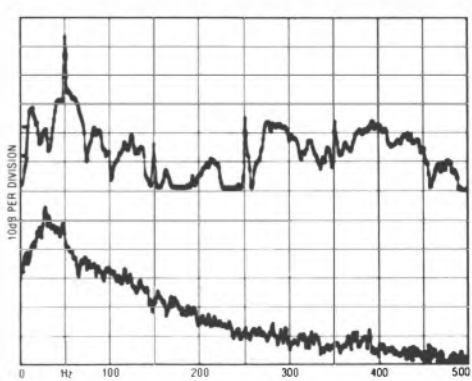
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

BEST BUY

Dual CS505

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks
Tel (0753) 888447

In production now for a number of years, the *505* design has undergone a continuing series of cumulative minor improvements which have helped maintain its competitive position. Price has also been kept in check.

The player is based on an old-style steel deck plate, supported on four foam-damped coil springs. This deck plate is heavily flanged to increase rigidity, and the modest platter is equipped with a fairly heavy rubber mat.

Belt driven by a 16-pole synchronous motor, the *505* is fitted with a unique variable pitch control, achieved by the use of a multi-lobed expansible motor pulley. Correct speed setting is achieved via stroboscope markings on the platter rim, though these were found none too easy to use.

For the latest *505* version, the *505-II* tested here, the tonearm has been revised and is now fitted with a special detachable headshell with quite a firm fixing. This came ready supplied with the redoubtable Ortofon *OM10* cartridge, and while we briefly tried an ellipitical-tip version during the tests, we felt the *OM10* gave superior results in this deck.

Lab report

A notable feature of this new version is the significant reduction in rumble, which has improved from a satisfactory figure of 67dB to a new average of 73dB. Spectrum analysis showed the usual contribution of motor vibration components, but these were not considered to be very serious. Speed characteristics were much as before with good wow and flutter, while good torque was also demonstrated, the mild 0.2% slowing under load being up with some of the best examples, and helping to offset the low inertia of the platter. Vibration and acoustic isolation factors remain unchanged, at a good level, and well above average for the price.

The new arm possessed a moderate effective mass, measured at 10g, this including mounting hardware. The headshell itself weighed a modest 4g. The arm was well aligned and the pivots were reasonable, proving moderate in friction but subject to a rather small pre-load; more than a gentle twist to the arm resulted in audible bearing 'clicking'. Biasing was accurate and downforce calibration acceptable. Arm structural resonances were chartered with the cartridge supplied; as can be seen on the graph, the first weakness appeared at 90Hz, while the main problems occurred at 220 and 400Hz, this result apparently not a great improvement on the previous design. Above 600Hz, however, the resonances were pretty well behaved.

Sound quality

The *505's* sound was tuneful, lively, punchy and somewhat 'forward' in presentation. Pitch and

timing were also good, while the bass was fairly good and the stereo image had quite a respectable depth as well as above-average focus. It could sound a little muddled in the mid and treble but not seriously so, and the cartridge suited it well — we would not change it.

Conclusion

The *505* has managed to maintain its competitive position and provides a competent hi fi sound. In our view it is the clear 'under £100' group leader, so much so that the less expensive players, including Dual's own *514*, do not really stand much of a chance. Strongly recommended as a complete package with the *OM10* cartridge, the latest *505* wins Best Buy status.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

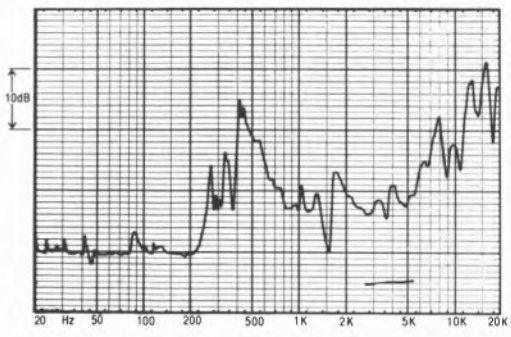
Type.....semi-auto, belt drive, subchassis
Platter mass/damping.....0.85kg/good
Finish and engineering.....very good/good
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.075%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.95%/0.08%
Absolute speed error..... – 0.1%
Speed drift, 1 hour/load variation..... + 0.065%/ – 0.2%
Start-up time to audible stabilisation.....2.4 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 72/ – 74dB

Arm section

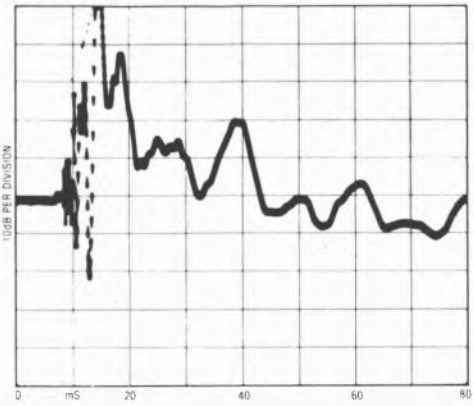
Approximate effective mass, inc screws, excl cartridge.....10g
Type/mass of headshell.....special detachable/40g
Geometric accuracy.....good
Adjustments provided.....overhang/offset
Finish and engineering.....very good/good
Ease of assembly/set-up/use.....very good/very good/very good
Friction, typical lateral/vertical.....40mg/20mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....225mg/225mg
Downforce calibration error, 1g/2g..... - 0 12g/ – 0.2g
Cue drift, 8mm ascent/descent.....very slight, 3.5 secs/3 0 secs
Arm resonances.....average +
Subjective sound quality.....average +
Arm damping.....decoupled counterweight

System as a whole

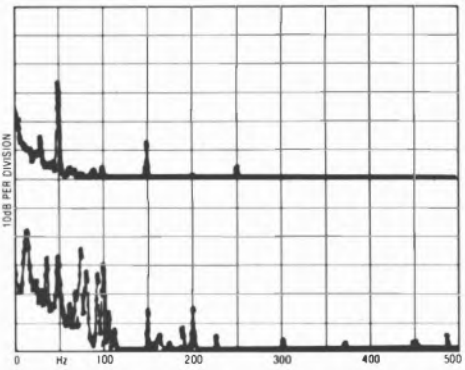
Size (w x d x h)/clearance for lid rear.....43.5 x 37 x 14cm/7cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....average +
Subjective sound quality of complete system.....good
Hum level/acoustic feedback.....good/good
Vibration sensitivity/shock resistance.....good/good
Estimated typical purchase price.....£90



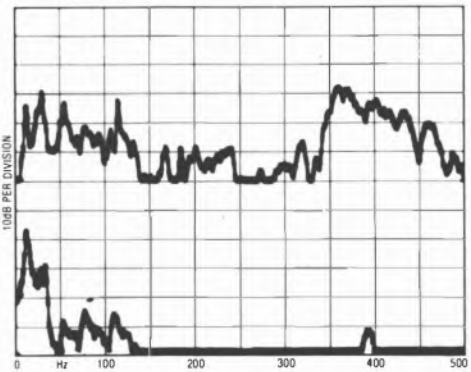
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



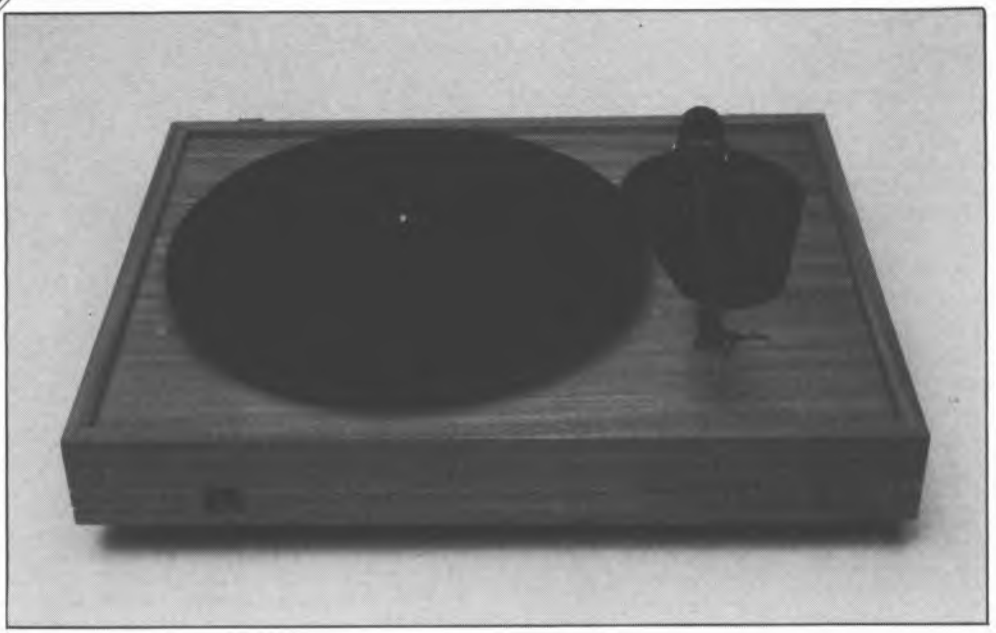
Breakthrough, acoustic (above) and vibration (below)

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

BEST BUY

Dunlop Systemdek IIX

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



The *IIX* is an entirely new model from Dunlop, effectively replacing the successful *Systemdek II*. Floating subchassis models are rare at the £115 level, and the *IIX* is accordingly one of a select few. In the manner of its suspension it resembles the Pink Triangle; the subchassis hangs on fairly small diameter coil springs adjustable from above. Good chassis dynamics are ensured, and it can be seen to swing freely in the required planes of motion. The standard Dunlop oil-feed bearing is used and all vital parts are well engineered.

Formed of steel plate, the subchassis is reinforced by an aluminium girder extrusion linking main bearing to tonearm mount. A plate glass platter plus felt mat surmounts the inner platter drive hub, and a standard synchronous motor (with two-speed pulley) is used to power the deck via a precision rubber belt.

The plinth has a good finish plus a decent lid, mounted on good hinges. Arm mounting is straightforward and cable dressing no problem; for testing we fitted a Mission *774LC*, this ensemble being factory priced at about £180. However, we have been informed by Dunlop that in future they may be able to offer their own Japanese-sourced 'LC' arm.

Lab report

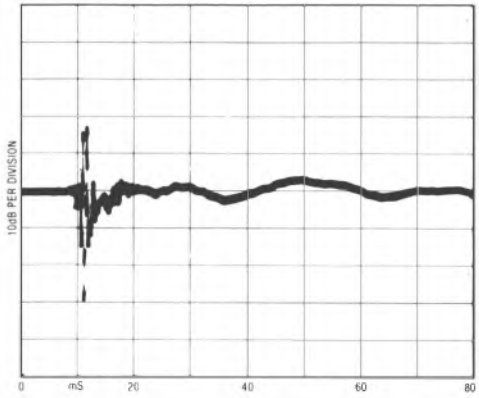
Founded on the good results of the earlier *II*, the *IIX* performed well on test. Platter mass was a realistic 1.8kg with average disc damping accorded by the felt mat. When the Dunlop disc clamp was used, some improvement occurred, this seen in the reproduced impulse response.

Weighted wow and flutter was moderate at 0.09% while unweighted flutter was fine at 0.1% as was wow at 0.12%. The deck did run a little fast but showed excellent torque, the 0.13% slowing under load being a fine result, indicative of the complete absence of subjective programme dynamic wow. DIN B rumble was also very good at −80/82dB, spectral analysis showing some 100Hz motor harmonics but at a harmless level.

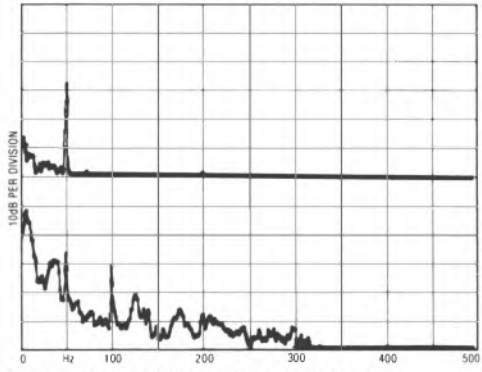
This model was another front-rank performer as regards vibration and acoustic isolation — very little energy gets in above 30Hz.

Sound quality

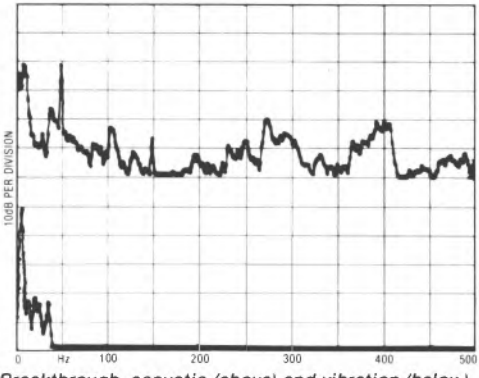
Fine results were obtained on audition. Stereo images were well focused, while good depth and midrange detail were evident. The bass was notable for its clean, even quality, showing good attack and tunefulness.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

Tonally, the deck sounded a little bright and forward with a hint of 'echo' in the mid, and it could also sound a trifle 'louder' than the best of its competitors. Rumble and wow were inaudible.

Conclusion

A year or so on, and Dunlop have improved the original *II* to produce the *IIX*, adding a plinth and a cover in the process but keeping the original price. Another likeable deck, particularly good on rock programme where its strength in the bass is decisive, the *Sys‹emdek IIX* comfortably scores a Best Buy rating.

GENERAL DATA	Motor unit
Type	belt drive, subchassis
Platter mass/damping	4.75 kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting lead	3 core/—
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.14%/<0.05%
Absolute speed error	+ 0.05%
Speed drift, 1 hour/load variation	synchronous/ – 0.16%
Start-up time to audible stabilisation	4.3 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 76/ – 78 dB
Size (w × d × h)/clearance for lid rear	41 × 34 × 16.5cm/6.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/excellent
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£220

BEST BUY

Dunlop Systemdek IIS

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

Presumably Dunlop were so pleased with the performance of their model *II* that they felt it was worth developing the design to an even higher standard, and hence the emergence of the more expensive *IIS*. This model includes the excellent concave platter of the original *Systemdek*, a massive machined Mazak casting which weighs a generous 4.75kg. A thin felt mat is permanently bonded to the platter and in conjunction with the Dunlop clamp supplied firmly clamps the record, the concavity helping to remove warps at the expense of a mere 1° or so tilt in the record plane with respect to the cartridge. A tonearm with a head rotation facility is ideal, allowing proper compensation of this angle, although in practice few users would be aware of the effect.

The three inboard suspension springs were rather compliant, and held all the dynamic chassis modes to 4Hz and below, this including rotation. The chassis itself is a bit top heavy, and yaws more than usual — this could adversely affect wow. The established steel and aluminium plate subchassis has also been retained, but is now of increased thickness and strength. Improvements are also apparent in the matter of arm lead dressing, which when optimised helps to control the rotational mode.

Lab report

There was no need to fear suspension effects on the speed characteristics, which in the event measured well. DIN peak wow and flutter held to a fine 0.08%, with superbly low flutter and satisfactory wow. The motor and drive demonstrated excellent torque, with the 0.16% slowing under load indicative of minimal dynamic wow effects. Start-up was good considering the massive platter.

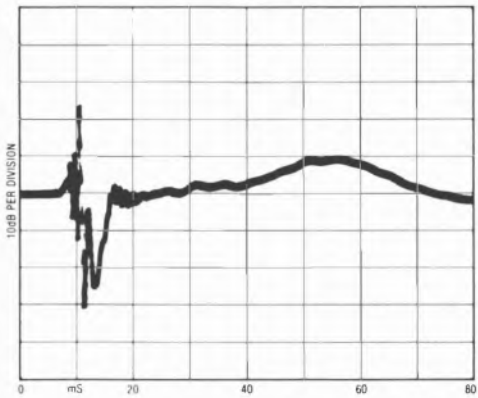
Rumble was also more than satisfactory at −76/−78dB, the deck's failure to reach −80dB being the result of a coincidence of the subchassis/arm resonance at 300Hz and the DIN B peak weighting curve!

The disc impulse response was pretty good, though evidence of a longer low frequency resonance was apparent in the decay region around 20Hz. Acoustic isolation was rated as very good, while the vibration isolation was truly excellent.

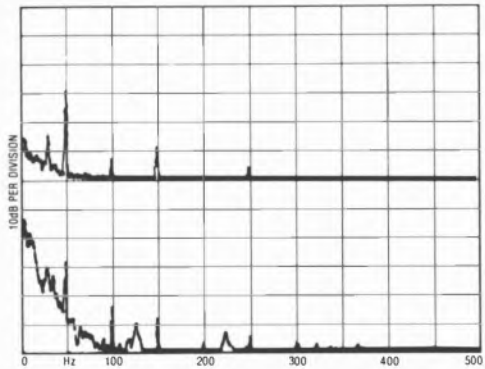
Sound quality

First impressions were of a gutsy 'Dunlop' bass, fondly remembered from the original *Systemdek*, and in our view a property of the massive platter.

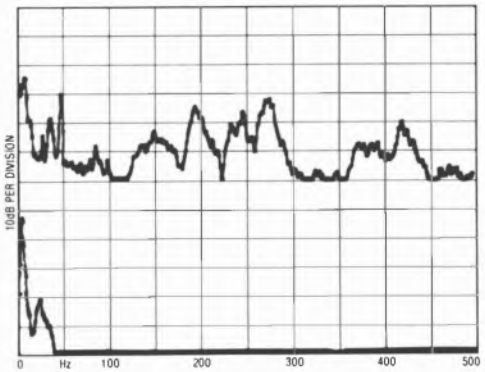
The sound was solid and well contained, with



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

a crisp open midband. Pitch stability was very good, and the turntable exploited the dynamics and transient attack that were present in the programme. The stereo images were stable, and well focused, while the sound stage was transparent, and deep, except in a small area of the lower midrange.

Conclusion

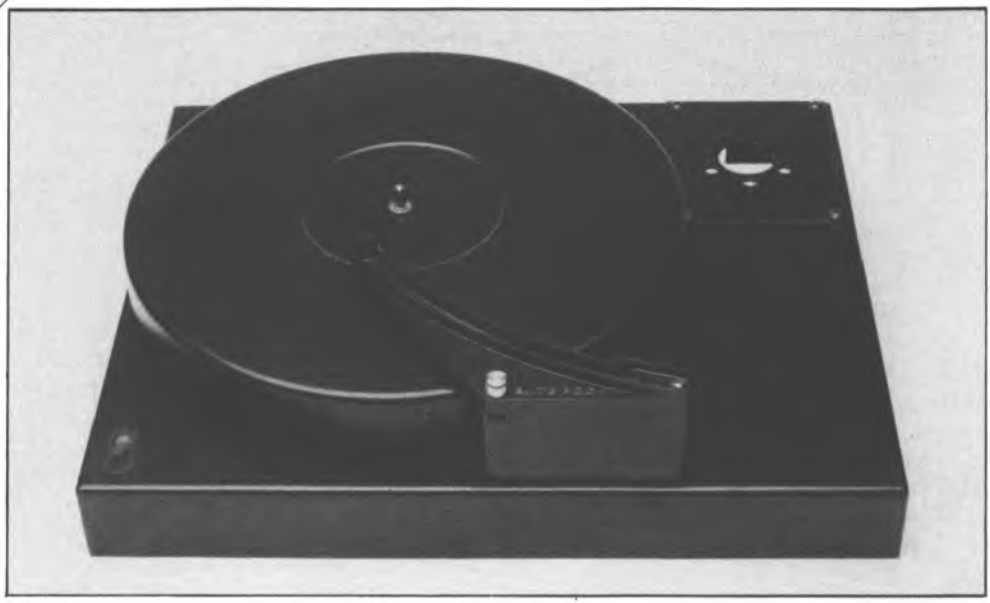
This is the best sounding Dunlop that *HFC* has tested yet. It renders obsolete the earlier *III* and offers a very good standard at a moderate price, and despite my reservations concerning appearance and the odd lid, a strong recommendation is clearly deserved.

GENERAL DATA	Motor unit
Type	belt drive, subchassis
Platter mass/damping	4.75 kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting lead	3 core/—
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sign a 2)	0.08%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.14%/<0.05%
Absolute speed error	+ 0.05%
Speed drift, 1 hour/load variation	synchronous/ – 0.16%
Start-up time to audible stabilisation	4.3 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 76/ – 78 dB
Size (w × d × h)/clearance for lid rear	41 × 34 × 16.5cm/6.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/excellent
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£220

RECOMMENDED

Elite Townshend Rock II

Elite Townshend Ltd, Enterprise House 44-46 Terrace Road, Walton-on-Thames, Surrey
Tel (09322) 46850



This new Elite turntable is designated *Rock II* to distinguish it from the original master design developed at Cranfield Institute of Tecnology. This was in fact only built in very small and highly expensive quantities. Lessons learned from its development have subsequently been applied to this new model, which sells typically at £280, plus £65 for the cover and platform if required.

The original *Rock* made much use of a mineral-filled resin for mass and damping, but with the new model gypsum is employed to the same end, for example in the solid platter and the weight plinth/chassis. Both these components use a fabricated metal skin to contain their mineral castings.

The *Rock II* is a solid-plinth model with a synchronous motor firmly bolted in place, a rubber cord drive belt linking the motor to the inner hub of the two piece platter. The unit achieves a substantial degree of environmental isolation through the use of a suspension consisting of three air filled rubber balls (squash balls, I believe). The lid is not attached to the plinth but to the base plate and hence remains isolated. Speed change is done by hand.

One special feature is the incorporation of a large silicone fluid damper mounted on the plinth which operates at the headshell end of the chosen arm. This is designed to help control both the audio band structural resonances in the tonearm, as well as the cartridge subsonic resonances, without imposing excessive forces on the cantilever in the record warp frequency range. Shock resistance and record 'rumble' are said to be improved in this manner.

No set up or alignment is required and, apart from the necessarily limited cartridge access, the turntable was easy to use, with arm lead dressing proving to be uncritical.

Lab report

The loaded platter weighed a notable 2.9kg, with its plastic enamelled surface forming the disc support. As such it showed good damping in respect of the disc impulse, which showed an even characteristic. Tonally, the platter should sound neutral. No platter rining was observed.

No problems were experienced in the speed department. DIN peak wow and flutter was fine at 0.1% weighted with the individual contribution of wow at 0.21% — satisfactory — while flutter at less than 0.05% looked very good.

Absolute speed accuracy was fine and within 0.1%, while torque was more than

satisfactory, this confirmed by the modest 0.25% slowing under the test load. No overshoot was observed. Start-up time with our sample was a little slow at 6.8 seconds, but this improved to 4.8 seconds with a new pulley. The DIN B rumble figures were fine at −77/−77dB, given the unpromising motor location; spectral analysis did show the presence of some mild motor vibration breakthrough, though at a pretty inaudible level.

The simple design proved to be remarkably effective in supressing airborne acoustic feedback and vibration — it performed well albeit not superbly on these counts. It also proved well above average in its handling of shock when using the damper, and was also uncritical of location.

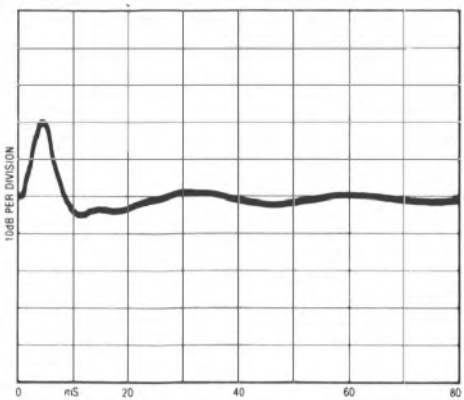
Sound quality

The *Rock II* did well on audition, demonstrating a good stability of pitch, with a neutral, even-handed tonal balance. It performed competently throughout the frequency range with firm clean bass, good perspectives in the mid-range, and an unexaggerated treble. In fact, the treble seemed 'cooler' and less exuberant than usual when the deck was used with an *Ittok* arm. Stereo focus was good, and cartridges tracked well with reduced low frequency noise. A pleasing level of stereo depth was available.

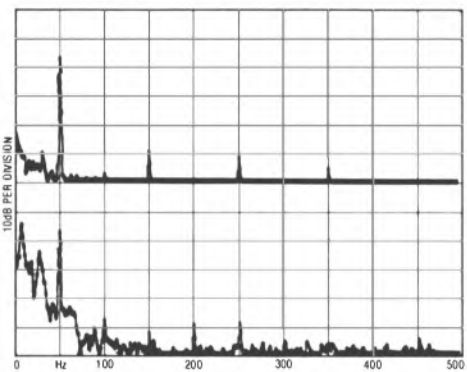
Conclusion

I would hesitate to place this model in the highest sonic category, but it nonetheless has a lot going for it. The damper does the job it is claimed to do, particularly with good cartridge combinations, and the deck needs no setting up — a plus point for many purchasers. It offers a performance near to that available from a true subchassis turntable, doing so with a high level of neutrality, or if you like, a low level of coloration. As such it represents an interesting proposition and the standard attained merits recommendation.

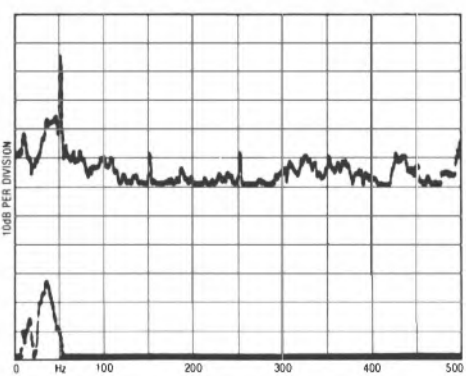
GENERAL DATA	Motor unit (with arm damper)
Type	belt drive, rigid plinth
Platter mass/damping	2.9 kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting lead	3 core/—
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.1%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.21%/0.05%
Absolute speed error	+ 0.1%
Speed drift, 1 hour/load variation	synchronous/ − 0.25%
Start-up time to audible stabilisation	6.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)	− 77/ − 78 dB
Size (w × d × h)/clearance for lid rear	40 × 33 × 11.5cm/none
Ease of use	good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	good/very good
Estimated typical purchase price	£280 (optional cover £65)



Disc impulse transmission showing damping



Breakthrough, acoustic (above) and vibration (below)



Rumble, electrical (above) and total (below)

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

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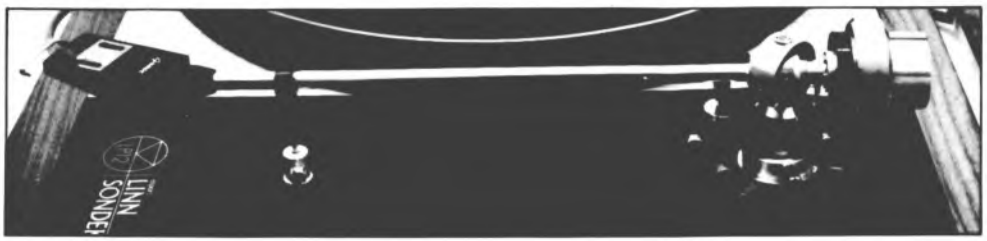
HAYDEN

Dual AUDIO

Hayden Laboratories Ltd. Hayden House, Chiltern Hill, Chalfont St. Peter, Bucks. SL9 9UG.

Grace G707

Russ Andrews Turntable Accessories, Edgebank House, Skelsmergh, Kendal, Cumbria LA8 9AS
Tel (05398) 3247



This well-known and elegant 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 applies bias compensation via a thread.

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. However, the distributor, who also handles the Supex cartridges, will be well qualified to help here.

Lab report

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 models (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'.

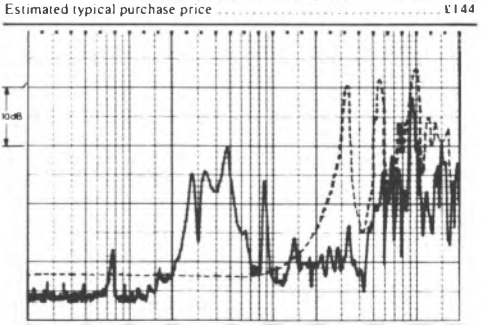
Sound quality

In assessment for previous issues 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.

Conclusion

Though the *G707* remains worth considering, more recent introductions have reduced its competitiveness a little.

GENERAL DATA	Grace G707
Approximate effective moving mass (excl cart. inc screws)	7g
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	£144

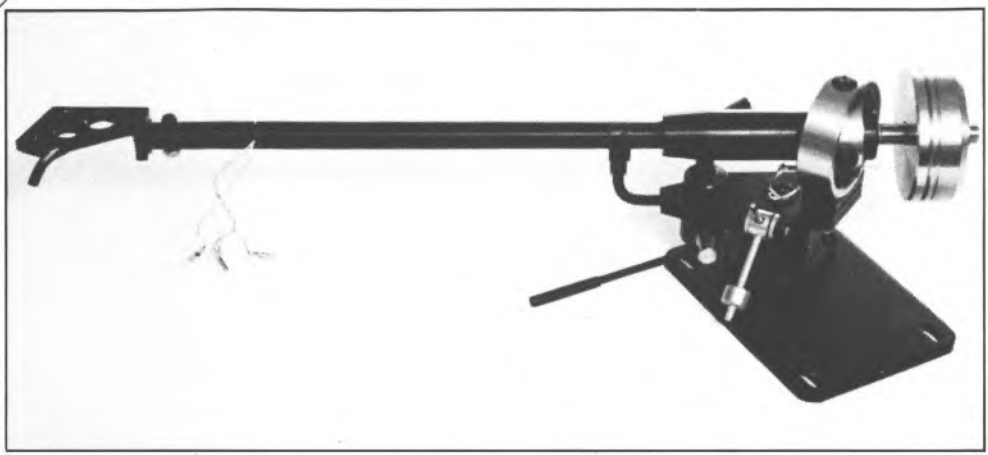


Arm resonances (compared to cartridge resonances, dotted).

RECOMMENDED

Helius Standard

Helius Designs, The White House, Aldington, Eversham, Worcs WR11 5UB
Tel (0386) 830083



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

A medium mass design, the arm tries to avoid any injurious decoupling between the firm, large-area cartridge mounting platform, and the arm mounting base. The full-circle nested gimbal bearing is finely adjusted for moderate friction and zero detectable play, a condition critical to sound quality. The arm should therefore be carefully handled if this condition is to be maintained. An unusual ball race is employed with only three balls per race aligned to maintain mutual contact as well as firm contact with the bearing needle and of course the race itself.

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

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

While the overall finish and constructional standard was very good, the wiring around the bearings was exposed and somewhat untidy — particularly the single strand third earth. Wires must be kept in a good state of adjustment if the arm sensitivity is not to be impaired.

Lab report

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

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

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

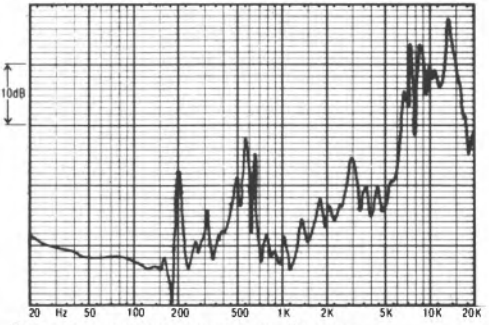
Sound quality

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

Conclusion

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

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	12g
Type/mass of headshell	special detachable/7g
Geometric accuracy	excellent
Adjustments provided	overhang/height/lateral
Finish and engineering	very good/very good
Ease of assembly/setting-up/use	good/difficult/very good
Friction, typical lateral/vertical	50mg/10mg
Bias compensation method	thread and lever
Bias force, rim/centre (set to minimum)	N/A
Downforce calibration error	uncalibrated
Cue drift, 8mm ascent/descent	moderate, 0.9 secs/4.2 secs
Arm resonances	fairly good
Subjective sound quality	good+
Lead capacitance/damping method	70pF/none
Estimated typical purchase price	£150

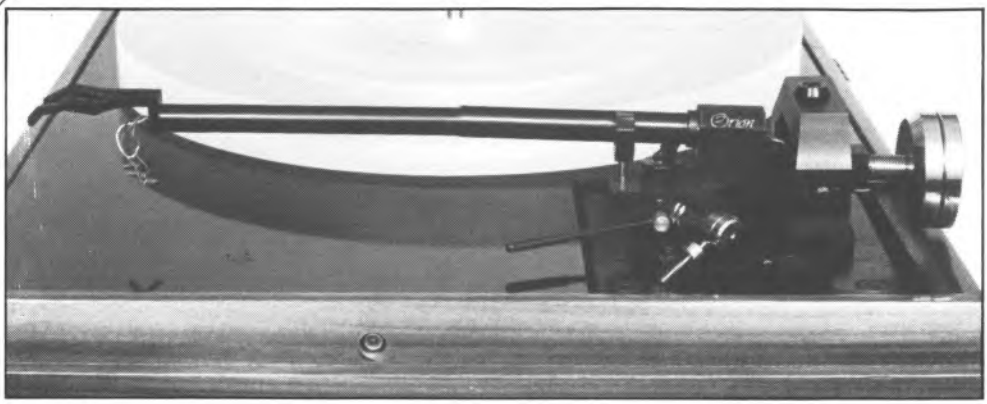


Structural arm resonances, audio band

RECOMMENDED

Helius Orion

Helius Designs, The White House, Aldington, Eversham, Worcs WR11 5UB
Tel (0386) 830083



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

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

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

The main arm beam, in alloy tube, has an extended larger diameter first section to distribute vibrational modes. At the front the standard Helius right-angled alloy cartridge platform is fitted, here rigidly bonded in place. A revision to the shell, which is in hand at the time of writing, includes a curved section to reinforce the right angle and marginally increase the mass — probably by 2-3 grams only.

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

Lab report

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

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

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

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

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

Sound quality

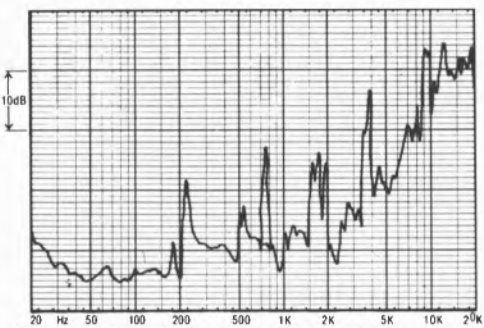
On audition there was no doubt whatsoever concerning the high calibre of this tonearm. The bass was particularly good, showing depth, weight, eveness and good articulation. The midband was neutral as well as transparent, matching the unexaggerated musical treble register. Stereo effect was very good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

Conclusion

With the current series the fine sound quality is maintained and finish has been much improved. Cue descent is still too slow, but in other respects the arm is excellently engineered with rigid bearings, free from slack. It remains very expensive but its performance wins it recommendation.

GENERAL DATA Tonearm

Approximate effective mass, inc screws, excl cartridge	12g
Type/mass of headshell	non-detachable
Geometric accuracy	excellent
Adjustments provided	height/overhang/offset
Finish and engineering	excellent/excellent
Ease of assembly/set-up/use	very good/good/average
Friction, typical lateral/vertical	<20mg/<20mg
Bias compensation method	uncalibrated thread and lever
Bias force, rim/centre (set to 1.5g elliptical)	175mg/225mg
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	0.75 secs/10 secs
Arm resonances	good
Subjective sound quality	very good
Arm damping	none
Estimated typical purchase price	£425



Structural arm resonances, audio band

RECOMMENDED

Heybrook TT2

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

First reviewed in its original form, the Heybrook *TT2* turntable has since undergone some revision after its first couple of years in production. A new cast aluminium subchassis with reinforcing flanges around the whole of its cruciform shape replaces the original box-section welded steel subchassis, which had a rather high mass. Such a major change indicated that a completely new review of the *TT2/II* was in order.

While this model is superficially reminiscent of a *Sondek,* a closer examination will reveal that Heybrook have used a rather different set of solutions to the problems of turntable design, solutions which do not appear to derive from any attempt to compromise engineering quality or finish. At the same time, the *TT2* is quite competitively priced if compared with certain of the more expensive brand leaders in the specialist field.

A very strongly constructed plinth is used, essentially of 45mm thick composite, only cut away where space is required for the arm leads, motor and associated wiring. Suspended on three multi-turn coil springs, the subchassis can be aligned from above, via three socket-head bolts fixed by an ingenious locking system.

A closely-toleranced main bearing is fitted, consisting of a steel shaft supported on a hardened thrust ball, and running in plain bronze sleeves. The alloy platter weighs 2.8kg, and is in two pieces, the inner section also forming the drum on which the belt runs. A felt mat is standard.

Currently, the *TT2* suspension is set on the firm side, to provide better control, while a fairly stiff short belt has been chosen as likely to minimise wow effects. The main subchassis modes are in the 4.5 to 5Hz range, and correct arm lead dressing offers better control of the higher frequency rotational modes than before.

Arms tried with the *TT2* included the Linn *LVX* and the Alphason, but perhaps the most obvious choice was the Rega *RB300,* the two products complementing each other on grounds of their fine engineering and value.

Lab report

The well-constructed main bearing exhibited negligible play, while the subchassis proved to be well adjusted. A fine weighted wow and flutter figure of 0.065% was recorded, with equally good results for the flutter and wow when separately weighted, at 0.08% and 0.07% respectively. The deck ran fast by an acceptable 0.5%, while high torque was shown by the excellent 0.18% slowing under test loading. Dynamic wow will not be a problem here.

DIN B weighted rumble was very low at almost – 80dB, but spectrum analysis did show some moderate motor related mechanical

frequency components, specifically at 100Hz and 200Hz. The latter however measured at – 78dB and in consequence was quite harmless.

The felt mat provided much the usual pattern of results for the disc impulse response; following a large initial transient, damping was fairly good although some mild 100Hz ringing can be seen in the decay response, this possibly platter rock.

Sound quality

On audition the latest *TT2* was felt to offer an improvement over the earlier version, notably in terms of better transparency and depth, tied in with a clearer exposition of the dynamic contrasts in the music.

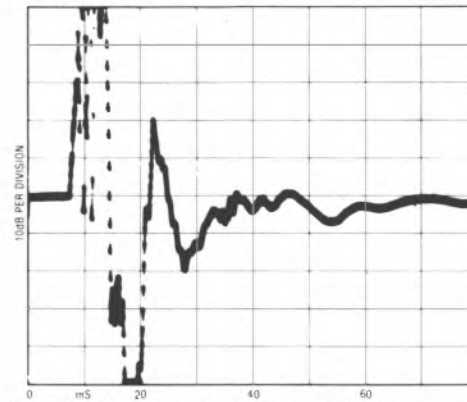
Pitch stability, rhythm and timing were all to a very good standard, while the bass was a strong point, with a welcome firmness coupled with good extension to the lower bass frequencies.

Solo singing focused well in the stereo sound stage, the latter exhibiting good space and depth. It compared well with far more expensive designs, making only slight concessions in areas of detail and dynamics on the most complex material.

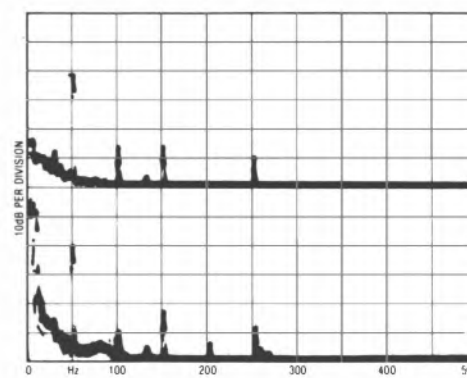
Conclusion

One cannot help but be impressed by the fine finish and construction of this durable subchassis design, as well as by its competitive pricing and good performance both in the lab and the listening room.

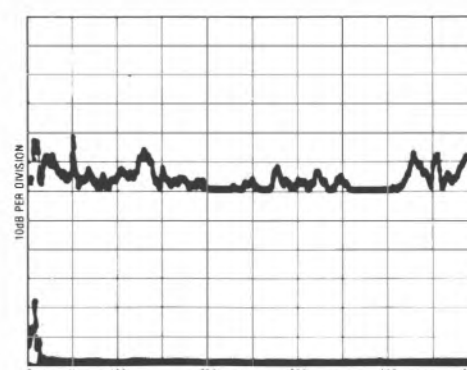
Strong points included very low wow (approaching the Linn in this area) as well as its fine bass. It was easy to set up, remaining stably aligned, and attains a firm recommendation.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



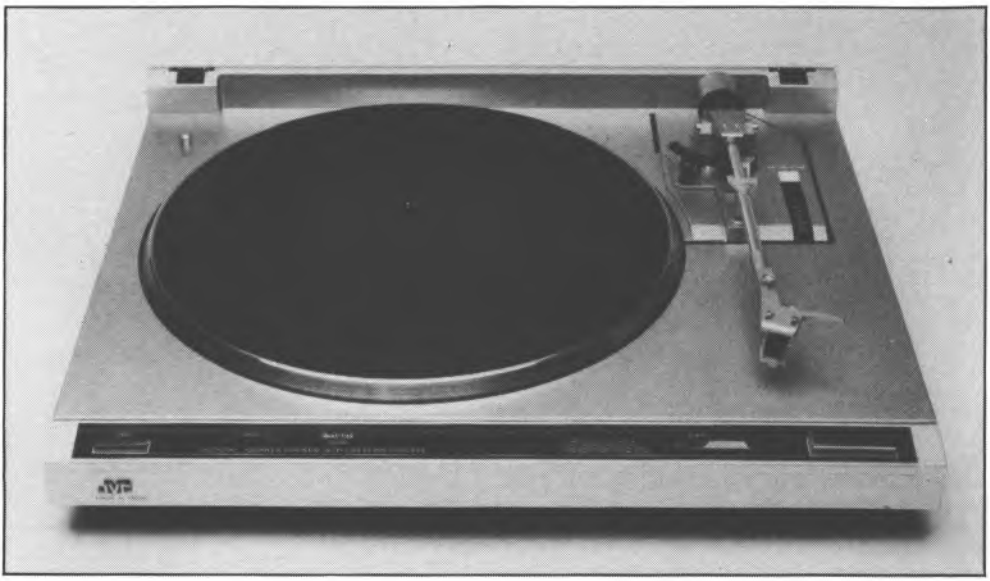
Breakthrough, acoustic (above) and vibration (below)

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

GENERAL DATA	Motor unit
Motor Section	
Type	belt-drive, subchassis
Platter mass/damping	2.6kg/average +
Finish and engineering	very good/excellent
Type of mains lead/connecting lead	3-core/ –
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.065%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.007%/0.08%
Absolute speed error	+ 0.5%
Speed drift, 1 hour/load variation	<0.1%/ – 0.18%
Start-up time to audible stabilisation	3.8 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 80/ – 78dB
Size (w x d x h)/clearance for lid rear	44 x 37 x 15.5cm/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	very good/fairly good
Estimated typical purchase price	£235

JVC QL-A200

JVC (UK) Ltd, 12 Priestley Way, Eldonwall Trading Estate, Staples Corner, London NW2
Tel 01-450 2621



An inexpensive but well finished Japanese turntable, the *QLA200* sells for under £100 complete with a modest moving magnet cartridge. It has a sort of suspended subchassis, but the spring compliance is so low as to make it almost a rigid plinth in practice. A direct drive motor is used with quartz-locked reference speeds, and a lightweight tonearm is fitted. Automatic start and stop facilities are also provided. The cartridge supplied was not accurately aligned in the rather flimsy plastic headshell on the review sample. Arm bearings exhibited some notchiness and play in the vertical plane. The platter was well finished but somewhat lightweight at 0.85kg, and the thin and resonant polystyrene cover did not augur well for acoustic isolation.

Lab report

With the quartz reference on board, the deck's speed accuracy was predictably perfect. The main bearing had negligible play and returned a fine rumble figure of −78/79dB, DIN B weighted. Spectral analysis showed only a minor incidence of pole switching harmonics, although noise below 80Hz was rather poorer than average, this being outside the DIN weighting band.

Fine wow and flutter readings were also obtained, the DIN peak result being 0.07% and the separate contributions of flutter and wow similarly good. Absolute speed error was within 0.05% while slowing under load was zero, held by the reference lock. A mild overshoot was detected following the load removal, but start up was fine at three seconds.

Acoustic breakthrough was rather worse than average and the deck did little better on vibration rejection, as the graphs will testify. The disc impulse response was also disappointing with serious long term resonance modes excited after the initial transient had passed.

Turning to the arm, effective mass was judged moderate at 10.5g, the shell alone weighing a modest 4.5g. The lateral notchiness resulted in a peak friction reading of 170mg which is poorer than average, but in the vertical plane a far better 20mg was recorded. Biasing was quite good and downforce calibration very accurate.

Charted with the installed cartridge, the structural resonances of the arm were not judged to be very good, the arm 'breaking' severely at 200Hz with a massive 20dB step in level, this indicative of poor coloration and stereo.

Sound quality

Despite its unpromising arm, this JVC did not fare too badly on audition. The midrange suffered from some nasal coloration, while the

treble was a bit bright and gritty, and not much stereo depth was apparent. The bass was soft and lightweight. Overall, the cartridge supplied was felt to be a good match, however.

Conclusion

Surprisingly perhaps, in view of earlier comments, this deck was not to my mind a complete write off. The motor was quite competent and the acceptable cartridge survived the shortcomings of the arm, which should be better set up in future production. The deck is not in the recommended class, but is worth considering, representing reasonable value for money.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

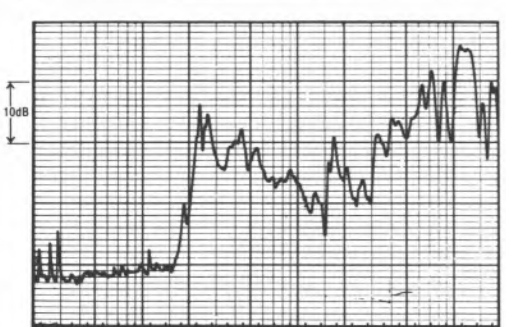
Type.....semi-auto, quartz, direct drive
Platter mass/damping.....0.85kg/average –
Finish and engineering.....very good/average
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.07%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.09%/0.06%
Absolute speed error..... – 0.05%
Speed drift, 1 hour/load variation.....none/none
Start-up time to audible stabilisation.....3 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 78/ – 79dB

Arm section

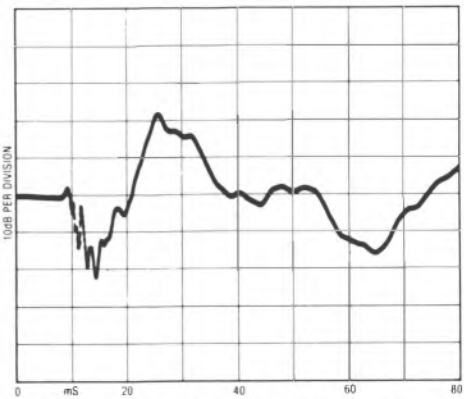
Approximate effective mass, inc screws, excl cartridge....10.5g
Type/mass of headshell.....non-standard detachable/4.5g
Geometric accuracy.....average –
Adjustments provided.....overhang/orfset
Finish and engineering.....very good/average
Ease of assembly/set-up/use.....very good/very good/very good
Friction, typical lateral/vertical.....170mg/20mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....280mg/300mg
Downforce calibration error, 1g/2g.....none
Cue drift, 8mm ascent/descent.....1.5 secs/2.5 secs
Arm resonances.....poor
Subjective sound quality.....poor
Arm damping.....none

System as a whole

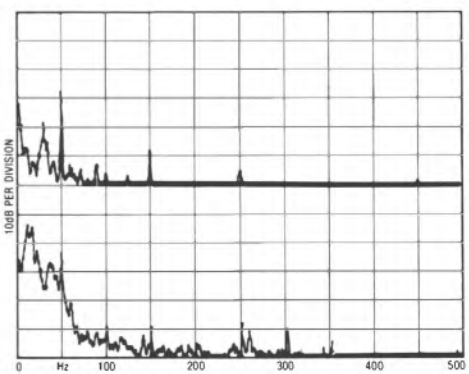
Size (w x d x h)/clearance for lid rear..43.5 x 36.5 x 10.5/cm/none
Ease of use.....very good
Typical acoustic breakthrough and resonances.....fair
Subjective sound quality of complete system.....average –
Hum level/acoustic feedback.....good/poor
Vibration sensitivity/shock resistance.....average – /fairly good
Estimated typical purchase price.....£90



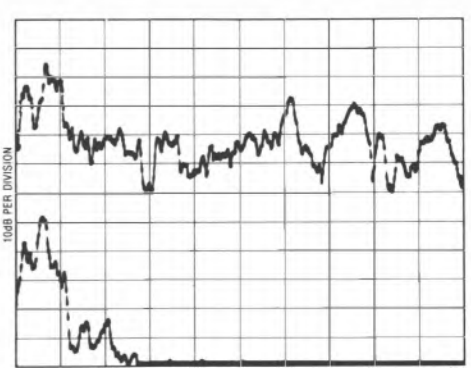
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

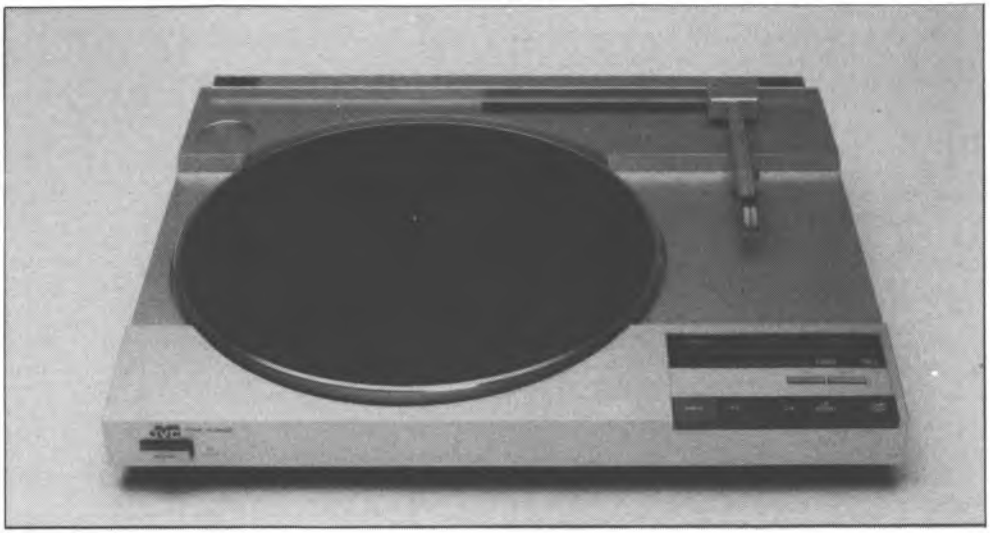


Breakthrough, acoustic (above) and vibration (below)

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

JVC LL1

JVC (UK) Ltd, 12 Priestley Way, Eldonwall Trading Estate, Staples Corner, London NW2
Tel 01-450 2621



A fair representative of the current breed of linear tracking turntables, the *LL1* is JVC's contribution to this growing area of the market. Perhaps Technics could be said to have pioneered the type a few years ago with their splendid *SL10,* but since then a number of downmarket models have emerged from various sources. The *LL1* costs just £125, the price including a JVC cartridge in the popular T4P' mounting format, which incidentally was also originated by Technics.

Constructed largely of plastic, the *LL1* has a rather light platter with just an 0.55kg mass. No subchassis is provided for isolation, though the whole assembly is supported on moderately compliant feet which afford a small degree of feedback protection. The lid is rather resonant, which does not help with regard to acoustic isolation, but although the tonearm is plastic it is of a pretty rigid girder construction. Its mounting was, however, found rather flexible, though bearing play as such appeared moderate. The operating controls all worked well and the overall finish was very good.

Lab report

Wow and flutter was satisfactory at 0.11%, with moderate wow but rather high flutter (0.15%), this probably due to the light platter. Speed drift was also moderate, while slowing under load was fine at 0.2%. Start up was rapid, actually clocked at 1.3 seconds, with the DIN B rumble measurement quite satisfactory at – 73/75dB.

Spectrum analysis of rumble showed the presence of a fair number of motor related components, these easily distinguished from the plain electrical-only noise shown in the upper trace.

Disc damping was below average, as the impulse photograph showed. Large low-frequency ringing was present, probably chassis rocking at 30-40Hz. Turning to the breakthrough spectrum, the turntable performed better than we expected; acoustic input was fairly well handled, while the soft feet did help to keep the worst of the higher-frequency vibration energy at bay.

The tonearm was low in mass, estimated at just 4g. No adjustments are provided, the whole thing being factory set and aligned for the T4P cartridge, which sets its own downforce. Friction was comparatively low and of course, no bias compensation is required with a parallel tracking tonearm such as this.

All the automatic functions operated satisfactorily. Structural arm resonances were chartered with the cartridge installed, and suggested a good lower range characteristic marred by an excessive number of minor resonances at higher frequencies.

Sound quality

Interestingly the *LL1* sounded slightly better than the conventionally-designed *QL-A200.* It

provided a little more depth and better stereo focus, though the bass was still comparatively weak, and lacking in definition. The treble was rather bright and abrasive and the player might well benefit from one of the 'softer' sounding cartridges such as a model from the Shure T4P range.

Conclusion

For the money asked, the *LL1* was not thought very impressive — not as good as an earlier generation of similarly priced but conventional quartz-motored turntables, some of which used to do well in *HFC*. No recommendation is possible.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

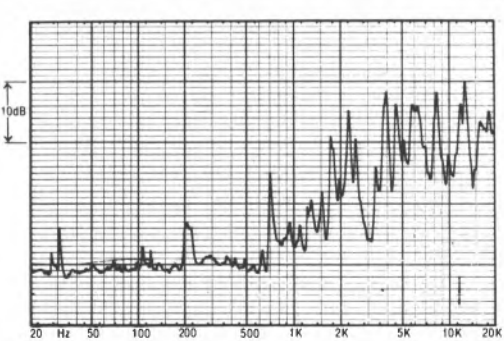
Type.....fully auto, belt-drive, linear tracking
Platter mass/damping.....0.55kg/average –
Finish and engineering.....very good/good
Type of mains lead/connecting lead.....2-core/phonos
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.11%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.1%/0.15%
Absolute speed error.....0.15%
Speed drift, 1 hour/load variation.....0.15%/ – 0.2%
Start-up time to audible stabilisation.....1.3 secs
Rumble, DIN B wtd, L/R average (see spectrum) ..... – 73/ – 74dB

Arm section

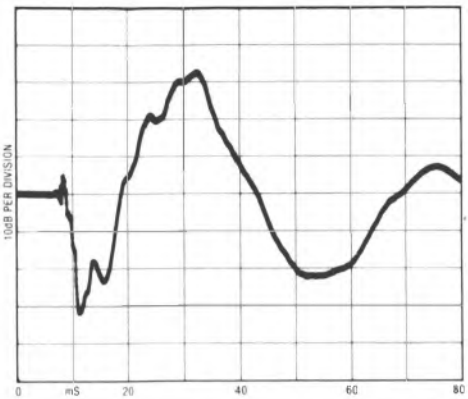
Approximate effective mass, inc screws, excl cartridge.....4g
Type/mass of headshell.....T4P mounting
Geometric accuracy.....excellent
Adjustments provided.....none
Finish and engineering.....excellent
Ease of assembly/set-up/use.....excellent
Friction, typical lateral/vertical.....20-40mg/20-40mg
Bias compensation method.....—
Bias force, rim/centre (set to 1.5g elliptical).....—
Downforce calibration error, 1g/2g.....—
Cue drift, 8mm ascent/descent.....excellent, 3.0 secs/2.5 secs
Arm resonances.....—
Subjective sound quality.....—
Arm damping.....—

System as a whole

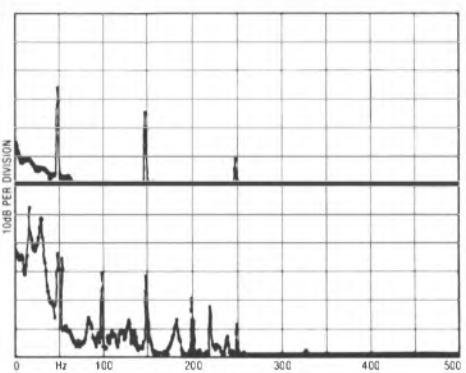
Size (w x d x h)/clearance for lid rear.....43.5 x 36.5 x 10cm/none
Ease of use.....excellent
Typical acoustic breakthrough and resonances.....fairly good
Subjective sound quality of complete system.....average –
Hum level/acoustic feedback.....fairly good/fairly good
Vibration sensitivity/shock resistance.....fair/good
Estimated typical purchase price.....£125



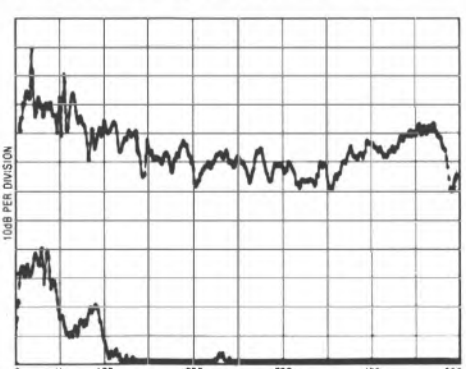
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

JVC QLY5F

JVC UK Ltd., Eldonwall Trading 'Estate, Staples Corner, 6-8 Priestley Way, London NW2.
Tel 01-450 2621

Features and design

A top model from the JVC range, the *QLY5F* incorporates this company's version of the 'electronic' tonearm using linear force 'motors': one is visible at the side of the arm in a flat box section; the other is located within the plinth and handles motion in the horizontal plane. Servo connection for feedback control allows simple arm adjustments to be made *via* two dials: one is for Q (variable electronic damping of the subsonic resonance); the other controls downforce, which automatically sets the bias compensation proportionally. In other respects the arm is straightforward, possessing a universal shell, and offering a highish 19g effective mass suited to lower compliance cartridges, in this case of 8–20cu due to the damping provided (see graph).

Fitted with a fairly solid 2.6kg platter, the substantial plinth and rubber sprung feet construction carries a quartz lock direct drive motor. Pitch control is absent, and instead JVC provide automatic arm cueing with power traverse. The plinth has a high gloss rosewood type finish, but unfortunately a tinted lid made of one of those rather resonant grades of polystyrene is fitted; this forms an effective acoustic trap and echo chamber, feeding unwanted energy into the disc and arm bearings *via* the rigid hinges and plinth.

The platter is fitted with a sensible flat rubber mat which offers good disc support, and the internal operating sequences are organised under microprocessor control to ensure a freedom from damaging sequences. However these systems can prove frustrating, as manual override is impossible, and one has to wait for a particular sequence to finish before trying something else.

Lab results

The platter damping was sufficient to allow the expanded 'X10' presentation of the impulse response; while the mid frequencies seemed well damped, the upper range was less so, and the response was dominated by a platter rocking mode at around 22Hz, which was also coincident with the higher order plinth/foot lateral resonance.

The motor gave a fine set of results – state of the art in fact – and the high torque provided a rapid start up, free of overshoot or instability.

The arm was geometrically well-aligned, and unusually for an automatic it offered variable height and headshell tilt as well. Friction was sensibly small – certainly below 30mg – and is thus suitable for tracking at as low as 1g downforce. The measurement of bias levels was complicated by the simultaneous presence of downforce, but the figures at a 1g setting gave 140mg edge and 110mg centre – rather low and in the wrong ratio. Only internal adjustment could correct for this imbalance and error. Downforce calibration was 20% high when set at 1g, but improved to +2.5% at 2g, and the automatics operated very smoothly. The variable damping was plotted with the number corresponding to appropriate downforce, '0' representing zero damping; in this instance a setting between 1 and 2 seemed optimal. As shown by the graph, the arm resonance behaviour was not very clean in the audio range, which probably relates to the electronic gadgetry attached to it; the trend proved both complex and 'lumpy', and defied simple analysis. Acoustic breakthrough was barely average. with the lid the main offender, while the rubber feet were comparatively ineffective at blocking vibration below 150Hz.

Sound quality

Considering the *QLY5F*'s elevated position in JVC's range, and its highish price, the listening test results were well below the expected standard, rating average or slightly below

average. The sound was considered to be midrange dominant, lacking in bass depth of weight, and with a susceptibility to feedback and 'boom'. A disappointing resolution of fine detail and stereo focus was demonstrated, with a subdued and somewhat 'grainy' treble.

Conclusion

Once again we have evidence that good 'engineering' plus a high level of finish and attainment on traditional technical performance parameters is no guarantee of decent sound quality when assessed critically. Mechanically the *5F* plays records well, but if sound quality is the main priority for the purchaser, it represents poor value.

Disc impulse transmission, magnified X10.

GENERAL DATA Integrated Turntable, Servo Arm

Motor Section

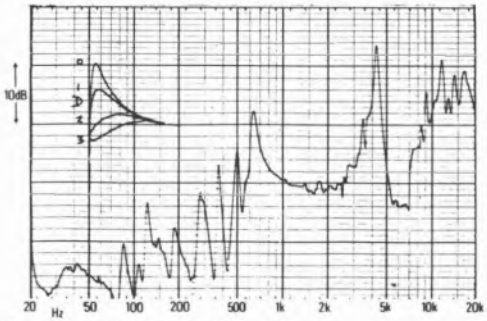
Type	quartz direct drive, fully automatic
Platter mass/damping	2.6kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable 33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	<0.1%/<0.05%
Absolute speed error	<0.01%
Speed drift 1 hour/load variation	<0.01%/<0.01%
Start up time to audible stabilisation	approx 1sec
Rumble: DIN B wtd L/R av (see spectrum)	–77dB

Arm Section

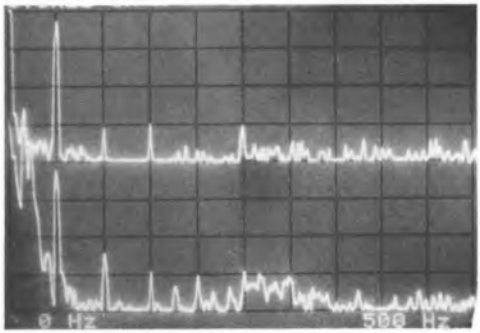
Approximate effective mass inc screws, excl cartridge	17g
Type/mass of headshell	universal detachable/11g
Geometric accuracy	very good
Adjustments provided	overhang, lateral angle, arm height, tilt
Finish and engineering	very good/very good
Ease of assembly/setting up/use	very good/very good/very good
Friction: typical lateral/vertical	less than 30mg/less than 30mg
Bias compensation method	electronic
Bias force: rim/centre (set to 1.5g elliptical)	140mg/110mg
Downforce calibration error: 1g/2g	+0.2g/+0.05g
Cue drift/8mm ascent/descent	negligible/0.5sec/1.5secs
Arm resonances	average +
Subjective sound quality	average +
Lead capacitance/damping method	95pF/variable electronic, damping subsonic

System as a whole

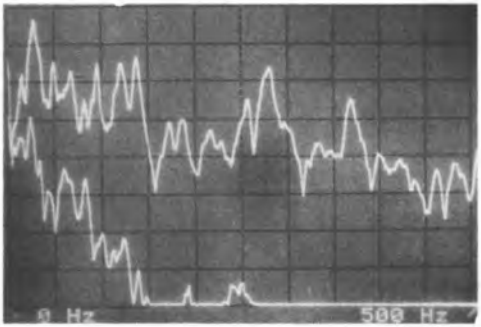
Size/clearance for lid rear	48.0(w) x 43.5(d) x 14.5(h)/7cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/fair only
Vibration sensitivity/shock resistance	fair/good +
Estimated typical purchase price	£220



Arm resonances and damping.



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



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

RECOMMENDED

Linn Sondek LP12

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

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

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

'Valhalla' solves these problems by effectively isolating the motor electronically from the mains supply. Mains power is rectified and smoothed to feed a bi-phase 100V low distortion power amplifier acting as the motor source. The exact 50Hz frequency is synthesised from a quartz oscillator. When fed clear, stable 50Hz, the motor generates less vibration and mains harmonic components, attaining a near perfect pulley speed stability over both the long and the short term. Power into the belt is more stable, with (in theory at least) a lower rumble and reduced subchassis vibration resulting from the power feed. For simplicity's sake the single 33 rpm speed has been retained.

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

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

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

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

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

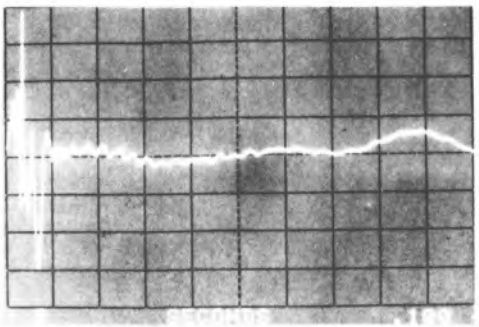
The well damped platter weighs some 4.1kg. Our assessment of disc damping was revised for this issue, and while the initial transient was certainly poorly damped by the felt mat, the impulse died away quickly thereafter, this a good result. A measurement taken last year showing the frequency transform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

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

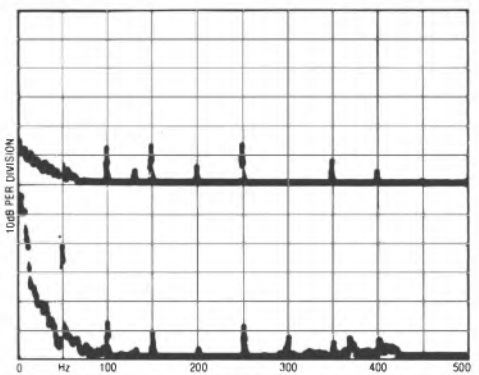
The *LP12* was not the very best in the issue as regards vibration isolation or acoustic breakthrough but the curves did confirm a high standard for these parameters nonetheless. Shock resistance was also quite good, with both acoustic feedback and hum very good.

Sound quality

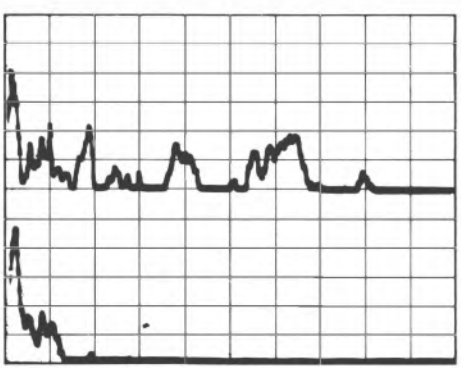
A few years ago it was considered heresy to suggest that turntables could make a 'sound' at all, but meanwhile the *Sondek* has been a leading exponent in demonstrating just how different the subjective performances can actually be. It scored an excellent rating on audition, notwithstanding some mild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



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

LINN SONDEK *continued*

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

After careful and prolonged listening the *LP12* was found to excel in its ability to retain the timing, tempo, rhythm and pitch of complex percussive sections, failure here producing some loss of interest on the part of the listener. Additional qualities included rapid post-transient decay producing 'transparent silences' between successive notes and these were all too often obscured by hangover in other models. The felt mat also provided a level of tonal integration of bass and treble now considered optimum for the deck. However some anomalies were heard – a mild upper bass richness with marginally 'loud' and forward midband. The *Ittok* arm still produces a spectacularly good sound with the *Sondek;* the Alphason arm also matched it well.

Conclusion

For this issue we reassessed a *Sondek* with the most recent minor enhancements, these including the viscous main bearing oil and new suspension lock nuts. No change in performance was measured but some improvement in sound quality was observed. The musical attack and detail in the midrange shows a small improvement, this tending to strengthen the subjective stereo focus, while the bass was more forceful, possibly excessively reinforcing the upper-bass forwardness that we have previously noted. This seemed rather obvious with the Rega *RB300* arm. However, the *Sondek*'s position is little altered and it continues to carry our strong recommendation.

GENERAL DATA	Motor unit
Motor Section	
Type	manual, belt-drive, synchronous motor, sub-chassis
Platter mass/damping	4.1kg/good
Finish and engineering	excellent/excellent
Type of mains/connecting leads	2-core
Speed options	33rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.09%/0.05%
Absolute speed error	– 0.2%
Speed drift, 1 hour/load variation	quartz-locked/ – 0.13%
Start-up time to audible stabilisation	6 secs
Rumble, DIN B wtd L/R average (see spectrum)	– 80 dB
Size/clearance for lid rear	44.5(w) x 36(d) x 15(h)/5.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	excellent
Hum level/acoustic feedback	very good/very good
Vibration sensivity/shock resistance	very good/good
Estimated typical purchase price	£408

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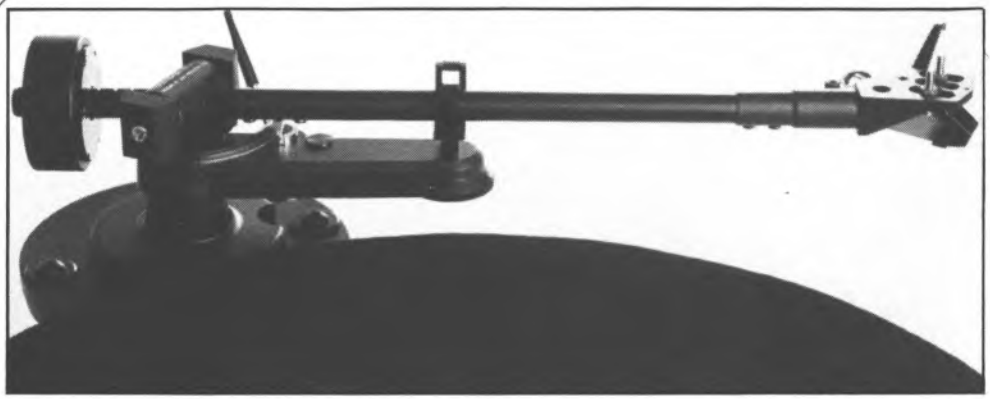
RECOMMENDED

Linn Basik LVX

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



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

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

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

The *LVX* uses the new large arm pillar but the baseplate is still unique to the Basik series inasmuch as a cutout is required to accommodate the cue damper cylinder. The low capacitance output cable is to *Ittok* specification though the headshell tags and pins are not gold plated. However the 'giveaway' Linn Basic cartridge is included with the arm, and could be regarded as a no-cost 'starter' (see review).

Lab report

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

Sound quality

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

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

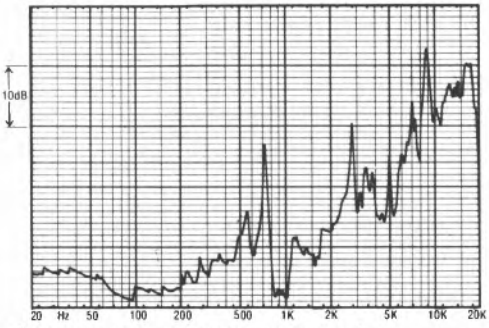
The overall tonal balance was very satisfactory, and as a whole the stereo image was well defined with both depth and ambience. It sounded a little 'thin' in the midrange, and the bass lacked some tautness, tending to appear a little 'boppy'. Treble was sweet and musical but lost some detail and stereo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

Conclusion

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

(Note: a new-type Audio Technica cartridge is now fitted. Linn are said to be working on an mc-dedicated model of the LV-X.)

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	12.5g
Type/mass of headshell	special detachable/7g
Geometric accuracy	very good
Adjustments provided	overhang/offset/height
Finish and engineering	very good/good
Ease of assembly/setting-up/use	very good/good/very good
Friction, typical lateral/vertical	approx 50mg/less than 10mg
Bias compensation method	internal spring
Bias force, rim/centre (set to 1.5g elliptical)	150mg/150mg
Downforce calibration error, 1g/2g	−0.1gm/0.1g
Cue drift, 8mm ascent/descent	negligible, 1.0 secs/3.3 secs
Arm resonances	good
Subjective sound quality	good +
Lead capacitance/damping method	100pF/counterweight decoupling
Estimated typical purchase price	£85 inc. cartridge

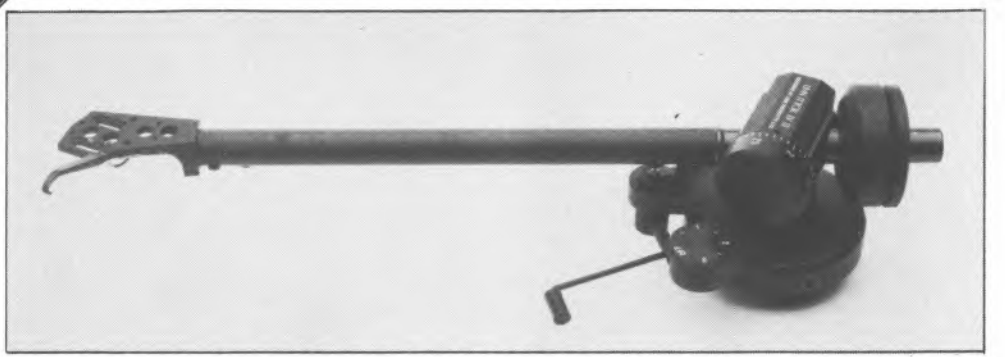


Structural arm resonances, audio band

RECOMMENDED

Linn Ittok LVII

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



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

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

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

This arm proved convenient to use, the effective cueing system controlled by a lengthened finger lever fitted with a roller at the top. This aids cueing on floppy subchassis turntables and reduces unwanted spurious shock effects post cueing. In marked contrast to the majority of upmarket audiophile designs, the *Ittok* comes fitted with a well calibrated and respectably accurate dials for both downforce and bias, the latter adjustable during play. A precision low-torque flat coil spring is used for downforce, with a linear coil spring for bias correction. The small but worthwhile improvements noted with later models include an increase in diameter of the main pillar cylinder together with a larger socket head clamping bolt allowing an unrivalled strength three-point lock to be obtained between arm and base. The main tube is now hard anodised in a darker shade of grey with a lacquer coating and the bonding of various parts has also been uprated by the use of larger bolts with heads capable of accepting greater tightening torque.

Lab report

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

As has been noted previously, the close nature of the coupling between arm and mounting board meant that the latter becomes

influential as regards final sound quality.

Sound quality

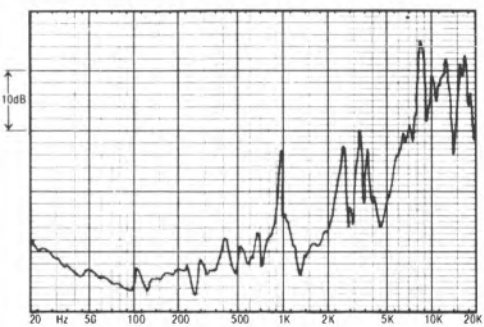
The overall rating is a secure 'very good, but as with all acoustic components the final result obviously represents some sort of balanced compromise. In our view the *Ittok's* strengths lie in its subjective speed of response to transients, its fine transparency and its ability to reveal atmosphere,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

Conclusion

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

GENERAL DATA Tonearm

Approximate effective mass, inc screws, excl cartridge	est. 13.5g
Type/mass of headshell	non-detachable
Geometric accuracy	excellent
Adjustments provided	height/overhang/lateral angle
Finish and engineering	excellent/excellent
Ease of assembly/setting-up/use	very good/very good/very good
Friction, typical lateral/vertical	less than 10mg/less than 10mg
Bias compensation method	internal spring
Bias force, rim/centre (set to 1.5g elliptical)	175mg/195mg
Downforce calibration error, 1g/2g	less than 0.03g/0.038g
Cue drift, 8mm ascent/descent	negligible, 0.8 secs/1.8 secs
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	100 pF/none
Estimated typical purchase price	£253



Structural arm resonances, audio band

RECOMMENDED

Logic Tempo Electronic

Logic Ltd, 19 Hurlbutt Road, Heathcote Industrial Estate, Warwick CV34 6TD
Tel (0926) 20302

Joining Logic's established *DM101* turntable, which now costs upwards of £400, we have the new *Tempo* range, comprising a normal synchronous drive motor unit at £119, plus a superior version with inbuilt electronic power supply, at £160. Either unit can be fitted with one of two Logic tonearms, namely the latest *Datum* (£75) and the Japanese-sourced Logic *DA2* (£44). For our tests we choose the *Tempo Electronic* with *Datum* at £232 inclusive.

With the top-of-the-range *101* setting the pace, Logic have tried hard to reproduce much of the sound quality of the original model in their new designs, in-depth listening forming an important part of the development process. Perhaps in consequence of this, the design is in some respects rather unusual. The plinth and chassis are combined, the whole unit mounted on surprisingly compliant, foam-core-damped springs.

Learning from Rega's expertise in designing good-sounding plinths, the *Tempo's* is made from a composite material, with a special arm mounting plate mechanically matched to both the arm and plinth for optimum mutual termination. The solid-looking plinth lipping is in fact a structural plastic moulding integral with the structure, and not applied as an afterthought. It might be supposed that one concession to price could be seen in the lid attachment to the plinth, *a la* Michell, but as with the *Focus One,* the materials chosen have good damping properties and will minimise the effect of lid-coupled acoustic energy.

For the *Electronic,* the power supply consists of a non-quartz but satisfactorily stable power oscillator, with convenient electronic switching for the two speeds. The platter is plate glass, surmounted by the popular felt mat.

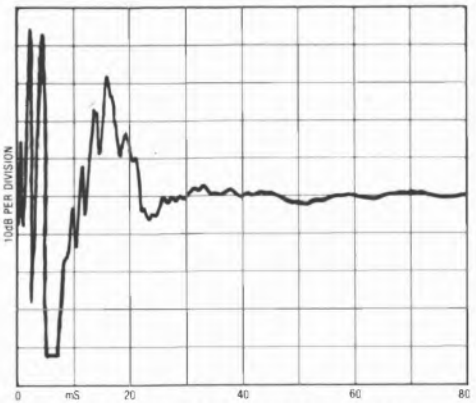
Lab report

The motor fixing on the chassis contributed to an excellent result for DIN peak wow and flutter, right at the limit of measurement at 0.04%. Linear flutter was also excellent at 0.05%, while linear wow was also very satisfactory at 0.12%. Absolute speed was slightly slow by 0.04%, but an adjuster is provided for the critical user. Drift was fine while good torque was shown. Slowing under load was controlled to an 0.25% speed loss. Start-up took a modest three to five seconds, with negligible speed overshoot.

Fine DIN B weighted rumble results of – 78/79dB were observed, and spectrum analysis showed that motor breakthrough was well controlled. Conversely the position of the power supply under the tonearm would appear to have resulted in a higher-than-usual level of electrically induced hum, though not unduly so.

The disc impulse response was typical for a felt mat — and note the welcome absence of any serious succeeding resonances in the decay response.

Despite the lid position, the *Tempo's* rejection of acoustic interference was quite good, while the feet did an effective job of blocking shelf-borne vibration, the performance comparable to many subchassis designs.

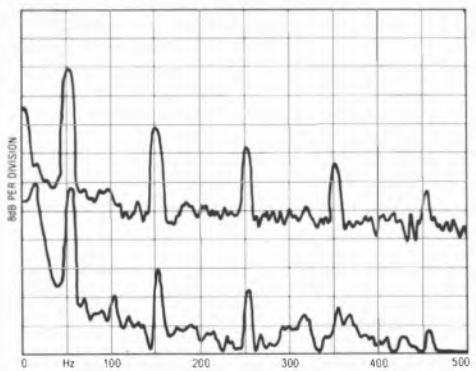


Disc impulse transmission showing damping

Sound quality

This turntable proved to be a fine match for the *Datum* arm, bringing out its best points, indeed sufficiently so to try Logic's *Claro* moving coil cartridges. The results for the combination were in fact surprisingly good.

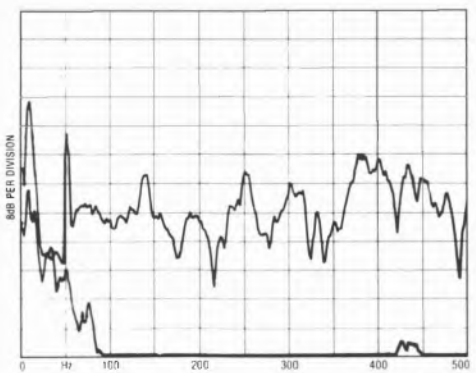
The *Tempo* provided a nicely balanced musical sound with particularly good midrange. Stereo images were well focused with good representation of depth and width. At low frequencies the effect was of slight 'plumpness' and yet detail and extension were also clearly in evidence. Both rumble and wow were judged inaudible with fine subjective pitch stability.



Rumble, electrical (above) and total (below)

Conclusion

The prospective purchaser will have to judge for himself which offers better value — the *Synchronous* or the *Electronic*. The latter certainly performed well in this review while in many respects the former should provide similar results. The lasting impression was of a carefully developed, musically balanced design, well matched to Logic's own fine tonearm. At a competitive price, the *Tempo Synchronous* probably does enter Best Buy territory, while the *Electronic* is firmly recommended.



Breakthrough, acoustic (above) and vibration (below)

GENERAL DATA Motor unit (arm available)

Motor Section

Type	synchronous or electronic belt-drive, sprung feet
Platter mass/damping	2.5kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting lead	3-core/—
Speed options	manual change 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.04%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.12%/0.05%
Absolute speed error	– 0.4%
Speed drift, 1 hour/load variation	0.2%/ – 0.25%
Start-up time to audible stabilisation	3.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 79/ – 78dB
Size (w x d x h)/clearance for lid rear	47 x 36 x 6.5cm/7.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	good +
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	fairly good%good +
Vibration sensitivity/shock resistance	very good/good
Estimated typical purchase price	£160 (synchronous motor, £120)

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

RECOMMENDED

Logic DM101

Logic Ltd., 19 Hurlbutt Road, Heathcote Ind. Est., Warwick CV34 6TD
Tel (0926) 20302

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

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

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

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

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

Lab results

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

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

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

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

significant result and believed due to this revised suspension.

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

Sound quality

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

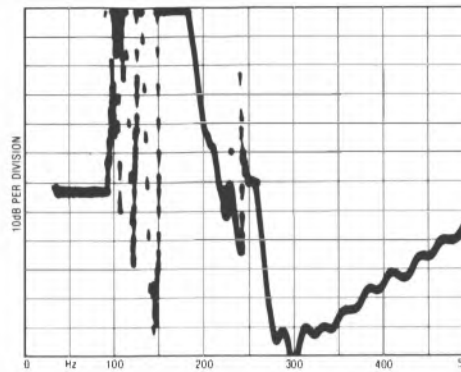
Conclusion

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

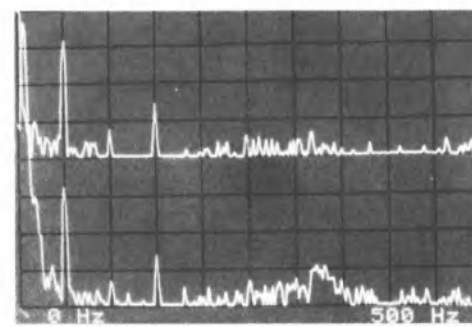
Update

Production models from early 1983 onwards had electronic power supply with two speed switching. Cosmetic and suspension revisions have also been carried out.

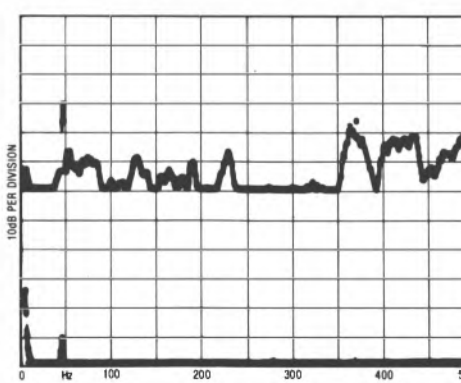
GENERAL DATA	Motor unit
Motor Section	
Type	manual, belt-drive, synchronous motor, sub-chassis
Platter mass/damping	3.0kg/fairly good
Finish and engineering	excellent/very good
Type of mains/connecting leads	2-core
Speed options	33/45 rpm
Wow and flutter(DIN peak wtd, sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.22%/0.05%
Absolute speed error	+0.01%
Speed drift, 1 hour/load variation	synchronous/ – 0.3%
Start-up time to audible stabilisation	5.5 sec
Rumble, DIN B wtd L/R average (see Spectrum)	– 77 dB
Size/clearance for lid rear	48(w) x 39.5(d) x 15(h)/6.5cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/excellent
Vibration sensivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£345



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



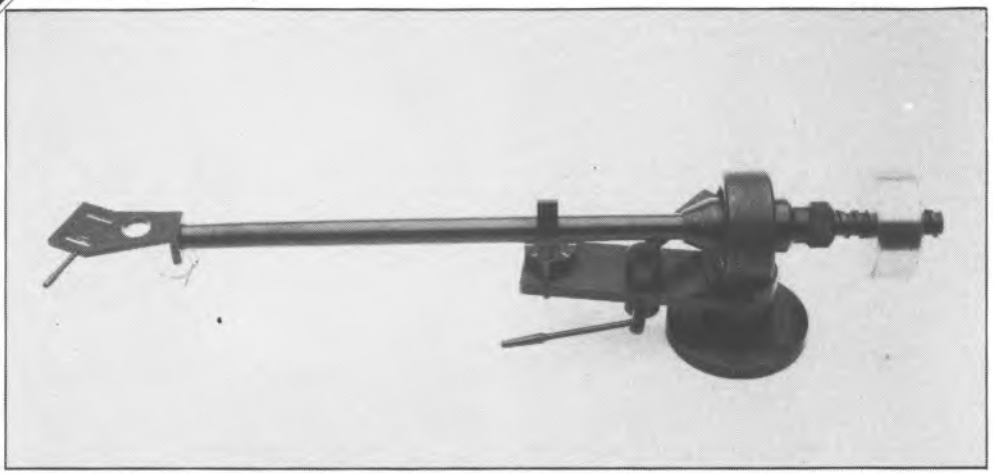
Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Logic Datum

Logic Ltd, 19 Hurlbutt Road, Heathcote Industrial Estate, Warwick CV34 6TD
Tel (0926) 20302



A medium mass design at 10g or so, with mounting headware, the *Datum* is suited to a wide range of moderate compliance cartridges in the 10-22cu range, this suitability including some moving-coil types, judging by its performance on the new *Tempo* turntable. Although moderately priced, the arm actually is built for maximum rigidity, with a strong bearing assembly of the gimbal variety, plus an alloy main beam with a permanently attached strong cartridge mounting platform. Reassessed for this issue, the Datum tonearm is now made by Logic themselves, rather than by outside contractors, and shows a number of improvements over the version supplied for earlier tests.

The calibrated, rotating counterweight is fixed in position by a contra-locking system with no decoupling. Considerable energy is transmitted to the pillar, so the quality of mounting needs some consideration on the chosen turntable.

Adjustments for height, offset angle and overhang are all possible, but no provision has been made for vertical rotation of the cartridge. The latest version has an internal spring bias compensator, as well as improved assembly.

Lab report

The bearings were free of play — indeed on the review sample they were set fractionally too tight in the lateral plane, where a just satisfactory 60mg of friction was measured. In the vertical plane, the friction was fine at 15mg. The *Datum* was felt to be well aligned and the new bias compensator also worked well, delivering compensation forces very close to the target standard. Downforce calibration was low by a small amount, for example, up to 0.14g at the 2.0g dialled setting.

Charted for resonances the arm possessed a mode at 300Hz which was rather lower in frequency than expected. This was probably due to the counterweight while the main beam modes were up at 700Hz to 900Hz indicating good overall rigidity.

Sound quality

Considered an improvement over the earlier version, the current *Datum* provided a good, competitive sonic standard. The bass was pretty firm and even, with good detail, and while a hint of 'nasal coloration' was apparent in the mid register, this was well controlled when the arm was installed in the *Tempo*. The treble was better still, being well balanced and showing good detail.

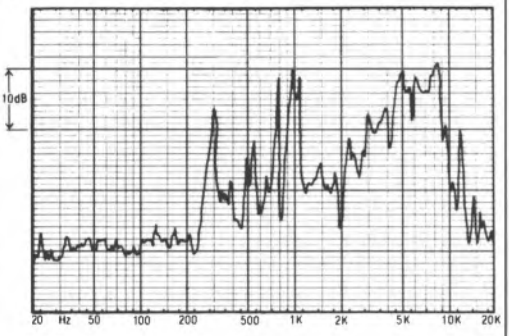
Stereo images were well focused with a good representation of depth and ambience, and again this was shown to best advantage in the Tempo player.

Conclusion

In its latest form the *Datum* has maintained a sufficiently competitive standard to deserve a recommendation. It seems more critical of turntables than some of its competitors, possibly as a result of its above average rigidity, but this also helps to endow it with a good overall performance at a realistic price. Used with the Logic *Tempo*, it is a clear recommendation.

GENERAL DATA Tonearm

Approximate effective mass, inc screws, excl cartridge	10.5g
Type/mass of headshell	non-detachable/—
Geometric accuracy	very good
Adjustments provided	height/overhang/offset
Finish and engineering	good, very good
Ease of assembly/set-up/use	very good/very good/good
Friction, typical lateral/vertical	60mg/15mg
Bias compensation method	internal spring
Bias force, rim/centre (set to 1.5g elliptical)	200mg/230mg
Downforce calibration error, 1g/2g	– 0.06%/ – 0.14%
Cue drift, 8mm ascent/descent	0.8 secs/0.8 secs
Arm resonances	good, see graph
Subjective sound quality	good +
Arm damping	130 pF/none
Estimated typical purchase price	£75



Structural arm resonances, audio band

Lux PD290

HW International Ltd, 3-5 Eden Grove, London N7 8EQ
Tel 01-609 0293

This moderately-priced integrated player could sell on its Lux,•sorry looks, alone! Finish and styling are in the excellent Lux tradition, although to some extent beauty is only skin-deep — the *PD290* is another of those lightly constructed rigid plinth/rubber feet designs.

Powered by a quartz-locked direct-drive motor, the platter has a fine finish and a moderate weight of 1.35kg. The main bearing tolerance was very good with no detectable slack; but conversely the motor foundation on the plinth was none too strong and the platter could be rocked fairly easily with respect to the plinth.

Made from a highly resonant grade of polystyrene, the clear lid is hinged directly onto the plinth — no discouragement to acoustic feedback. The arm was thought pretty flimsy, with a rather weak detachable headshell, and significant play was noted in the vertical arm bearings. Semi-automatic functions are provided, these including motor start with arm cueing.

Lab report

The motor Lux have fitted gives very good speed characteristics. DIN peak wow and flutter measured 0.09% with flutter alone 0.06% and wow 0.11%, these two figures linear peak weighted. Absolute speed was accurate while speed loss under load was zero, due to the quartz locked reference. Start-up time was average at 3.5 seconds, while the motor exhibited a slight speed overshoot here.

Rumble, DIN B weighted, was fine at 74/78dB, the spectrum analysis showing a reasonably low incidence of spurious rumble noise. Most belt driven decks can of course improve upon this standard. The deck did not perform very well with respect to vibration isolation below 100Hz and the acoustic isolation, as predicted, was quite poor, particularly above 250Hz. The disc impulse response was not too encouraging — a wild looking series of higher frequency ringing was followed by long lived resonances fully active after nearly 100ms had expired.

Tonearm bearing friction levels were just satisfactory while the bias compensation was inadequate, at about one third of the optimum value. Downforce calibration was however fine. Charted for structural arm resonances, this design was not judged to be very rigid with the first break seen as low as 180Hz and with serious modes present at both 240 and 460Hz.

Sound quality

On audition the *290* performed a litte better than the lab results might suggest. Although not outstanding in any respect, it provided a pleasantly bland and inoffensive performance. The stereo

sound stage was rather flat and two dimensional, and the natural dynamics of the programme were somewhat compressed, robbing the reproduction of its full excitement. The sound was not really 'transparent' and yet was quite easy to live with.

Conclusion

For the non-critical user who likes Lux styling and finish, and who requires a basic turntable, the *PD290* could be worth considering. In that case the recommendation is to fit a competent moving magnet cartridge in the £15-£25 range and mount the deck on a rigid shelf well away from the loudspeakers.

GENERAL DATA Integrated turntable

Motor Section

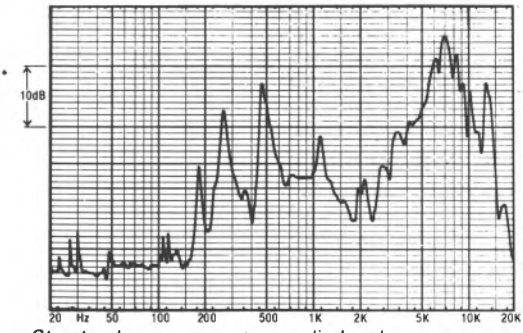
Type.....semi-auto, quartz, direct drive
Platter mass/damping.....1.35kg/good
Finish and engineering.....excellent/good
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.09%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.11%/0.06%
Absolute speed error..... – 0.05%
Speed drift, 1 hour/load variation .....none/none
Start-up time to audible stabilisation.....3.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 74/ – 78dB

Arm section

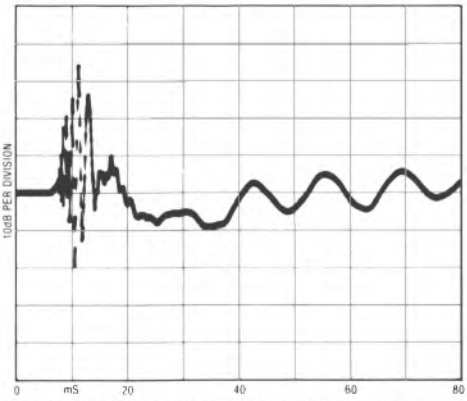
Approximate effective mass, inc screws, excl cartridge....10.5g
Type/mass of headshell.....non-standard, detachable/3g
Geometric accuracy.....fairly good
Adjustments provided.....overhang/offset
Finish and engineering.....very good/average
Ease of assembly/set-up/use.....very good
Friction, typical lateral/vertical.....60mg/60mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....80mg/80mg
Downforce calibration error, 1g/2g..... – 0.02g/none
Cue drift, 8mm ascent/descent.....very good, 2.0 secs/3.0 secs
Arm resonances.....average –
Subjective sound quality.....average –
Arm damping.....none

System as a whole

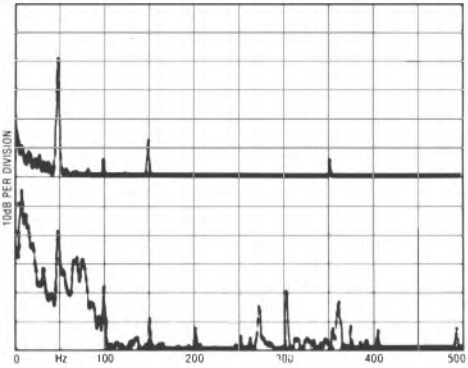
Size (w x d x h)/clearance for lid rear.....44 x 37 x 15cm/6cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....fairly poor
Subjective sound quality of complete system.....average –
Hum level/acoustic feedback.....good/poor
Vibration sensitivity/shock resistance.....poor/fairly good
Estimated typical purchase price.....£145



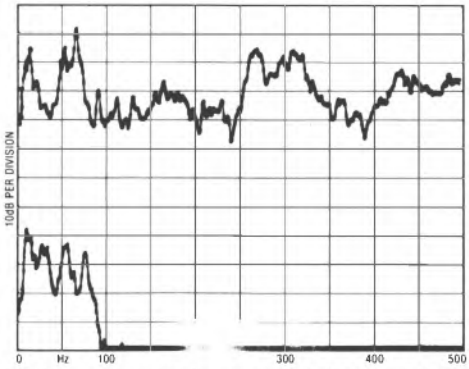
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Lux PD370

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

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

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

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

Lab report

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

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

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

Sound quality

Just making the 'good' category, the *370*

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

Conclusion

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

GENERAL DATA Integrated turntable

Motor Section

Type.....manual, quartz-lock, direct-drive, vacuum platter
Platter mass/damping.....2.5kg/very good
Finish and engineering.....excellent/very good
Type of mains/connecting leads.....3-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)
0.06%/less than 0.04%
Absolute speed error.....– 0.05%
Speed drift, 1 hour/load variation.....none
Start-up time to audible stabilisation.....2.5 secs
Rumble, DIN B wtd L/R average (see spectrum).....77/78 dB

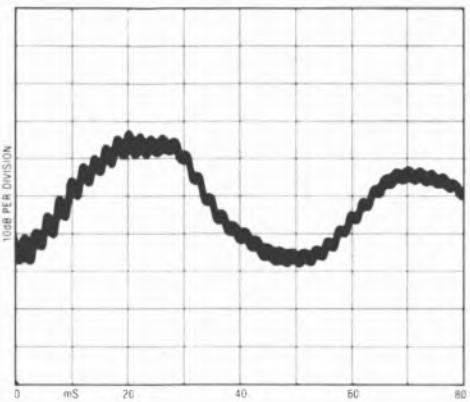
Arm Section

Approximate effective mass, inc screws, excl cartridge...13g
Type/mass of headshell.....non-detachable
Geometric accuracy.....very good
Adjustments provided.....overhang/offset/lateral
Finish and engineering.....excellent/very good
Ease of assembly/setting-up/use...good/very good/very good
Friction, typical lateral/vertical.....80mg/20mg
Bias compensation method.....lever
Bias force, rim/centre (set to 1.5g elliptical).....150mg/100mg
Downforce calibration error, 1g/2g.....+ 0.05g/none
Cue drift, 8mm ascent/descent...noticeable, 0.5 secs/1.3 secs
Arm resonances.....average +
Subjective sound quality.....average +
Lead capacitance/damping method
150pF/counterweight decoupling

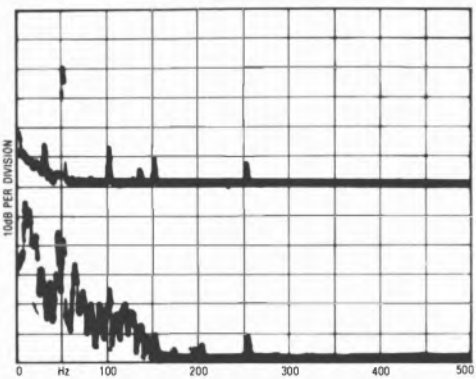
System as a whole

Size/clearance for lid rear.....44(w) x 36(d) x 17(h)/6cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....good
Subjective sound quality of complete system.....good
Hum level/acoustic feedback.....very good/fairly good
Vibration sensivity/shock resistance..average/below average
Estimated typical purchase price.....£199

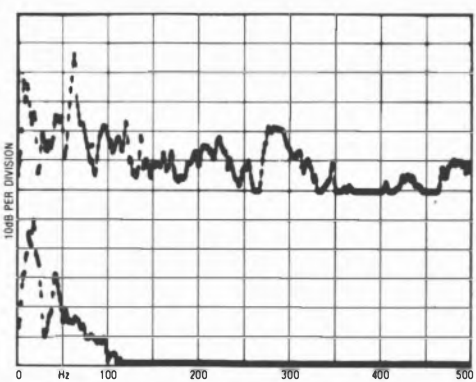
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Lux PD 300

HW International Ltd, 3/5 Eden Grove, London N7 8EQ.
Tel 01-609 0293

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

The *300* is a two-speed belt drive model, using an electronically controlled high quality DC motor. A quartz oscillator reflector type stroboscope is fitted for reference, since the drive is not quartz-locked, and fine variable speed control is *via* thumbwheels mounted underneath near the front edge. One complication in previous assessments arose with the solid flat platter, as the suction pump supplied an equivalent of 30kg pressure, and any dust or grit on the record underside or platter surface will tend to impress itself onto the record surface when the vacuum is engaged. However, a very thin rubber platter mat is now available which does not impair the *300*'s excellent disc damping (see *PD370* review) but effectively negates any worry over hard disc contact and damage. Furthermore the model now costs around two thirds of what it did.

Lab report

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

ment in vibration isolation; but shock resistance was somewhat impaired.

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

Sound quality

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

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

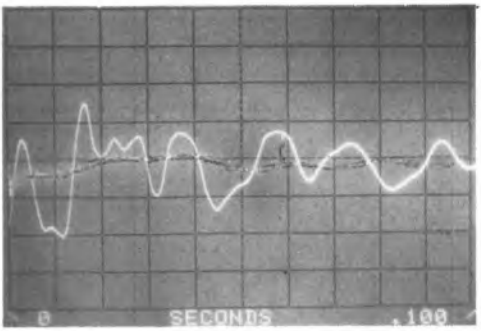
Conclusions

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

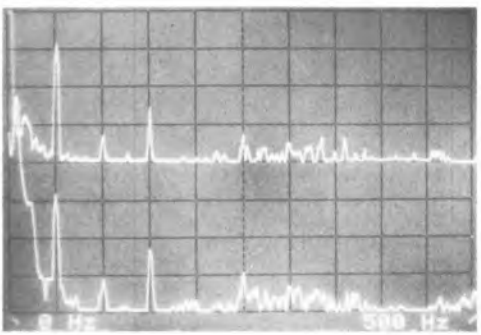
Reassessed for this 1984 edition, the *'300* has been found to give fine results using Rega *RB300*, Zeta and Alphason tonearms, and others are possible. The *PD300* has certainly retained its position as a competitive performer. If slightly modified as described (by removing the rubber dampers from the springs) then the sound is better still, with its particular strengths of good neutrality, plus excellent pitch and timing, much in evidence.

GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	3.5kg/excellent
Finish and engineering	both excellent
Type of mains lead/connecting leads	3 core + earth
Speed options	variable, 33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	<0.1%/<0.05%
Absolute speed error	quartz referenced
Speed drift 1 hour/load variation	+0.25%/<0.1%
Start up time to audible stabilisation	approx 2.8secs
Rumble: DIN B wtd L/R av (see spectrum)	−78/−77dB
Size/clearance for lid rear	49.0(w) x 42.0(d) x 18.8(h)/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good+
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	very good+/fairly good
Typical purchase price	£500 when reviewed now £375

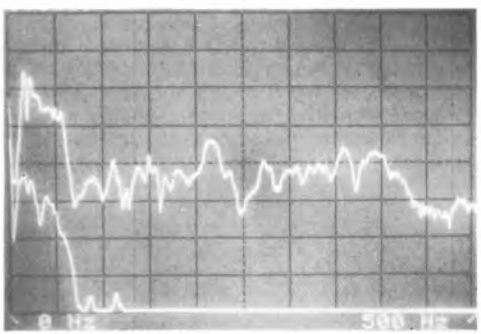
*see text



Disc impulse transmission, magnified X10.



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



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

Lux PD310

HW International Ltd, 3-5 Eden Grove, London N7 8EQ
Tel 01-609 0293

With this heavyweight turntable, Lux fill the gap in their range between the true 'dreadnought' *PD350* and the established *300*. The *PD310* has a massive suction platter, conveniently energised by the *VS-300* remote electrically powered pump, and the latter can in fact be purchased separately as an accessory for the *PD300,* thereby improving its vacuum performance.

While the *PD300* is a subchassis type turntable, the *310* uses a very strong reinforced plinth with cast metal inserts to maximise coupling between tonearm base and the platter. The overall weight of this superbly finished motor unit is 18.5kg, with the cast aluminium platter making up 3.4kg of this. A 500kg/cm^2 moment of inertia is quoted, which relates to the high concentration of mass at the platter periphery.

A 'free' servo-controlled brushless dc motor is used, possessing substantial power and fitted with a large chromed pulley. Electronic switching for two speeds is provided, together with individual control of pitch by +10% and −6%. Absolute speed may be determined to high accuracy by means of the quartz oscillator, synthesised stroble illumination. The motor is coupled to the platter periphery by a long-life polyurethane belt and despite the high mass, the run up is quoted at three seconds (which was verified on test), indicating fine motor torque.

As the deck is a solid plinth type, vibration isolation is only attributable to the fairly stiff feet. The heavy non-resonant lid is fabricated from thick acrylic.

Lab report

The platter main bearing was of excellent quality though mild platter rocking was possible, as can be seen from the otherwise excellent disc impulse response. Here two graphs are shown, one with standard thick rubber mat and without vacuum clamping and the other using the wafer thin mat with vacuum clamping. The former shows a fairly normal, well controlled impulse but the trace with clamping on shows superb attenuation of the leading transient, now almost invisible. However, a low frequency resonance has appeared, this previously masked and analysed at 53Hz.

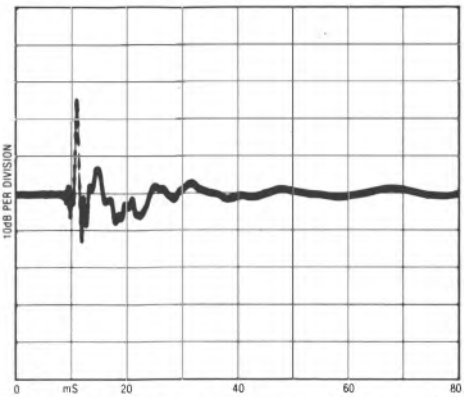
DIN peak wow and flutter was almost perfect at 0.06% with a negligible flutter content and slight wow, the linear reading here 0.11%. Absolute speed was better than 0.05% while drift was moderate and slowing under load proved very good at 0.12%; accordingly pitch stability should be very good.

With the motor mounted on the plinth, some rumble might be expected. In fact, a good reading of −76/78dB DIN B weighted, was recorded, and when this was subjected to spectrum analysis it could be seen that the noise was restricted to 130Hz and below, the main offender being at 60Hz, −60dB, which was pretty good nonetheless.

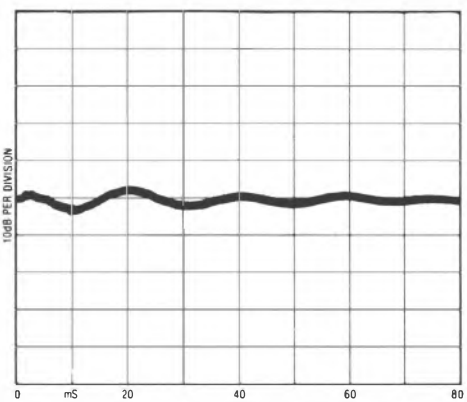
The deck's high mass helped to produce a fairly good result for vibration isolation, and acoustic breakthrough was of an even nature, if not outstanding in its rejection. Acoustic breakthrough was notably improved when the lid was detached.

Sound quality
Auditioned using a Zeta tonearm, with Linn *Asak* and Van den Hul *MC1B* cartridges, the *PD310* produced a powerful and well-founded sound. With the disc vacuum clamped, the mid and treble were exceptional with excellent tonal balance — a gracious laid back effect with a fine resolution of detail and depth. Stereo images were very stable and the pitch stability, as predicted, was superb. The bass was pretty good but lacked the speed and ultimate articulation of the best suspended subchassis types. It gave an impression of restful stability.

Conclusion
This superbly-built turntable is a fine product and offers fuss-free operation. The sound was generally good, as was the lab performance, and while at this price a recommendation is out of the question on value grounds, the deck is certainly well worth considering.



Disc impulse transmission showing damping, without vacuum platter clamp

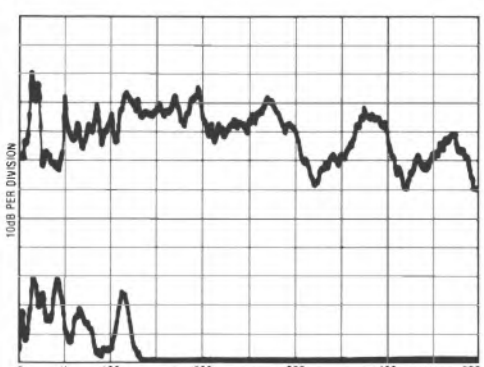


Disc impulse transmission showing damping, with vacuum platter clamping on

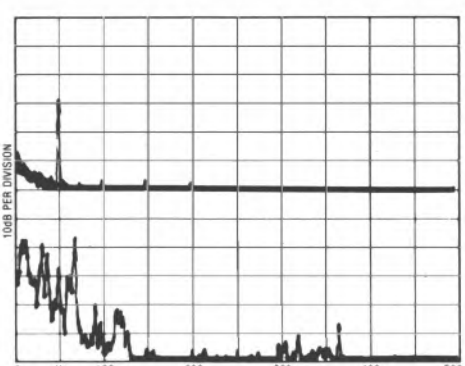
GENERAL DATA Motor unit

Motor Section

Type	belt-drive, vacuum disc stabiliser
Platter mass/damping	3.5kg/superb
Finish and engineering	excellent/excellent
Type of mains lead/connecting lead	3-core/—
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.06%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.11%/<0.05%
Absolute speed error	– 0.05%
Speed drift, 1 hour/load variation	– 0.25%/ – 0.12%
Start-up time to audible stabilisation	3.0 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 76/ – 78dB
Size (w x d x h)/clearance for lid rear	49 x 40.5 x 19.5/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	very good/fairly good
Vibration sensitivity/shock resistance	fairly good/good
Estimated typical purchase price	£560



Breakthrough, acoustic (above) and vibration (below)

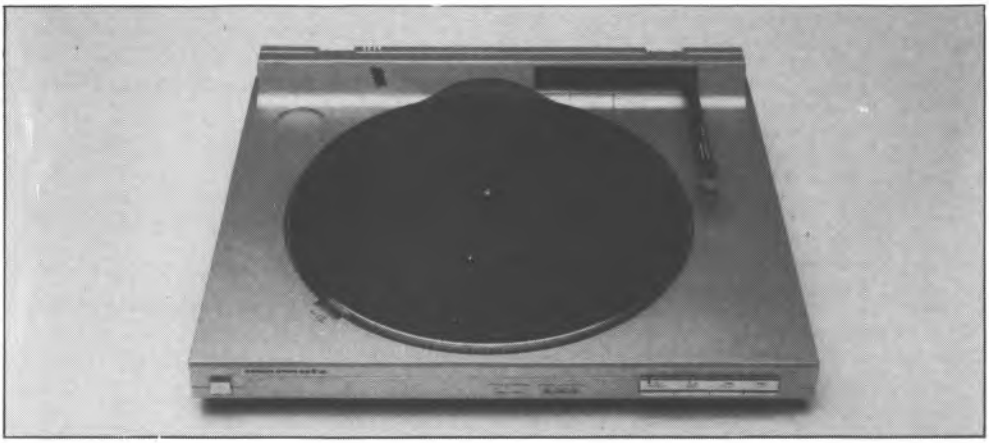


Rumble, electrical (above) and total (below)

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

Marantz TT530CT

Marantz Audio (UK) Ltd, 15-16 Saxon Way Industrial Estate, Moor Lane, Harmondsworth, Middlesex UB7 0LW
Tel 01-897 6633



Aside from the £1000 plate-glass *Esotec*, the Marantz players submitted to *HFC* have all been inexpensive. However, the *TT530* is a little upmarket in its use of a parallel or linear tracking arm mechanism; although it could be argued that this feature has only a dubious importance as regards sound quality, linear tracking designs usually incorporate some degree of automation, record presence and size detection, plus auto speed selection and return at end of side.

This player is powered by a simple servo-controlled direct drive motor, fitted with a fairly low-mass platter weighing 0.85kg. The plastic tonearm has the increasingly popular T4P mounting, and came fitted with a modest moving magnet cartridge of matching compliance. T4P can be a blessing for the inexpensive player where it eliminates alignment problems and helps to achieve a sensible subsonic arm/cartridge resonance via a low mass arm construction. In the case of the *TT530*, arm mass was estimated at 5.0g. The fixed nature of the design does actually preclude a number of the usual lab measurements, but all possible tests were carried out.

Lab report

Wow and flutter was higher than expected, but judging by the DIN weighted reading of 0.12%, should be satisfactory. Wow and flutter components making up the total were well balanced, but the performance was less secure on the question of speed stability and torque. The *TT530* slowed 0.35% under load, the importance of this reading made more serious by the notable speed overshoot when the loading was removed, as this amounted to 0.4%. As a result I could not guarantee a freedom from dynamic pitch variations.

Another weakness was noted in connection with rumble or unwanted mechancial noise at low frequencies. Barely adequate readings of 64/66dB DIN B were measured, and the second sample requested for checking did not arrive before this review was completed. Spectrum analysis of the rumble signal revealed a mains related harmonics, probably due to an inadequately isolated transformer.

Isolation performance was weak, as both acoustic and vibration energy were poorly rejected; the deck's performance was much below average here. Examining the disc impulse, the initial transient was quite well handled, but a serious, slow-decaying low frequency resonance followed the impulse. This was in the 20-30Hz region and was identified as a platter rocking mode, promoted by compliance of the main bearing mounting.

Turning to the arm, most facilities worked well. The arm resonance graph, taken using the attached cartridge, was surprisingly tidy, while an admirable smooth rise in energy response was charted from 50Hz to 20kHz. Unfortunately, the arm was not mass-loaded to the T4P standard.

Sound quality

The promising arm performance was, unfortunately, not sufficiently reflected in the

results of the listening tests. Pitch instability, or audible wow, was identified, while some mechanical hum could also be heard on quiet passages. Acoustic feedback margins were poor, the player proving quite microphonic.

Bass was poor, lacking in either power or definition, while some mid coloration was apparent. Stereo images were also rather flat and the dynamics were thought unexciting.

Conclusion

Marantz need to try much harder, we feel, if they want to make headway in the more critical areas of the UK turntable market. They have the muscle but as yet it seems they lack the inspiration; this model cannot be recommended.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

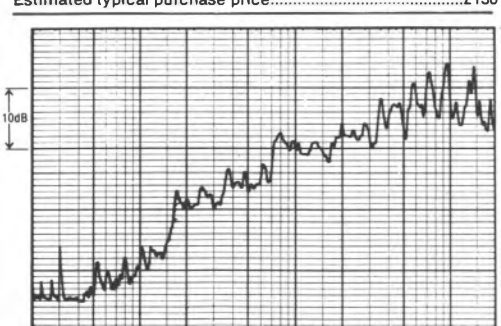
Type	fully auto, direct drive, linear tracking
Platter mass/damping	0.875kg
Finish and engineering	very good/average
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	manual/auto variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.12%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.14%/0.1%
Absolute speed error	adjustable pitch
Speed drift, 1 hour/load variation	0.2%/ – 0.35%
Start-up time to audible stabilisation	3.3 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 64/ – 66dB

Arm section

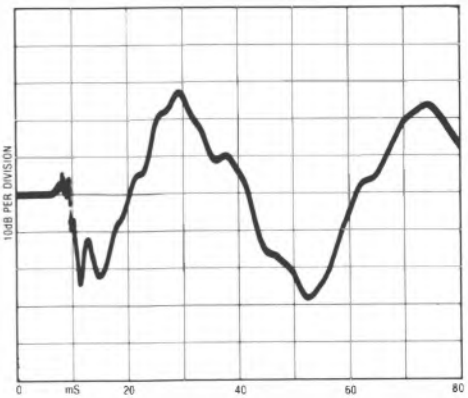
Approximate effective mass, inc screws, excl cartridge	5g
Type/mass of headshell	non-detachable, T4P
Geometric accuracy	excellent
Adjustments provided	none
Finish and engineering	very good/average
Ease of assembly/set-up/use	excellent
Friction, typical lateral/vertical	—
Bias compensation method	—
Bias force, rim/centre (set to 1.5g elliptical)	—
Downforce calibration error, 1g/2g	—
Cue drift, 8mm ascent/descent	2.0 secs/2.0 secs
Arm resonances	good
Subjective sound quality	average
Arm damping	none

System as a whole

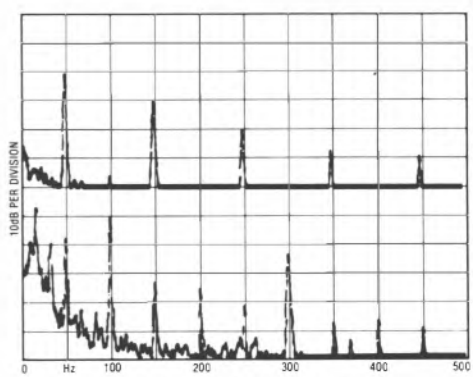
Size (w x d x h)/clearance for lid rear	41.5 x 35 x 10cm/0.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	poor
Hum level/acoustic feedback	fair/poor
Vibration sensitivity/shock resistance	poor/good
Estimated typical purchase price	£130



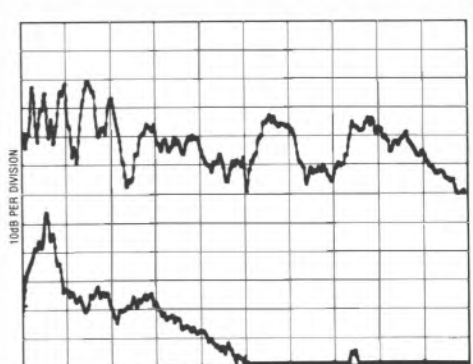
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

Marantz Esotec TT1000

Marantz (UK) Ltd, 15-16 Saxon Way Industrial Estate, Moor Lane, Harmondsworth, Middlesex
Tel 01-897 6633

Features and design

Marantz' move back into the 'superfi' market is spearheaded by their new *Esotec* range, which includes a turntable costing close on £1000 and offered as a universal motor unit. 'Simplicity' best describes this remarkable creation, comprising a heavy plate on feet fitted with a motor and platter. Subscribing to the ultra-rigid, ultra-heavy approach to chassis design, the deck plate is composed of a massive laminate 38mm thick – two 15mm plate glass panels covering an 8mm aluminium alloy interlayer. This assembly alone weighs 25.3kg and forms a strong inert foundation for the motor and tonearm. As no lid is provided, the elimination of acoustic energy coupling from this source at least is eliminated.

In theory a super-rigid and massive deck such as this, equipped with a dynamically balanced tonearm, should not require vibration isolation in the dominant 5–200Hz range, since the deck section comprises a mechanical closed loop. Provided that the arm mount does not flex with respect to the platter this condition should be fulfilled. In fact, the Marantz *1000* does come quite close to achieving this theoretical objective.

An external power supply, built into a veneered box, feeds the quartz-lock direct drive motor, which is fitted with a 3.4kg balanced aluminium alloy platter. A glass mat fits securely on this platter, and may be augmented by any other suitable mat of felt or silicone type rubber as desired. Glass is itself a good medium, but needs to be kept clean to prevent disc abrasion by micro grit, etc, during handling.

The operating controls comprise subtle electronic touch pads on the deck plate – on/off and 33/45 rpm speed change – with control of mains on the power box. The large diameter adjustable feet have some inbuilt rubber isolation which is likely to be effective in the higher frequency range. One aspect which could be very important to some purchasers is the good resistance this type of turntable affords to footfall shock on springy floors, achieved by its high total mass and overdamped suspension.

Lab results

Marantz have selected an exceptional motor for use in this model; one which provides state of the art figures on all measurement modes for wow, flutter and rumble, both weighted and unweighted. The motor's dynamic behaviour was very good with no speed overshoot on load change, while the high torque was confirmed by the rapid 1.5 second start up. When subjected to spectrum analysis mechanical rumble was very low; on this graph the total energy and the trace for static

electrical breakthrough have been superimposed, showing a negligible difference right down to −100dB.

Disc termination was sufficiently good to allow X10 scaling of the impulse response, and the result was fine in all respects, the mid/low frequency component around 35Hz probably relating to a platter rocking flexure. Breakthroughs were pretty good, though the vibration isolation was fading below 100Hz and the acoustic component showed some unevenness; the peak at 35Hz was probably again associated with the platter.

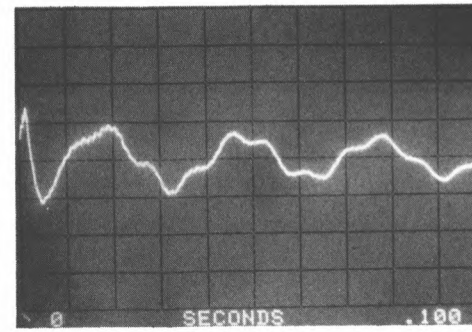
Sound quality

Tried with several tonearms including the Mission *774*, the Helius and SME *III*, the *TT1000* performed very well subjectively. Demonstrating very good stability with regard to low frequency floor movements, some loss of bass attack and low frequency extension was apparent on our coffee table location, but transfer to a more substantial wall-mounted shelf provided a great improvement. The sound was characterised by a feeling of relaxed security, with accurate pitch and comfortable stylus tracking, while tonally it was well balanced and integrated. The standard glass mat and in particular the Mission arm gave fine results in this location, proving capable of accepting the *Asak*. But many other cartridges are also suitable, including the *Karats* and the more delicate Denons.

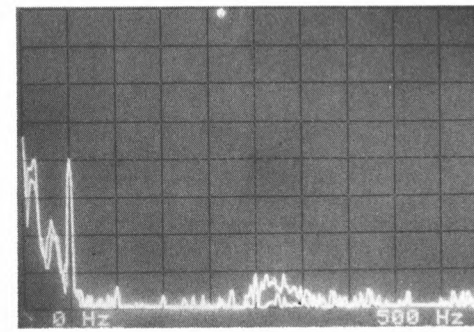
Conclusion

Admittedly very costly, the *TT1000* offers a high quality shock resistant motor platform which is tolerant of tonearms. Well sited, the reproduction is excellent, demonstrating low coloration levels. If you can afford it and like its looks, there are few objections that can be raised against its purchase, but in value for money terms recommendation is not appropriate. Like the big Luxman this is more of a design/engineering exercise than an attempt to put BSR out of business, and it succeeds well in attaining the desired prestige.

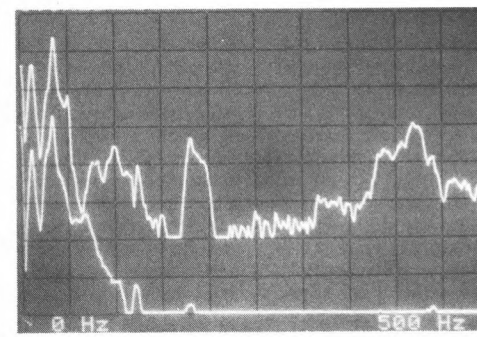
GENERAL DATA	Motor Unit
Type	direct drive, manual quartz lock
Platter mass/damping	3.4kg/fairly good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	2 core, power box/N/A
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.1%/0.08%
Absolute speed error	<0.01%
Speed drift 1 hour/load variation	<0.01%/<0.01%
Start up time to audible stabilisation	approx 1.5secs
Rumble: DIN B wtd L/R av (see spectrum)	−78dB
Size/clearance for lid rear	51.0(w) x 43.0(d) x 16.0(h)/ no lid
Ease of use	very good
Typical acoustic breakthrough and resonances	good+
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	good/very good
Estimated typical purchase price	**£999**



Disc impulse transmission, magnified X10.



Rumble (0–500Hz lin), (electrical component superimposed).



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

RECOMMENDED

Michell Focus Motor

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

Features and design

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

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

Lab results

As the figures show, this model now provided exemplary results for wow and flutter, both separately assessed and weighted. Torque and speed accuracy were both good, and although the weighted rumble figures were also fine at near −75dB (several dB better than before), spectrum analysis did reveal a 100Hz component at −73dB, which is poorer than average. The disc impulse response was quite good allowing X10 scaling and demonstrating good high frequency damping. Acoustic breakthrough was above average and vibration isolation fine, but shock immunity was not spectacular.

Sound quality

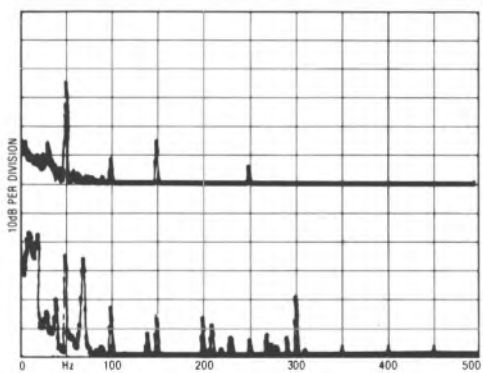
For some reason the deck never seemed quite at home with the *Focus* arm, but it provided pleasantly balanced and relaxed results in partnership with the Linn *Basik*. Above average with the lid installed, the bass was reasonably clean, the midrange quite transparent and detailed, and the stereo presentation above average. The sound was distinctly cleaner however with the lid removed, and for critical listening this is worth doing.

Conclusion

Possessing a fine handcrafted finish and distinctive styling, the *Focus* has improved significantly in mechanical terms since its introduction. It is now available at an attractive package price (£170), factory fitted with the Linn *Basik* arm/cartridge. This package gains a comfortable recommendation, and indeed the motor unit alone is worth considering at around £130.

(Note: On the latest version of the Focus, retested for this edition, Michell have revised the motor mounting as well as the plinth/chassis material. Lab figures are very similar this time except for a slight worsening in mains rumble component, but overall conclusions remain unaltered.)

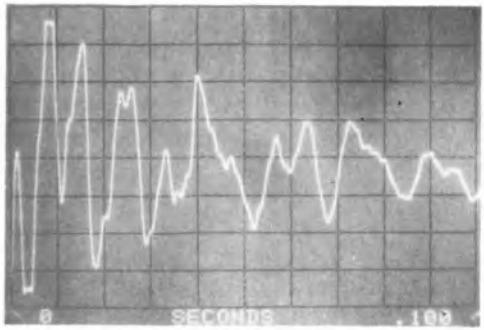
GENERAL DATA	Motor unit
Type	manual, belt-drive, synchronous motor
Platter mass/damping	2.1kg/good
Finish and engineering	very good/very good
Type of mains/connecting leads	3-core
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.06%/less than 0.04%
Absolute speed error	+ 0.25%
Speed drift, 1 hour/load variation	synchronous/ – 0%
Start-up time to audible stabilisation	7.5 secs
Rumble, DIN B wtd L/R average (see Spectrum)	75 dB
Size/clearance for lid rear	43(w) x 37(d) x 15(h)/10cm
Ease of use	good
Typical acoustic breakthrough and resonances	average +
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/above average
Vibration sensivity/shock resistance	good/fairly good
Estimated typical purchase price	£135



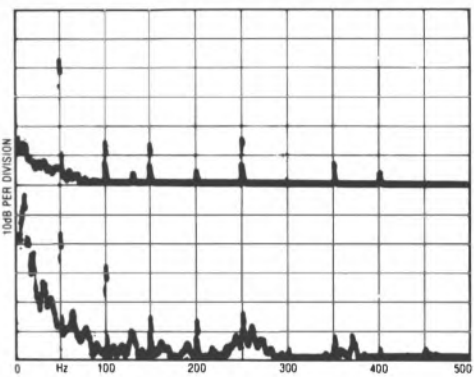
Rumble, electrical (above)and total (below) on latest sample — compare previous result.

Update

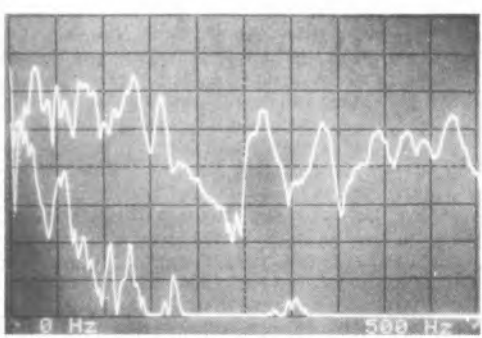
The Linn LVV tonearm shown in the photo is no longer available. Though stocks of the Focus/LVV package may well still be with dealers the slightly more expensive Focus/Mission 774LC package can be recommended. An improved 'S' version of the turntable is also now available at £189 without arm.



Disc impulse transmission, magnified X10.



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



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

RECOMMENDED

Michell GyroDec

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

A recently developed model, the *Gyrodec* represents Michell's concept of a top-quality no compromise turntable. A large design fitted with a costly hand fabricated glass-clear acrylic case and lid, the *Gyrodec* has provision for the symmetrical attachment of one or two arms as required. Carrying a five-year guarantee, it has been well thought out with regard to setting-up and all parts are accessible without the need for the removal of baseplates and so on.

Representing Michell's first subchassis design, the massive spoked 'wheel' chassis casting is preloaded with lead weights to largely counterbalance the arm masses. The whole is suspended in compliant coil springs resiliently mounted within the three suspension towers adjacent to the platter, and as previously mentioned, the system is readily adjusted from above upon removal of the spring covers. Special mounting plates of thick alloy are provided for individual arms, these of different mass to give a constant state of balance without recourse to changing springs. The alloy platter is loaded for both mass augmentation and for resonance distribution by an array of weights on the underside, these heavily gold plated.

A one piece component, the platter is driven at its grooved periphery by a thin rubber cord powered via a large hysteresis synchronous motor made by Papst. This is a low voltage type, fed via a small transformer in the mains supply lead. Two speeds are provide via the motor pulley, with the appropriate section easily selected by hand, since the drive is entirely exposed in this model.

A key feature is the incorporation of a full clamp absorption system for record damping. A polymer mat is used, in conjunction with a record label clamp, this bearing over a central washer and thus tensioning out all but the most stubborn of warps. In this respect the Gyrodec bears a great similarity to the Oracle.

Lab report

The platter weighed some 4.5kg and proved to be well damped with respect to the disc impulse response. The initial transient was well trapped, but a low frequency aftershock was present at about 40Hz — probably platter rock on the main bearing total compliance. Wow, flutter and integrated wow and flutter were all very low particularly for a belt drive. Absolute speed was about 0.2% slow while a further 0.3% slowing (slightly high) occurred on

standard loading. Start-up time to audible pitch stabilisation took a very long 9.5 seconds, mainly due to oscillation of the platter inertia against the belt compliance. Poorly damped, this could be an influence on subjective pitch stability on transient programme.

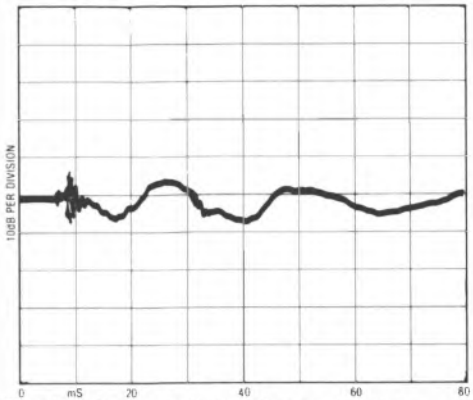
Rumble was very good at −77dB, showing just the slightest incidence of motor rotational components, and its resistance to acoustic and vibration breakthrough was so extraordinary that the scales had to be magnified by 10dB to bring the residual coupling into sight. Hum levels were fine and acoustic feedback excellent, while shock resistance was also very good.

Sound quality

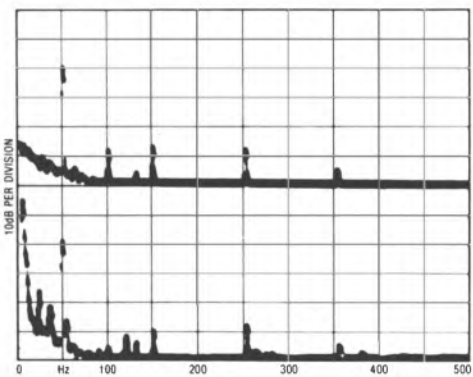
Just failing to make the top grade the *Gyrodec* scored a very high mark on audition. it sounded very neutral and transparent, producing stable and spacious stereo images with impressive depth. Bass was substantially even with weight, power and attack. Our one reservation concerned a something which may in practice prove less important to other listeners, namely dynamic wow. On rock programme with heavy transients a trace of pitch instability was evident, believed due to this effect.

Conclusion

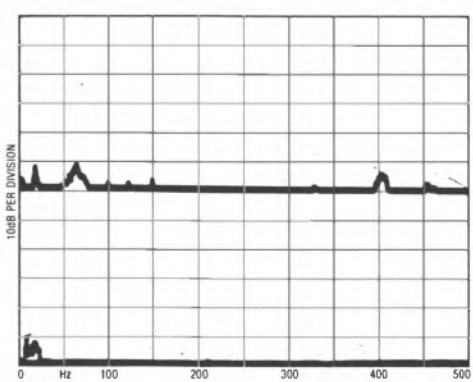
When previously reviewed, the *Gyrodec* excelled in many areas but suffered from a minor problem in the drive system. The pitch instability effects noted above have now been successfully conquered by the addition of a second drive belt. Accordingly, we now feel justified in recommending the Gyrodec even at its elevated price level.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

GENERAL DATA Motor unit

Type.....manual, belt-drive, synchronous motor, subchassis
Platter mass/damping.....4.5kg/very good
Finish and engineering.....very good/excellent
Type of mains/connecting leads.....2-core, line transformer
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....less than 0.04%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) less than 0.06%/0.04%
Absolute speed error.....−0.2%
Speed drift, 1 hour/load variation.....synchronous/−0.3%
Start-up time to audible stabilisation.....9.5 secs
Rumble, DIN B wtd L/R average (see spectrum).....−77 dB
Size/clearance for lid rear.....53(w) x 42(d) x 19(h)/4cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....excellent
Subjective sound quality of complete system.....very good
Hum level/acoustic feedback.....very good/excellent
Vibration sensivity/shock resistance excellent/very good
Estimated typical purchase price.....*£595

**includes dealer set-up, arm fittings, clamp mat system*

Mission Cambridge 775LCT

Mission Cambridge Ltd, Stonehill, Huntingdon, Cambridge PE18 6ED
Tel (0480) 57477

This new product from Mission forms a significant part of the £500 Mission record-playing system, soon to be followed by a less expensive system which should retail for around the £400 mark. To this end the *775*, benefiting from volume production, has been kept down in price, recently as low as £99 plus arm. In fact, the deck comes fitted as standard with a Mission *774LC* tonearm (see separate review), but it also has Linn-style arm mounting arrangements so can be fitted with a number of other compatible arms.

The prestigious *775SM* was assessed last time round and to all intents and purposes one could regard the *775* as a lower cost development of that design. A solid plinth construction is adopted, the plinth being made from a very thick and highly rigid composition board. Mission aim to 'close the loop' between arm and platter and thus exclude external interference, for isolation the plinth has three non-adjustable sponge feet in high-loss Sorbothane, these capped by load spreading cups.

A fairly resonant polystyrene lid is fitted while the two piece platter has an alloy outer disc weighing about 1.5kg resting on an inner plastic hub. The 500rpm synchronous motor is virtually rigidly mounted on the plinth, and could give rise to breakthrough problems. This is linked to the platter via a neoprene cord running on a 'V' groove pulley. Speed change is manual, effected by flicking the cord from one step in the pulley to the other. No alignment or adjustment is required and if fitted with a tone-arm, the *775* should work, immediately it is unpacked and the platter put in position.

Lab report

The limited shelf or support isolation was shown by the graphs where around 10dB of vibration rejection was apparent in the 30-500Hz range, as compared with 20-30dB for the subchassis designs. Acoustic energy was handled better if still below average, but both of the breakthrough curves were of an even and non-resonant character.

Using the thin felt mat, the disc impulse response was fairly typical of this type of mat, but the subsequent decay was rather quicker than usual. A slight 'ring' was evident at 180Hz, probably a platter rocking mode. Wow and flutter were only just satisfactory on an early sample, but improved with a second one. Rumble was certainly poorer than average but not unacceptably so at around −70dB, analysis showing the predicted emergence of some motor related components at a

satisfactory level. Torque was good with minimum slowing under load and the other speed characteristics were fine.

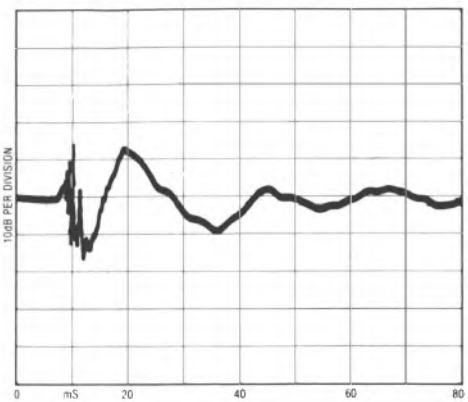
Sound quality

Assessed with the *774LC* tonearm, this turnable confounded some of our prejudices concerning solid plinth designs. It gave a tidy, coherent and well integrated sound. Dynamics were good, with an almost tactile percussive impact. Pitch and rhythm were also good, lending an almost 'boppy' effect with the help of an above-average bass quality, this being a bit lightweight but tuneful.

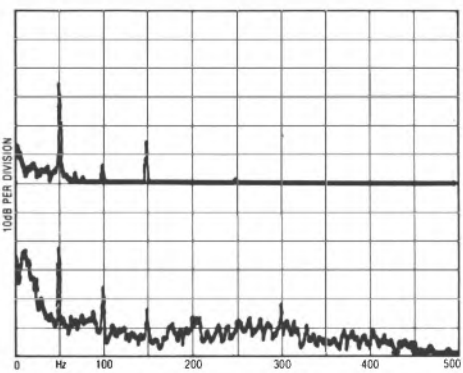
Stereo focus was impressive through the range was a trifle up front with some loss of depth. The sound was distincly improved when the lid was removed, and this is our recommendation for serious listening. Both deck and arm appeared well matched.

Conclusion

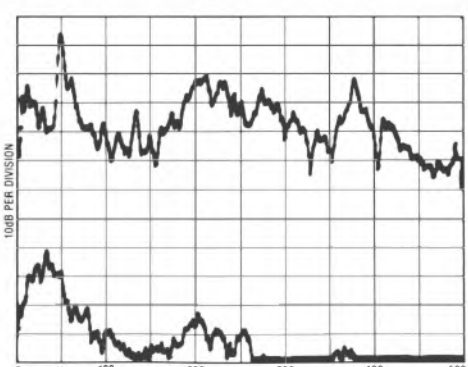
At £99 this motor unit comfortably achieved a recommendation. Supplied as a package with *774LC* tonearm plus a new Mission cartridge (£165), it can also be recommended but remember to lift off the lid to get the best results. Some care in siting the player would also not go amiss, with the optional position being a rigid wall shelf.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

GENERAL DATA Integrated turntable (inc cartridge); or motor unit only

Motor Section

Type.....belt-drive, subchassis
Platter mass/damping.....2.15kg/fairly good
Finish and engineering.....very good/good
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.1%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.18%/0.07%
Absolute speed error.....+0.1%
Speed drift, 1 hour/load variation.....0.09%/–0.21%
Start-up time to audible stabilisation.....1.8 secs
Rumble, DIN B wtd, L/R average (see spectrum).....–77/–75dB

Arm section (Mission 774LC)

Approximate effective mass, inc screws, excl cartridge.....12g
Type/mass of headshell.....non-detachable
Geometric accuracy.....very good
Adjustments provided.....height/overhang/offset
Finish and engineering.....excellent/very good
Ease of assembly/set-up/use.....very good
Friction, typical lateral/vertical.....30mg/30mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....120mg/120mg
Downforce calibration error, 1g/2g.....–0.08g/–0.2g
Cue drift, 8mm ascent/descent.....very good, 0.5 secs/4.0 secs
Arm resonances.....average +
Subjective sound quality.....good
Arm damping.....none

System as a whole

Size (w x d x h)/clearance for lid rear.....43 x 33 x 12.5cm/4cm
Ease of use.....good
Typical acoustic breakthrough and resonances.....fair
Subjective sound quality of complete system.....good
Hum level/acoustic feedback.....average/fair
Vibration sensitivity/shock resistance.....average –/fairly good
Estimated typical purchase price.....£165 (motor unit only, £99)

Mission 775S

Mission Cambridge Ltd, Stonehill, Huntingdon, Cambridge PE18 6ED
Tel (0480) 57477

This new turntable came fitted with a Mission *774* tonearm, at an inclusive price of £300, and accordingly the combination was assessed as an integrated player. A clear connection exists between the *775S* and the previous *775SM,* an upmarket Mission motor unit which sold for some £500 or so. As the *774* tonearm is itself sold for around £160 as a separate the *775S* combination would appear to be something of a bargain.

The massive 6.0kg 'SM' platter is also used for the new *775S*, in conjunction this time with the new thin felt Mission mat plus a Michell-type centre clamp. The plinth is made of high density MDF board. This rigid-construction turntable uses a belt drive from a plinth mounted synchronous motor, not the best position for a good signal to noise result. Changeover between 33⅓ and 45 rpm is by shifting the belt manually.

Three fairly stiff, high-loss Sorbothane feet are used to provide a tripod foundation. Mild play was evident in the main bearing of one sample, and subsequent investigation suggested that this was not atypical.

Lab report

The massive platter showed fine damping of the disc impulse response. The initial transient was well shaped, with good control of the subsequent decay. Wow and flutter, DIN peak weighted, proved very good at 0.07%. When asessed as separate flutter and wow components, the results were also very fine. Absolute speed was close to standard while good torque was shown by the results for speed loss under load. Start up was slow at six seconds, and the DIN B rumble result was also poor than average for its class at 72/74dB. While these ratings suggest a satisfactory result, in the case of large wideband speakers used with powerful amplifiers at high sound levels, there might be mild audible rumble. Spectrum analysis in rumble showed the intrusion of some motor rotation components.

The isolation performance was satisfactory, though not quite as good as for the weighter *SM*; conversely, the rumble and speed performance was superior to the older deck. The latest arm sample was briefly retested the results being shown in the accompanying table and graph (see also the original review of Sorbothane counterweight version which may well be supplied on request.)

Sound quality

Standards have improved all round in recent years; indeed Mission's own *LCT* turntable is impressive in several respects. We were therefore disappointed to find that despite the

superior pedigree of the *S*, the sound quality did not appear to justify the obvious additional manufacturing effort.

When compared for example with certain of its competitors, such as an AR turntable with Mission *774LC* arm, the *775S* sounded rather 'two-dimensional'. One listener described it as a 'wall of sound' effect. The bass was a trifle 'fat' and lumpy, while the midrange lacked real depth or transparency. In the treble some 'splash' was apparent, when used with a modestly-priced moving coil cartridge installed. Tonally, it was however pretty neutral and free from any aggressive tendencies.

Conclusion

On balance the results suggest that Mission's own *LCT* turntable outperforms the *S*, so the latter is not quite such a bargain after all. It certainly looks impressive but we feel that the *LCT* at not much more than half the price does a better job of communicating the excitement and the more detailed content of the music. As with the original *SM*, the *S* does not in our view qualify for recommendation; perhaps a change of tonearm could improve matters, but the performance of the motor unit itself probably would not justify any excessive expenditure in this direction.

GENERAL DATA Integrated turntable (motor unit plus arm)

Motor Section

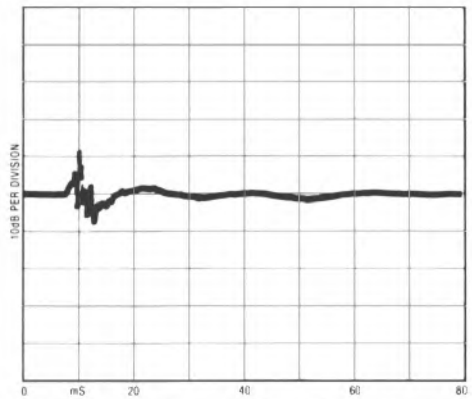
Type	belt-drive, rigid plinth
Platter mass/damping	6.0kg/very good
Finish and engineering	very good
Type of mains lead/connecting lead	3-core/phonos and earth
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.07%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.07%/0.09%
Absolute speed error	+ 0.15%
Speed drift, 1 hour/load variation	synchronous/ – 0.22%
Start-up time to audible stabilisation	6 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 72/ – 74dB

Arm section (Mission 774)

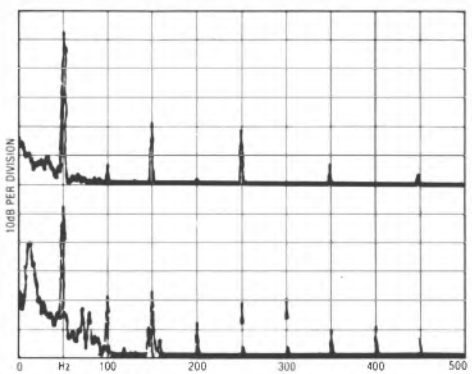
Approximate effective mass, inc screws, excl cartridge	5.5g
Type/mass of headshell	special detachable carrier
Geometric accuracy	very good
Adjustments provided	tilt height/overhang/damping
Finish and engineering	very good
Ease of assembly/set-up/use	very good/very good/fairly good
Friction, typical lateral/vertical	25mg/20mg
Bias compensation method	thread and lever
Bias force, rim/centre (set to 1.5g elliptical)	uncalibrated
Downforce calibration error, 1g/2g	– 0.1g/ – 0.15g
Cue drift, 8mm ascent/descent	negligible, 1.0 secs/2.0 secs
Arm resonances	good, see graph
Subjective sound quality	see text
Arm damping	180 pF/variable, silicone fluid well

System as a whole

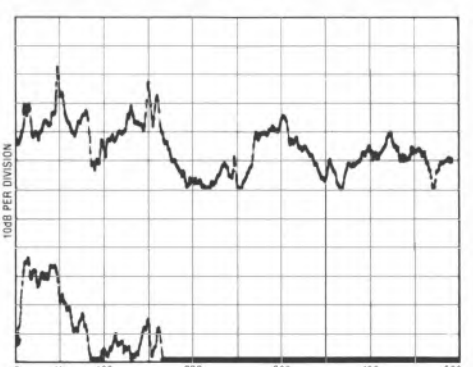
Size (w x d x h)/clearance for lid rear	43 x 39 x 15cm/3cm
Ease of use	average
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	average +
Hum level/acoustic feedback	satisfactory/good +
Vibration sensitivity/shock resistance	fairly good/good
Estimated typical purchase price	£300



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



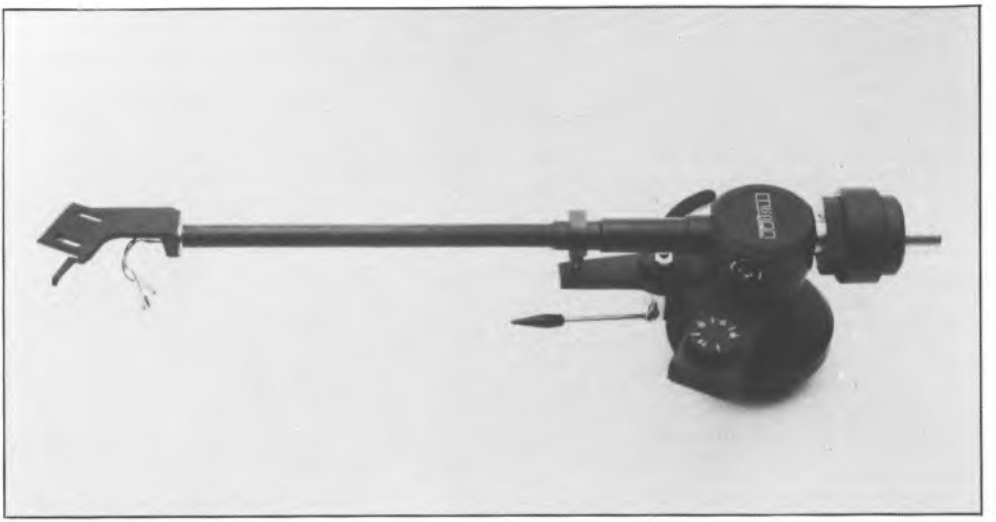
Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Mission 774LC

Mission Cambridge Ltd, Stonehill, Huntingdon, Cambridge PE18 6ED
Tel (0480) 57477



Supplied with the *775LCT* turntable, as well as with a number of decks from other manufacturers, this tonearm has become well established, in a market containing some notable competitors such as the Linn *LVX*.

Built to Mission's design in Japan, this tonearm is a conventional gimbal type, but with some interesting constructional features. The headshell is fixed, conceived as a rigidly mounted cartridge platform. Step-tapered, the main beam design has been chosen to distribute and moderate self-resonance, and is constructed from aluminium alloy. No damping is used for the counterweight, bar the inherent imprecision of its friction-locked rotating design.

Conveniently, the arm uses the same mounting arrangements as the Linn models, and indeed the arm pillars are essentially interchangeable in their mounting plates. Both makes use a side locking arrangement for arm height, fixed by a large socket head screw.

Current production provides for well adjusted bearings free from slack, and the standard of construction and finish are particularly good. A standard Japanese type connector is used, fitting the usual socket below the pillar.

Lab report

With hardware, the effective mass was noted at 12g, with a typical cartridge balanced out. This is rated as 'medium' and is best suited to cartridge compliance in the 10-20cu range. Geometric accuracy was fine, while adjustments were available for offset angle, overhang and height. The arm was considered to be well adjusted with low friction in both planes, typically 30mg. The internal spring bias compensator worked well in terms of low friction but gave forces around half that normally required, and if this is typical, the user should increase the dialled setting, or even better still, adjust by trial and error using a suitable record. Downforce calibration was set on the low side but not seriously so.

Cue drift was negligible though cue descent was slow for our test 8mm drop. Structural arm resonances were charted and showed a modestly damped counterweight mode at 180Hz but a rather better performance up-band, the next mode bing deferred until 600Hz and almost too small to identify. Something else happened at 800Hz but barring this irregularity, the rest of the range looked pretty tidy. 'Fairly good' is the rating here.

Sound quality

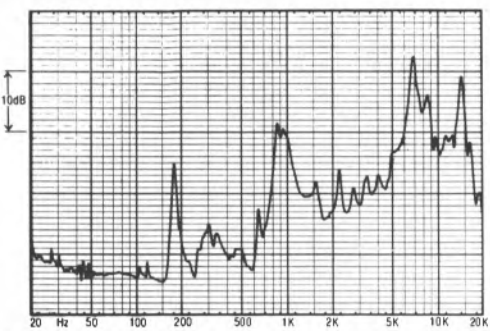
This arm is so popular that potential purchasers could audition it on a number of players to help gain a good idea of its intrinsic sound quality.

Taken overall, a clear explicit sound was produced, with good stereo focus as well as pleasing stereo depth. Depending on the cartridge, the upper frequency range could sound a little untidy, while some coloration was apparent in the midrange. Bass was comparatively secure and gave quite good detail and fairly good articulation. Generally partnered by modest moving magnet cartridges, it will also work well with some of the inexpensive moving coil models, though not in my view with the *TRAK*.

Conclusion

This well constructed tonearm meets a real market need, providing the right product at the right price level. It gave a good all round performance, while to a large degree, its acceptance and use on a number of decks confirms our judgement here. This arm is a clear candidate for recommendation.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	12g
Type/mass of headshell	non-detachable/—
Geometric accuracy	very good
Adjustments provided	height/overhang/offset
Finish and engineering	excellent/very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	30mg/30mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	120mg/120mg
Downforce calibration error, 1g/2g	– 0.08g/ – 0.2g
Cue drift, 8mm ascent/descent	0.5 secs/4.0 secs
Arm resonances	average +
Subjective sound quality	good
Arm damping	none
Estimated typical purchase price	£69

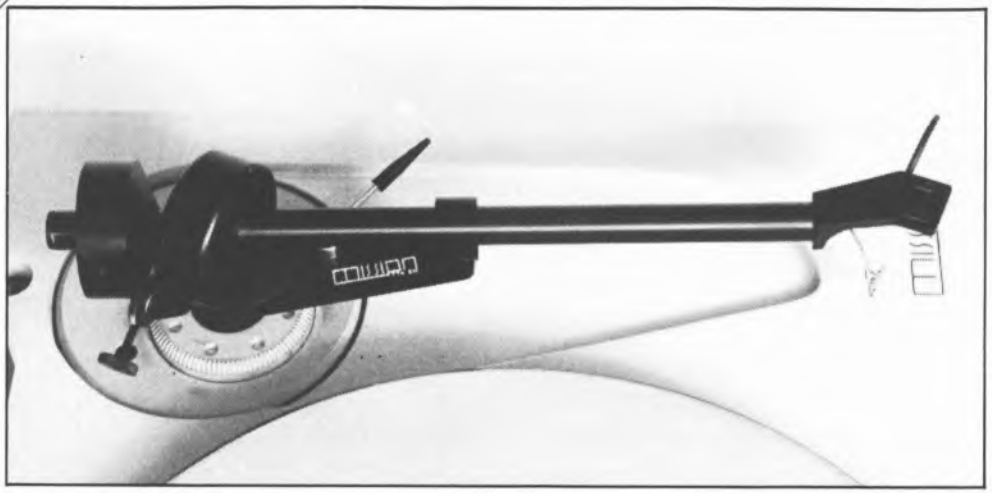


Structural arm resonances, audio band

RECOMMENDED

Mission 774SM

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



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

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

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

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

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

Lab report

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

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

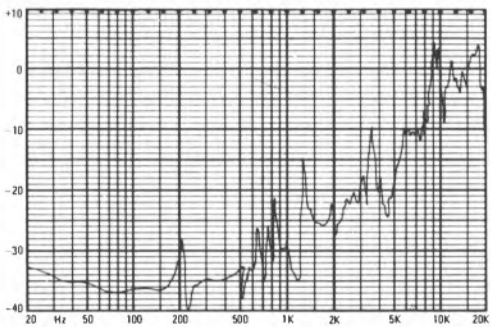
Sound quality

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

effect was one of relaxed security.

Conclusion

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



Structural arm resonances, audio band

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	16g
Type/mass of headshell	non-detachable
Geometric accuracy	*very good
Adjustments provided	overhang/offset/height
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	very good/difficult/very good
Friction, typical lateral/vertical	less than 5mg/15mg
Bias compensation method	thread and weight
Bias force, rim/centre (uncalibrated, set at max)	200mg/200mg
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	none, 0·6 secs/3.0 secs
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	85pF/none
Estimated typical purchase price	£197

**First sample tilted 2 deg from vertical, second sample fine*

RECOMMENDED

NAD 5120

NAD Ltd, Cousteau House, Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 27737

Note: earlier type arm shown here

Now significantly revised, the NAD *5120* remains a boldly unusual design. When reviewing the earlier version of this product for another publication, I criticised its floppy, printed circuit tonearm, and felt that it was also a touch expensive. At the time NAD UK reacted adversely, but nonetheless, the 'flat' tonearm has since then been replaced by a conventional tubular type, and the price has been cut to a competitive £99, this including the worthwhile Ortofon *OM10* cartridge.

Amazingly, at the price, this Czech-oslovakian-built turntable is a true floating subchassis type. The suspension needs no alignment, employing as it does the B&O style of leaf springing. The lightweight pressed alloy platter is beefed up by a substantial hard mat insert, bringing the total mass to a still-modest 1.15kg. The inner platter drum is of moulded plastic, belt-driven from the usual type of slow speed synchronous motor. One control actuates the speed change mechansism and another to control cueing. Auto-stop and lift-off facilities are incorporated. The non-resonant lid is formed from acrylic, while the plastic plinth is supported on hard rubber feet.

Lab report

This player achieved presentable results on wow and flutter measurement. Wow and flutter was 0.1%, DIN peak weighted, while the separate flutter and wow contributions were well balanced. Absolute speed was acceptably close and slowing under load was satisfactory at −0.28%. Rumble was however poorer than expected at −68/−64dB, DIN B weighted. Looking at the spectral analysis, some motor harmonics can be seen, at 100 and 200Hz, which were enough to affect the DIN reading.

Vibration isolation was pretty good, but the light platter did not promote a very strong result on rejection of acoustic breakthrough — this peaked at 360Hz. The disc impulse response was also unpromising; the initial transient was handled well, but the platter continued ringing at several frequencies there-after. Suspension dynamics were fairly good, if a touch 'whippy' in rotation.

Arm effective mass was measured at 9.0g, which suited the cartridge supplied, while lateral friction was rather high and measured 0.3g. This poor value interfered with the measurement of the bias compensation which had to go unrecorded. Downforce calibration was on the low side, which is not the best direction to err. The arm's resonant behaviour was considered poor, the graph being charted with the supplied Ortofon cartridge and hence representative of typical use conditions. The major break was at 350Hz and was particularly severe, but there were no problems over the rest of the range. The damper when used as instructed proved effective and was a useful extra in improving tracking and stability.

Sound quality

For a budget model, this latest NAD did pretty well. With the cartridge at 2.0g, the arm friction noted did not appear to pose any problem. The turntable exhibited some lower midrange

coloration although this was not too serious.

Stereo images were stable and showed some sense of depth and scale, while the bass was satisfactory, possessing a fairly tuneful quality, better than usual for the price.

Conclusion

This player was quite close to our Best Buy classification, but was held back by doubts concerning sample quality. The review model was an early one, but still should have exhibited better arm friction. The new arm still suffers from resonant 'breakup', albeit in a less serious manner than before. Despite these problems, however, value-for-money is high, and a recommendation is deserved.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

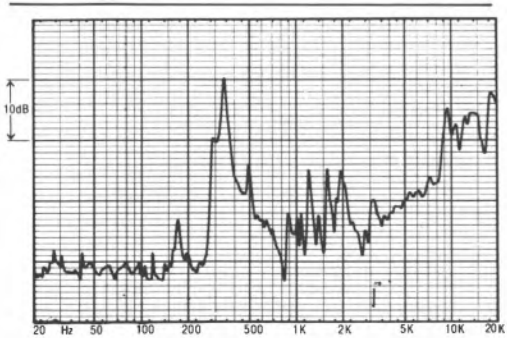
Type	semi-auto belt-drive, subchassis
Platter mass/damping	1.15kg/average +
Finish and engineering	very good/good
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.1%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.12%/0.12%
Absolute speed error	+0.25%
Speed drift, 1 hour/load variation	synchronous/ −0.28%
Start-up time to audible stabilisation	2.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	−68/64dB

Arm section

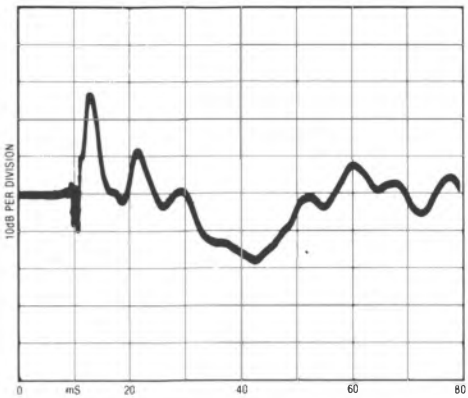
Approximate effective mass, inc screws, excl cartridge	9.0g
Type/mass of headshell	non-detachable/—
Geometric accuracy	good
Adjustments provided	overhang/offset
Finish and engineering	good/fairly good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	320mg/<20mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	see text
Downforce calibration error, 1g/2g	−0.15%/−0.3%
Cue drift, 8mm ascent/descent	<0.5 secs/2.5 secs
Arm resonances	poor
Subjective sound quality	average −
Arm damping	effective silicone dashpot

System as a whole

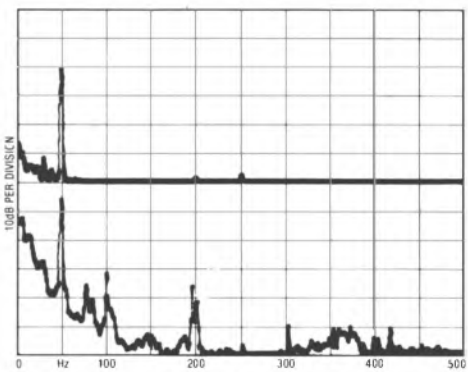
Size (w x d x h)/clearance for lid rear	42 × 35.5 × 11cm/3cm
Ease of use	very good
Typical acoustic breakthrough and resonances	average +
Subjective sound quality of complete system	average +
Hum level/acoustic feedback	good/good
Vibration sensitivity/shock resistance	good/fairly good
Estimated typical purchase price	£99



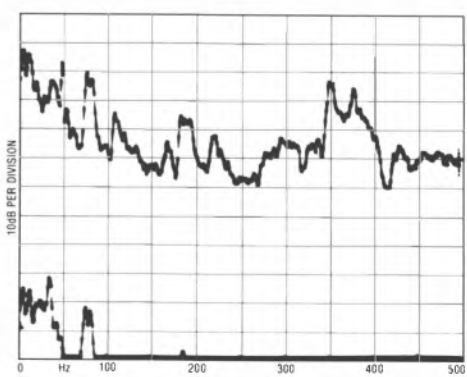
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

Nakamichi Dragon CT

Nakamichi B&W Ltd, Meadow Road, Worthing, Sussex
Tel (0903) 205611

This remarkable Japanese turntable is the offspring of an even larger Nakamichi model, which was the first to offer automatic record centring. Wow is an ever present problem with vinyl records and generally we all have to tolerate a degree of slow wow due to centre-hole eccentricity. For those addicted to piano or organ music, this wow sometimes goes beyond the levels of tolerance. This is where the magic *Dragon* would come in handy; that is, if you can afford it.

In addition to the main tonearm, the deck has a small sensor tonearm, which measures the eccentricity in each record placed on the platter by tracing the centre-locked groove after the runout. This done, the platter rotation stops and a concealed lever emerges to nudge the upper glass plate of the two piece platter in such a way as to adjust the centring of that record to near perfection.

Play may then commence, using the normal tonearm. Admittedly one has to wait a minute or two for this performance, but for many the results are worth it. A number of unplayable organ records in my collection became a joy to hear on this system — master-tape wow and flutter levels were re-established. For the record, while I can demonstrate a turntable wow and flutter down to 0.05% with a precision acetate test disc, the centre tolerance of the average vinyl disc will prevent figures any better than 0.15% and some can reach as high as 0.3%.

What else does the *Dragon* offer for its £900? Well, more than you might imagine. For a start it has a coil-spring suspended high-mass subchassis which is fully adjustable. The weighty two piece glass/cast alloy platter is fitted with a dense flat rubber mat, and operates in conjunction with a heavy centre damper, acting by gravity. The motor is a powerful quartz referenced direct drive, with electronic speed switching, stroboscope and pitch control.

Fitted with a rigid fixed headshell, the arm is robustly constructed and incorporates some semi-automatic functions and auto-return. The whole arm wand is detachable for easy cartridge fitment, and the junctions are well engineered. The lid is sensibly cantilevered from the base and is thus isolated from the subchassis, the latter made heavier by the centration electronics and mechanism it has to support. The whole is elegantly finished in a sober satin black with black ash veneer.

Lab report

Sailing through the lab tests, the Nakamichi gave excellent wow and flutter, zero speed

loss, high torque and perfect pitch stability. Rumble was excellent, at – 81/82dB DIN B. The only spurious component noted on the rumble spectrogram was one at 80Hz, this in any case being measured at a relatively harmless – 80dB down.

The massive platter proved capable of damping the mechanical disc impulse well. The trace shows the initial transient supressed in a few milliseconds, but is then flawed by some moderate low frequency resonance probably platter rocking.

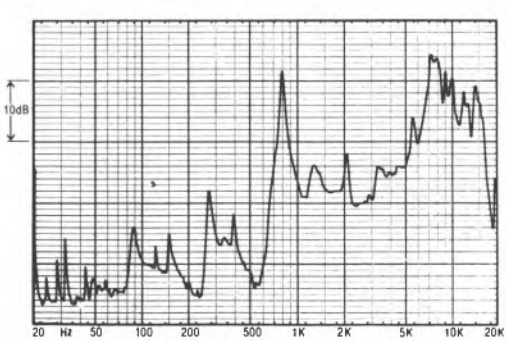
The graph published here for acoustic isolation is misleading, in that the scale here is 10dB lower, which makes the result look better than it is. Nonetheless the turntable did reject airborne energy well, while its vibration isolation was also pretty good. Chassis dynamics were reasonable, the assembly resonating in a vertical plane with a well damped 4-5Hz frequency.

The arm was quite high in effective mass at 18g, and is thus best suited to low compliance cartridges in the 7-14cu range. The geometry was fine, and it was also well engineered with bearings free from play. Friction levels were moderate but bias levels were set rather low, reading 100-150mg instead of 200-225mg. Structural resonances were rated just average, the graph showing some pillar/counterweight modes at 80 and 250Hz, while the main beam break was quite severe at 650Hz showing no great rigidity. Above 1kHz a tidier characteristic was apparent.

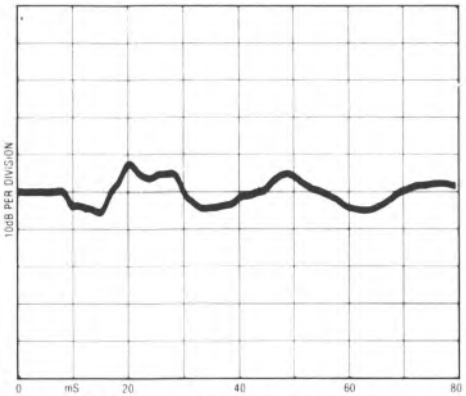
Sound quality

One area we obviously looked for with interest was a reduction in audible slow wow on records. With most discs and uncritical programme the effect was slight, unless one

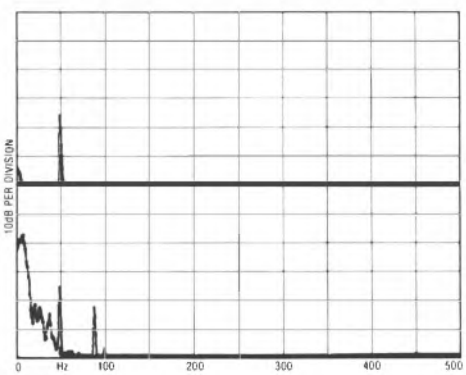
Continued overleaf



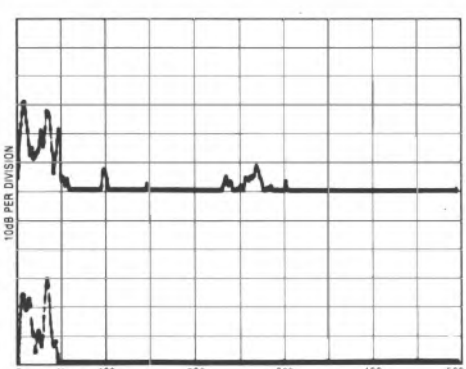
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

NAKAMICHI DRAGON CT *continued*

had previously become accustomed to the zero wow of CD, but on the worst-offending records the auto centring facility was a godsend.

In other respects the *Dragon* proved competent; it was resistant to feedback, and handled shock well, sounding a little 'old fashioned', like a good subchassis deck of a few years ago (one with a foam damped suspension and a rubber mat). The bass did not quite have the attack of modern designs, not did the mid show a particularly neutral tonal balance or resolve really fine detail; but conversely the stereo sound stage was wide, pretty deep and had good focusing.

Conclusion

Setting aside price for the moment, the *Dragon* was undoubtedly a pretty good turntable on grounds of its basic sound quality, this backed by a convincing set of lab results. In addition it offered a unique feature of automatic wow correction for your existing disc library; if this is important then the *Dragon* is well worth considering, but if not, the £900 price tag takes this interesting design well out of the 'value-for-money' range.

GENERAL DATA Integrated turntable

Motor Section

Type	semi-auto, quartz direct drive, subchassis
Platter mass/damping	3.2kg/excellent
Finish and engineering	excellent
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	<0.05%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	<0.05%/<0.06%
Absolute speed error	none
Speed drift, 1 hour/load variation	<0.01%/none
Start-up time to audible stabilisation	2.0 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 81/ – 83dB

Arm section

Approximate effective mass, inc screws, excl cartridge	18g
Type/mass of headshell	detachable wand
Geometric accuracy	very good
Adjustments provided	overhang/offset
Finish and engineering	excellent/very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	40mg/<20mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	100mg/150mg
Downforce calibration error, 1g/2g	– 0.1%/ – 0.2%
Cue drift, 8mm ascent/descent	very good, 1.5 secs/2.0 secs
Arm resonances	average
Subjective sound quality	good
Arm damping	none

System as a whole

Size (w x d x h)/clearance for lid rear	55 x 42 x 23cm/3.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	very good/good
Estimated typical purchase price	£900

OUR ATTITUDE?

It's sad that so many of today's music lovers appear to view the selection and purchase of hi-fi equipment as something akin to taking unpleasant medicine, ie "close your eyes, swallow hard and you'll feel better"

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SUBJECTIVE AUDIO LTD

Audio Consultants
2-4 Camden High Street
London NW1 0JH, England
Tel (01) 387 8281

RECOMMENDED

Oracle Alexandria

Absolute Sounds Ltd, 42 Parkside, London SW19
Tel 01-947 5047

Generally supplied as an integrated turntable, the *Alexandria* is the latest model from Oracle. It is an attractive design, built into a conventional plinth, and is finished in satin aluminium with a rosewood surround, and a hinged tinted cover.

Three detachable polished cylinders conceal the suspension springs, which are easily adjusted from above. The deck is powered by a Papst dc Hall effect motor, fitted with a large flywheel, the motor coupled to the platter by a precision flat belt. An outboard power supply is used, its external location affording low hum levels. The subchassis incorporates a spirit level to aid alignment and the two-piece platter helps belt loading. The outer platter section is fitted with a dense rubber damping ring on its periphery, and has been carefully balanced — there is an identifying keyway to maintain accurate alignment with the inner platter.

While it still has the established Oracle 'tacky' surface, to improve coupling to the disc, the mat is now carbon-fibre loaded to increase its rigidity. This is made use of in conjunction with a dome washer and the precision screw-down record clamp, which engages with the upper threaded portion of the platter spindle.

An average-sized conventional main bearing is fitted, incorporating oil lubrication. Engineering fit and tolerances are good throughout.

The turntable came ready fitted with the *Prelude* tonearm, which has a separate connection panel for a flexible signal link from the subchassis, to help allow free movement of the suspension. A conventional phono-connected cable runs from the plinth output sockets to the amplifier.

The arm has a fixed skeletal headshell, although this does possess an adequate cartridge mounting area. Many adjustments are provided, including lateral angle, overhang, tilt and height. The height adjustment allows correction for the cartridge vertical tracking angle (vta) during play, which may be rated as highly important by some users. Biasing is via the reliable thread and weight system and the arm also incorporates a sensitive end-of-side lift, a useful extra. Effective mass when set for a typical cartridge is around 9g, suiting it to cartridge compliances int he 10-25cu range, depending on cartridge mass. The arm's vertical geometry is also designed to improve tracking stability over high modulation passages and this behaviour was confirmed on test.

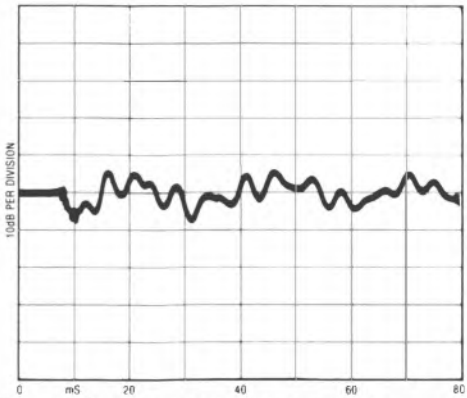
Lab report

The platter's mass was 3.1kg and in conjunc-

tion with the mat and clamp system, provided very good disc damping. However the platter itself was not free from resonance, as the disc impulse shows; here the finer long duration ripples are due to platter modes at 240 and 160Hz, identified via the frequency transform, but these aside disc damping was very good.

Wow and flutter, DIN peak weighted, was very good at 0.055%, with moderate linear wow and low flutter. Speed stability was fine, while good torque was also demonstrated, the

continued on page 153



Disc impulse transmission showing damping

GENERAL DATA Integrated turntable

Motor Section

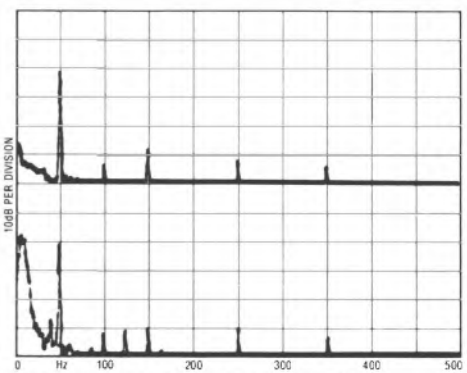
Type	belt-drive, subchassis
Platter mass/damping	3.1kg/average
Finish and engineering	excellent
Type of mains/connecting lead	2-core remote/phonos, earth
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.055%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.15%/0.07%
Absolute speed error	adjustable pitch
Speed drift, 1 hour/load variation	approx 0.15%/ – 0.25%
Start-up time to audible stabilisation	3.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 80/ – 82dB

Arm section

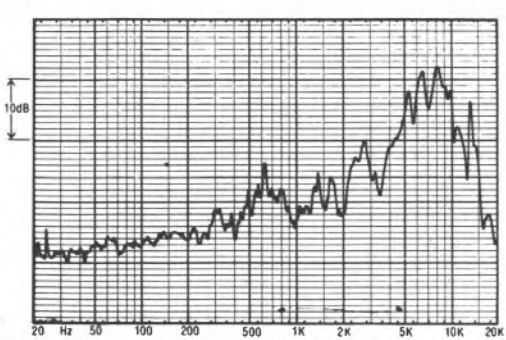
Approximate effective mass, inc screws, excl cartridge	9g
Type/mass of headshell	non-detachable
Geometric accuracy	very good
Adjustments provided	tilt/height/overhang/offset
Finish and engineering	very good
Ease of assembly/set-up/use	good
Friction, typical lateral/vertical	<20mg/<20mg
Bias compensation method	thread and lever
Bias force, rim/centre (set to 1.5g elliptical)	300mg/250mg
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	very good, 2.5 secs/1.5 secs
Arm resonances	average +
Subjective sound quality	good
Arm damping	none

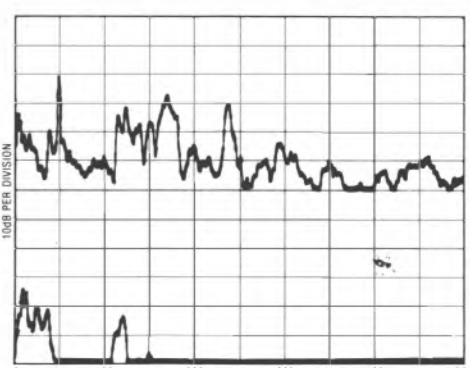
System as a whole

Size (w x d x h)/clearance for lid rear	49 x 38.5 x 15.5cm/6cm
Ease of use	very good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	good/fairly good
Estimated typical purchase price	£820



Rumble, electrical (above) and total (below)





Breakthrough, acoustic (above) and vibration (below)

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

Oracle Delphi

Absolute Sounds, 42 Parkside, London SW19.
Tel 01-947 5047

A distinctive and costly subchassis turntable, designed and built in Canada, the Oracle has established itself as a 'superfi' product both here and across the Atlantic. Possessing a skeletal 'open' appearance, the unit is founded on a thick acrylic base plate to which the moulded lid and adjustable feet are fitted. The elegant laminated magnesium alloy subchassis is poised on three bell-shaped multi-turn coil springs concealed in piers, and a knob is fitted to each pier to allow tight control of belt/platter alignment and level. It has been carefully designed to provide near perfect chassis balance and mass distribution, so that by control of spring compliance to suit various arm masses the intended stable 3.5Hz vertical suspension resonance may be obtained. A total of nine colour-coded springs are provided, together with a table detailing the combinations required for almost every quality tonearm made. In addition, an adjustable dynamic balancer is present below the chassis, clamped to the substantial housing of the main bearing. Fortunately comprehensive instructions are provided for all the lengthy setting up procedures and alignments.

A number of other special features are incorporated, including a unique disc support system and damping arrangement. A carbon fibre reinforced mat of the slightly 'tacky' highly absorptive type is used, with a small domed washer placed beneath it to slightly lift the record centre. A screw down record clamp, dished on its underside, bears down on the record at the periphery of the label, forcing it into contact with the mat, first at the edge and then with further clamp tightening progressively over the whole surface. The platter possesses a correct engineering profile, and has rim damping in the form of a dense neoprene sponge wave-trap fitted to its outer perimeter.

Belt driven, a high quality Papst DC motor is used, switchable by a front mounted electronic control between 33⅓ and 45 rpm. The power supply is arranged as a separate box, equipped with a mains flying lead for the attachment of a UK plug.

Lab results

Largely retested for this edition, the rumble showed a considerable improvement, with a large reduction in the 100Hz component. Total wow and flutter also improved to 0.05% – but linear wow was still a trifle high and speed slowing under load rather worrying, at close to 0.5%. Officially 'good to very good' on vibration isolation and acoustic breakthrough, the isolation was nonetheless imperfect with poorer rejection than before at 30Hz, 60Hz, 130Hz and 170Hz, the last also seen on the acoustic graph Disc impulse damping remained very good, though showing a low-frequency ring, estimated to be around 60Hz again.

Sound quality

The subjective effect of the disc termination was to lend a rather 'dry' and well-damped character to the sound, with a somewhat 'distant' mid and treble. Transients were reproduced very clearly, with good instrumental differentiation especially on complex choral material. Depth and stereo focus were both very good. The bass was 'dry', almost 'lean' in character. Tried with the Sumiko arm, the effect tended to a 'softened richness', which even the liveliness of the Koetsu failed to dispel, but which was nonetheless very pleasant. The *Ittok* is probably not an ideal match but it did provide greater 'liveliness' and 'attack', and when used with the Koetsu *Wood*, resulted in a fine, albeit costly, turntable, totalling around £1300.

Conclusion

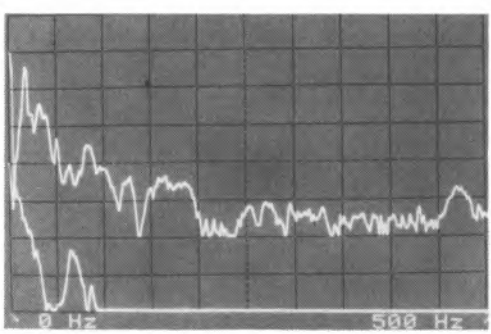
This superbly presented and finished design

represented a frustrating combination of strengths and weaknesses. Those favouring the former loved it, while those aware of its shortcomings were disappointed.

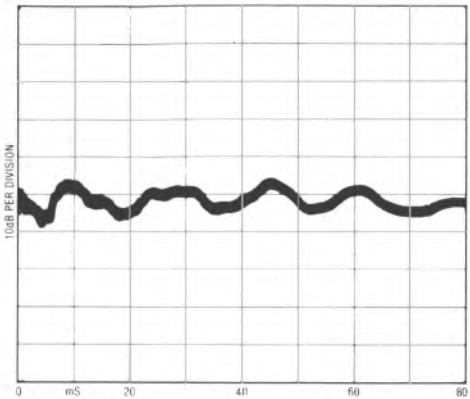
At this very high price, failure to keep perfect subjective pitch, plus the stiff rotational chassis vibrational mode and the residual vibration breakthrough all took their toll and these affects precluded recommendation. Nonetheless the Oracle can produce very good sounds with ancilliaries of appropriate quality, particularly on less pitch-demanding classical programme, as here the transient load requirements are generally less frequent and arduous.

GENERAL DATA Motor unit

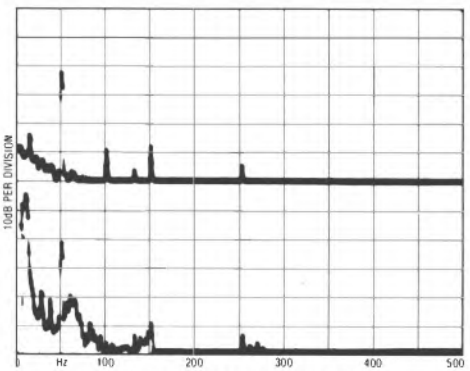
Type	manual, belt-drive, synchronous motor, subchassis
Platter mass/damping	2.8kg/excellent
Finish and engineering	excellent/excellent
Type of mains/connecting leads	2-core, line transformer
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.055%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.18%/0.05%
Absolute speed error	+ 0.45%
Speed drift, 1 hour/load variation	0.7%/ – 0.45%
Start-up time to audible stabilisation	4.8 secs
Rumble, DIN B wtd L/R average (see spectrum)	– 80dB
Size/clearance for lid rear	48(w) x 37(d) x 16(h)/8cm
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensivity/shock resistance	good + /fairly good
Estimated typical purchase price	£747



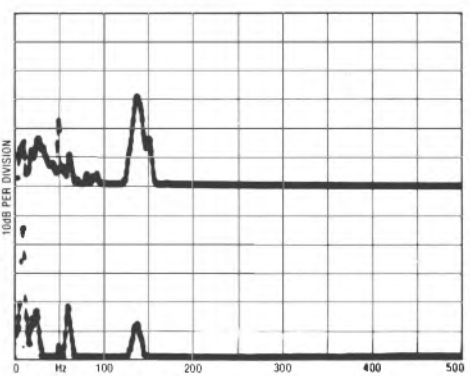
Breakthrough as modified (see text): above, acoustic; below, vibration.



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

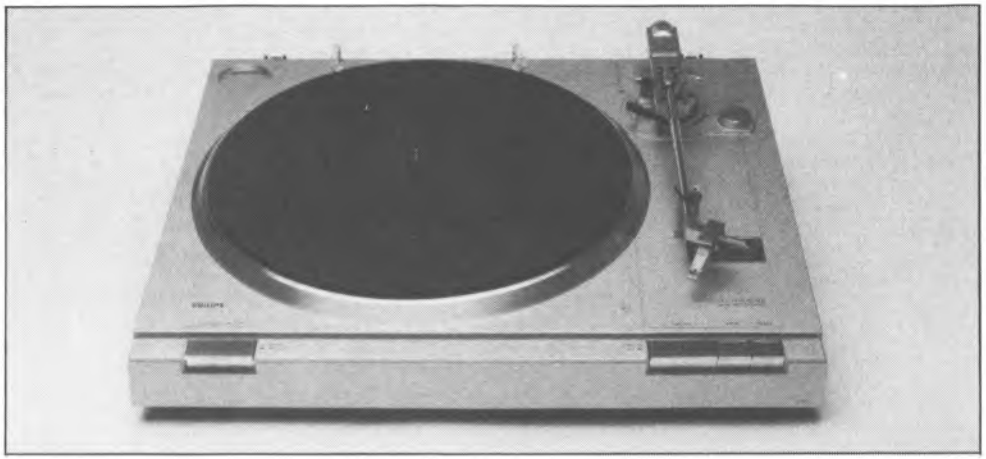


Breakthrough, acoustic (above) and vibration (below)

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

Philips F7230

Philips Electrical Ltd, City House, 420-430 London Road, Croydon, Surrey CR9 8QR
Tel 01-689 2166



This conventional turntable sells for around £90 complete with a Philips *GP330* cartridge factory fitted. At first sight the arm looks as if it is T4P-compatible but in practice it is not, the cartridge supplied being fitted with a spherical tip tracking at 2g downforce.

Fully automatic operation is included, though record speed must be selected manually in advance. Built on a lightweight plastic plinth, this player has no subchassis, and is mounted on cup shaped rubber feet. The light 0.625kg platter is fitted with a plain mat, and is belt driven by a synchronous motor.

The tonearm has several cosmetic features but did not appear to be well adjusted or very rigid, and there was considerable slack in the arm bearings. Low in mass, it was well suited to the supplied cartridge and would match others with compliances 15-30cu.

Completing the package is the feedback-prone lid — moulded in resonant plastic, it is coupled directly to the plinth via the lid hinges.

Lab report

Speed characteristics of this player were fine. Wow and flutter, DIN peak weighted, was most satisfactory at 0.08%, while a good balance of the wow and flutter contributions was also demonstrated. Slowing under load was satisfactory at 0.3%, and start up was rapid.

However, when we assessed rumble we found the results to be barely adequate by modern standards. DIN B readings of 65/68dB for left/right channels were measured, and the spectrum analysis showed that not only was random noise and main bearing noise poorer than average, but a broad range of motor vibration harmonics were also present, due to the inadequate design of the motor mounting.

Turning to the question of isolation, its performance here was considered to be one of the worst in the test group. Acoustic energy was attenuated very little, while shelf borne vibration was handled with hardly any improvement. The disc impulse response was a classic of its kind with negligible damping of the initial transient, which was followed by a burst of continued ringing — a poor result.

Moving on to the arm, the geometry was satisfactory and the measured friction was low in both planes of motion. Biasing was inaccurate — low at the rim and increasing to a realistic figure towards the centre. Downforce calibration was however satisfactory and cue operation fine, with a realistically fast descent.

Arm resonances were charted with the factory-fitted Philips cartridge. Arm flexure began as low as 130Hz with progressive modes at 200Hz, 400Hz and above, rating this model as below average in this respect.

Sound quality

On listening tests, sound quality was disappointing. It lacked clarity, and the overall impression was of a confused muddle, compared with respected references in its price category. Bass was weak and lacking in

definition, while the mid was two dimensional, and any significant differentiation of musical dynamics was absent. The treble appeared grainy as well as brittle, lacking subtlety or tonal differentiation.

Conclusion

It remains a mystery to me how a large company like Philips, which has superb engineering resources, should waste its time in producing second rate products such as this. Surely the need to tailor turntable designs for inclusion in rack systems does not have to result in poor quality goods. I can remember that no so long ago, Philips made subchassis turntables of good all round performance and at a competitive price — where are they now?

GENERAL DATA Integrated turntable

Motor Section

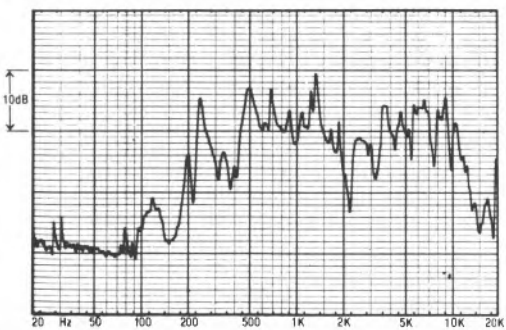
Type	fully auto, belt-drive
Platter mass/damping	0.625kg/average
Finish and engineering	excellent/average –
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.08%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.09%/0.08%
Absolute speed error	+ 1.2%
Speed drift, 1 hour/load variation	<0.1%/ – 0.3%
Start-up time to audible stabilisation	1.6 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 65/ – 68dB

Arm section

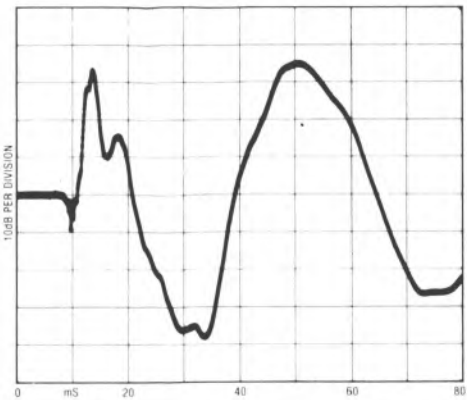
Approximate effective mass, inc screws, excl cartridge	6.0g
Type/mass of headshell	non-detachable/—
Geometric accuracy	good
Adjustments provided	none
Finish and engineering	very good/poor
Ease of assembly/set-up/use	excellent
Friction, typical lateral/vertical	20mg/30mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	120mg/225mg
Downforce calibration error, 1g/2g	none/ – 0.2g
Cue drift, 8mm ascent/descent	0.5 secs/1.0 secs
Arm resonances	average –
Subjective sound quality	average –
Arm damping	none

System as a whole

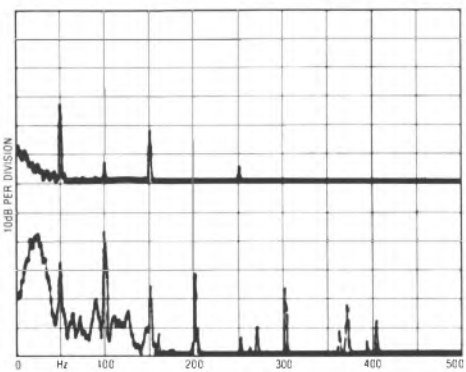
Size (w x d x h)/clearance for lid rear	42 x 36.5 x 11.5cm/5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	poor
Hum level/acoustic feedback	fair/poor
Vibration sensitivity/shock resistance	poor/poor
Estimated typical purchase price	£90



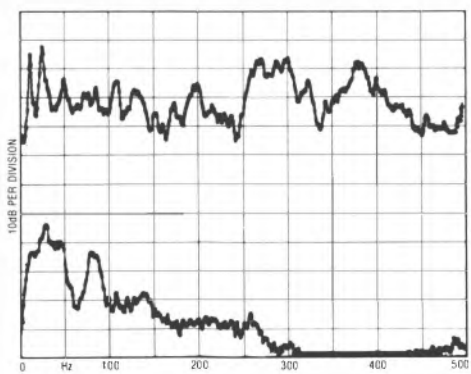
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)

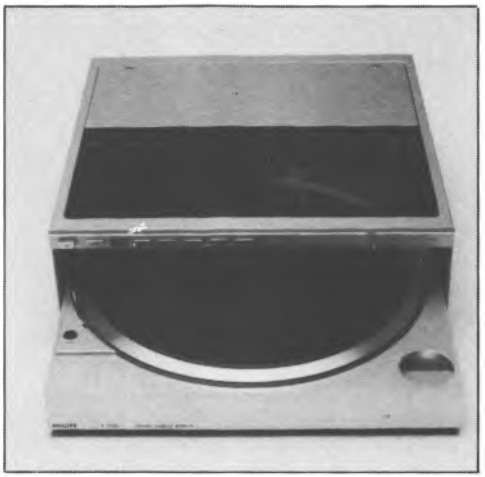


Breakthrough, acoustic (above) and vibration (below)

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

Philips F7430

Philips Electrical Ltd, City House, 420-430 London Road, Croydon, Surrey CR9 8QR
Tel 01-689 2166



Well and truly jumping on the Japanese bandwagon, Philips have produced the *F7430*, a £130 linear tracking, drawer loading player, with full facilities — though the suggestive 'two speed manipulation' feature advertised on the front panel in fact turned out to be connected quite innocently with the speed switch!

Drawer-loading turntables solve the problem which conventional decks pose for the designer of stacking systems — unlike conventional decks, they can be stacked! However, most drawer-loaders have the practical disadvantage that you have to wait for the drawer mechanism to operate each time you put a record on, and this can be irritatingly slow.

Conceived basically as a metal box, the *7430* is topped by a clear plastic sheet screwed into position. Controls are conveniently positioned on the top front edge while the front panel folds down to allow emergence of the platter ready for record loading. As might be expected, the machine is fully automatic and can sense record size, selecting the required speed; this can be over-ridden manually for 12in 45s. Another feature is the 'memo' facility, with which the deck can memorise the position of selected passages of any length to be repeated later — its relevance to normal listening is questionable; perhaps it is for learning the music?

With more or less solid construction, no subchassis is provided, while the plastic linear tracking arm is factory-fitted with a Philips *GP330* spherical-tipped moving magnet cartridge.

Lab report .

Our first sample was in fact faulty, exhibiting the strange fault of excessive flutter, which measured 1.5%, but a second sample proved satisfactory. Overall wow and flutter (DIN peak weighted) was 0.2% on the first sample, improving to 0.1% on the second. Speed error was fine but the platter slowed an excessive 0.5% under load, this weakness exaggerated by major overshoot on speed recovery.

Rumble, DIN B, was a satisfactory – 70dB, the spectrum analysis limited by an enforced use of a rumble lacquer disc (due to the drawer-loading design) rather than the preferred rumble coupler. The latter allows lower noise figures. The player's response to the disc impulse test was unsatisfactory, with poor initial damping and a continuing low frequency resonance at 20-30Hz which was probably platter rocking.

Analysed for energy rejection, the acoustic isolation was acceptable, but worsened at lower frequencies; vibration rejection was also comparatively weak.

The tonearm showed serious structural resonances, with a vicious first mode at 300Hz. Further resonances were not well controlled, with one seen as high as 10Hz. The low mass arm behaved well in other respects, though no real rigidity was apparent in its construction. Its linear tracking design precluded most other arm measurements; indeed the resonance graph could only be taken with the lid unscrewed.

Sound quality

This turntable sounded a little bright, with a noted 'two dimensional' quality, the stereo image seriously lacking in depth. Stereo focus was also impaired and the overall clarity could have been better. Pitch and timing were both suspect while the bass had an obstrusive one-note quality.

Conclusion

With this player, Philips have shown only that they can equal some of the worst machines imported from Japan — they have matched them trick for trick, light for light, button for

button. Never mind the quality, look at the features! Its weak sonic performance prevents any recommendation but perhaps it could have been worse.

(Note: In fairness to Philips, it must be pointed out that there are many similar turntables on the market which are not reviewed in this book, either because they are not available separately but only as part of a system, or because the manufacturers did not feel confident in submitting them for comparative testing — Ed.)

GENERAL DATA Integrated turntable

Motor Section

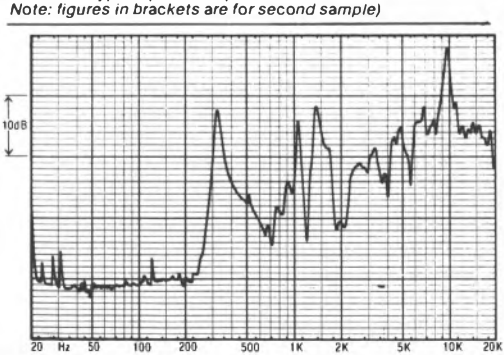
Type.....fully auto, belt-drive linear tracking
Platter mass/damping.....0.55kg/average +
Finish and engineering.....very good/average
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....(0.1) 0.2%
Wow and flutter (lin 0.2-6Hz/6-300Hz).....(02) 0.1%/(0.07) 15%
Absolute speed error..... – 0.25%
Speed drift, 1 hour/load variation.....0.25%/ – 0.5%
Start-up time to audible stabilisation.....2 secs
Rumble, DIN B wtd, L/R average (see spectrum).approx – 70dB

Arm section

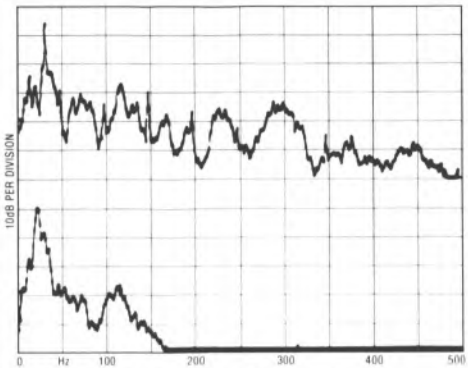
Approximate effective mass, inc screws, excl cartridge.....5g
Type/mass of headshell.....non-detachable/—
Geometric accuracy.....excellent
Adjustments provided.....none
Finish and engineering.....good/average
Ease of assembly/set-up/use.....excellent
Friction, typical lateral/vertical.....—
Bias compensation method.....—
Bias force, rim/centre (set to 1.5g elliptical).....—
Downforce calibration error, 1g/2g.....—
Cue drift, 8mm ascent/descent.....1.0 secs/1.0 secs
Arm resonances.....poor
Subjective sound quality.....average –
Arm damping.....none

System as a whole

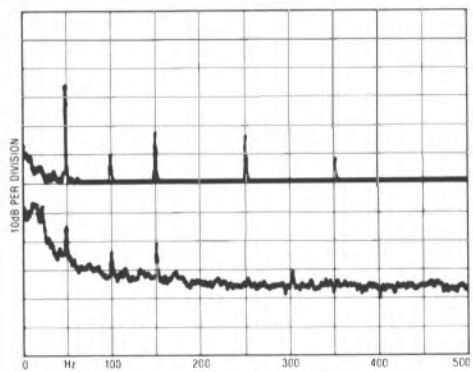
Size (w x d x h)/clearance for lid rear.....32 x 32.5 x 11cm/none
Ease of use.....excellent
Typical acoustic breakthrough and resonances.....average –
Subjective sound quality of complete system.....average –
Hum level/acoustic feedback.....fairly good/average –
Vibration sensitivity/shock resistance.....average – /average
Estimated typical purchase price.....£130
Note: figures in brackets are for second sample)



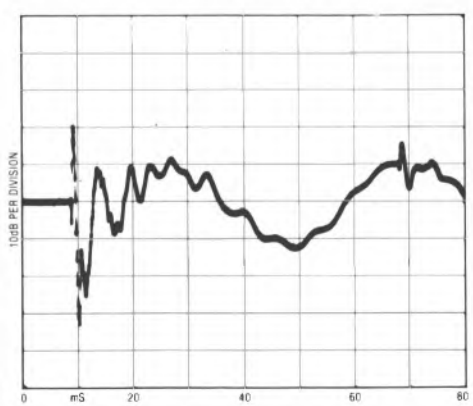
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

Pioneer PL88F

Pioneer High Fidelity (GB) Ltd, 1-6 Field Way, Greenford, Middlesex UB6 8UN
Tel 01-575 5757

A remarkable product, the *PL88F* hardly looks like a turntable at all. Its very construction in fact made life difficult for us in the lab, since much of the machine remains inaccessible to the reach or the use of certain of the measuring instruments!

A costly creation in a low profile steel cabinet, the *88F* is provided with an amplifier-style touch button control panel of surprising complexity. The arm is under complete power servo control, the fitted, fixed cartridge being a high-output moving-coil called the *PN41MC*, with an elliptical diamond-tipped stylus tracking at 2g. Distinguished by an inbuilt photoelectric cells and a lamp, the cartridge actually doubles as the programme track sensor for the arm automation, and is controlled by a central microprocessor — tracks may be programmed in order of choice. To load a record the appropriate button is pressed to open the front panel and cause the playing mechanism to slide forward in a 'ghostly' manner. Manual play is also possible in this 'load' position, a further button bringing the arm into view. Alternatively, after the record is in position, the whole may be closed up again (a rather slow procedure) and the deck left to its own automatic devices. Powered by a quartz-locked direct-drive motor, the deck's two speeds are manually or automatically selected and no fine variation is possible.

As with the *PL7*, the cartridge in the *88F* was also briefly assessed as part of the entire package.

Lab report

Considering the ingenuity involved in the production of this player, it was considered to be well engineered and finished. The modest platter weighed some 0.9kg and did not offer much disc damping, some low-frequency wobble being present after the initial impulse.

Wow and flutter in all measurement forms was excellent with a clean overshoot-free motor torque and superb speed stability. Start-up was rapid and DIN weighted rumble excellent, and to spec. Despite this, however, some mild 100, 200 and 300Hz rumble components were present, as revealed by the spectrogram.

The arm proved difficult to analyse as it was hard to physically get at it. Judged by the general behaviour of the unit as a whole, the arm was considered to be well adjusted and of reasonable quality. Obviously very easy to use and set up, the cue mechanism was nicely judged for rate. The resonance behaviour was established by the graph taken using the attached cartridge, the result suggesting a rather spiky, resonant character with a serious break at 350Hz. Charted frequency response for the cartridge showed an isolated 3-5dB peak at 11kHz, and a modest stereo separation around 20-25dB. The 30Hz to 6kHz range was however quite uniform.

Due to its enclosed nature, the *PL88F*'s acoustic isolation was quite good, and the vibration rejection was not so bad either. Shock immunity was above average while feedback resistance was reasonably good, partly due to the relatively heavy construction.

Sound quality

Auditioned as a complete unit with the platter both 'out' and retracted, the sound was undoubtedly the best of Pioneers tested this year. The mid was fairly transparent with clean transients and some stereo depth, and the bass was acceptably even, if lacking in real detail. The treble tended to a touch of brashness and fizziness, however.

Conclusion

The *PL88F* is a fairly satisfactory deck in terms of its sound quality; representing a triumph of ingenuity, it will, I suspect be bought for its appearance and operating facilities rather than sonic performance.

GENERAL DATA Integrated turntable (inc. cartridge)

Motor Section

Type.....programme search, front-load, quartz direct-drive
Platter mass/damping.....0.9kg/average
Finish and engineering.....very good/very good
Type of mains/connecting leads.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....less than 0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..0.06%/0.04%
Absolute speed error.....none
Speed drift, 1 hour/load variation.....none/none
Start-up time to audible stabilisation.....1.3 secs
Rumble, DIN B wtd L/R average (see spectrum).....– 78dB

Arm Section

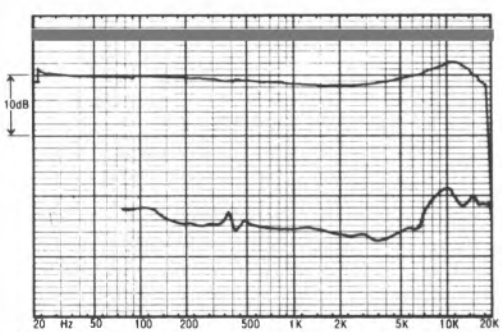
Approximate effective mass, inc screws, excl cartridge....N/A
Type/mass of headshell.....integrated
Geometric accuracy.....very good
Adjustments provided.....none
Finish and engineering.....very good/good
Ease of assembly/setting-up/use
excellent/excellent/excellent
Friction, typical lateral/vertical.....—/—
Bias compensation method.....—
Bias force, rim/centre (set to 1.5g elliptical).....—/—
Downforce calibration error, 1g/2g.....—/—
Cue drift, 8mm ascent/descent.....none, 1.1 secs/1.2 secs
Arm resonances.....*average –
Subjective sound quality.....*average
Lead capacitance/damping method.....—/none

System as a whole

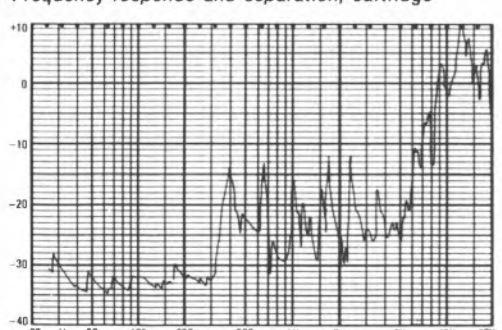
Size/clearance for lid rear.....42(w) x 33.5(d) x 10cm(h)/none
Ease of use.....excellent
Typical acoustic breakthrough and resonances.....good
Subjective sound quality of complete system.....average
Hum level/acoustic feedback.....very good/average
Vibration sensivity/shock resistance.....average/average +
Estimated typical purchase price.....£300

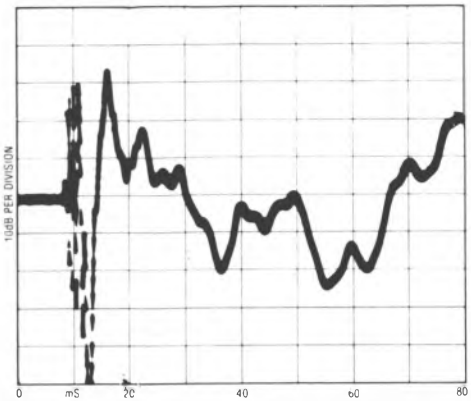
*with fitted cartridge

Note: tests carried out on 110V advance sample

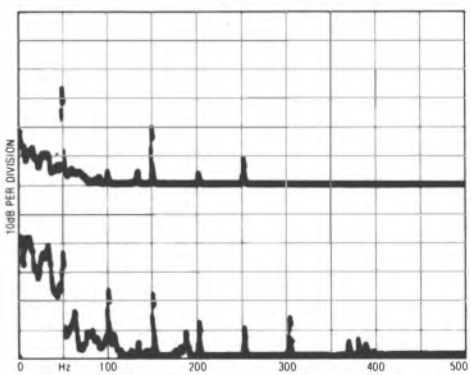


Frequency response and separation, cartridge

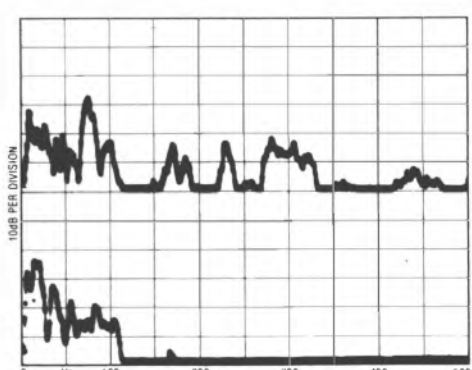




Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Pink Triangle

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

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

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

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

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

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

Lab results

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

The expanded X10 scaling proved possible for the disc impulse measurement, and the

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

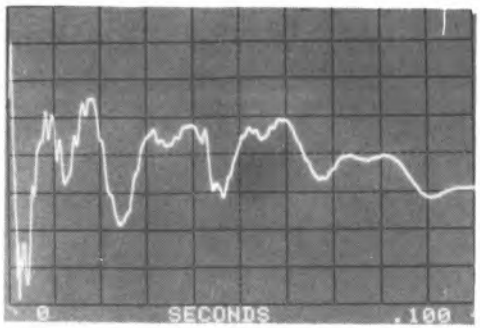
Sound quality

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

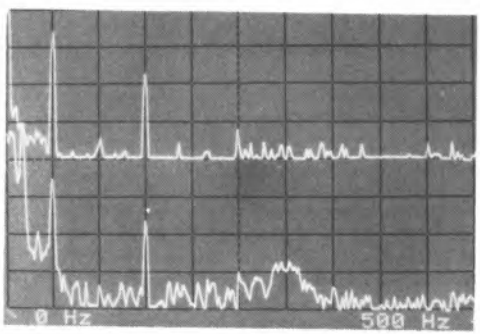
Conclusion

Since our tests for the last edition, Pink Triangle have come up with an interior change which has reduced slowing under load to a perfectly satisfactory 0.22%. On the latest review, a faulty belt (which unfortunately was not replaced by the time we went to press) produced rather high wow and flutter of 0.22%, but based on past experience we feel that this is atypical. Dynamic wow has been virtually banished on current production, so removing our only significant reservation concerning this fine-sounding player, and a full recommendation is thus appropriate.

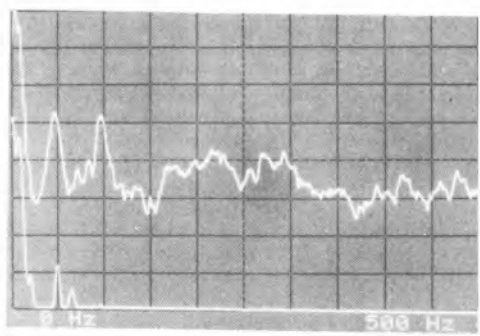
GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	1.7kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core/—
Speed options	33/45rpm (internally variable)
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	<0.06%/0.07%
Absolute speed error	adjustable, +1%
Speed drift 1 hour/load variation	+0.2%/−0.5%
Start up time to audible stabilisation	3secs
Rumble: DIN B wtd L/R av (see spectrum)	77/78dB
Size/clearance for lid rear	45.5(w) x 38.5(d) x 15.2(h)/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good+
Hum level/acoustic feedback	very good/excellent
Vibration sensitivity/shock resistance	excellent/good
Estimated typical purchase price	£398



Disc impulse transmission, magnified X10.



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

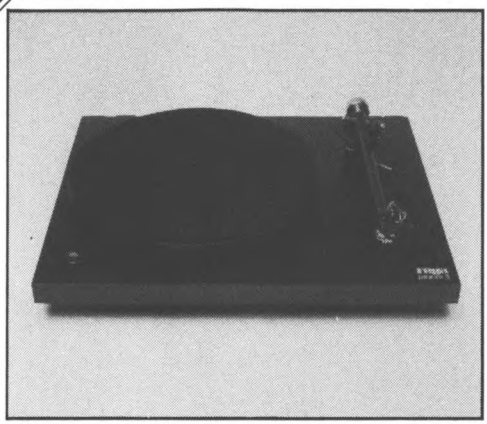


Breakthrough (0–500Hz lin): above, acoustic; below, vibration.

RECOMMENDED

Rega Planar 2 and 3

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



Since the last edition, Rega have introduced the *RB300* arm which is now standard fitting on the *Planar 3* deck. The performance of this new combination is discussed fully in the *RB300* review. At the time of writing the *Planar 2* is still supplied with the earlier Lustre-type as covered here.

A simple design, it comprises a solid chipboard plinth covered in tough matt black laminate. Three fairly stiff stepped rubber feet provide a stable tripod foundation while the high quality lid is directly hinged to the chassis plinth with neither springs nor isolation. A plain main bearing with a thrust ball is used, and tolerances were close here, with no detectable play. Belt-driven via a rubber cord, the inner platter hub is a reinforced plastic moulding, the uppermost projection forming the tapered centre spindle and the outer platter boss. The platter is made of thick plate glass (reduced in thickness for the *Planar 2*), and surmounted by a thick felt mat. In a simple and ingenious gravity suspension, a second drive belt is looped to support the slow speed synchronous drive motor and surpress vibration coupling to the platter.

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

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

Lab report

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

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

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

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

Sound quality

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

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

Conclusions

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

GENERAL DATA Integrated turntable

Motor section

Type	manual, belt-drive
Platter mass/damping	2.2kg/good
Finish and engineering	very good/very good
Type of mains/connecting leads	2-core/phonos and earth
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	*0.21%/0.45%
Absolute speed error	+0.4%
Speed drift, 1 hour/load variation	synchronous/ – 0.4%
Start-up time to audible stabilisation	4.5 secs
Rumble, DIN B wtd L/R average (see spectrum)	– 72/ – 70dB

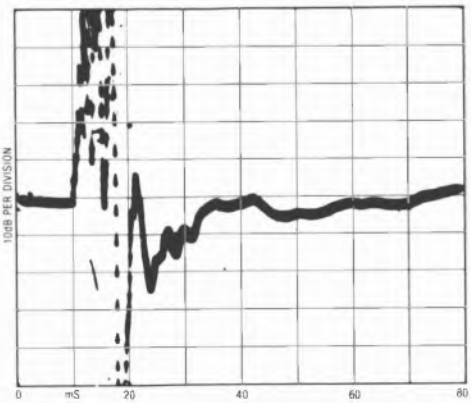
Arm section

Approximate effective mass, inc screws, excl cartridge	16g
Type/mass of headshell	universal detachable/8.0g
Geometric accuracy	very good
Adjustments provided	overhang/lateral angle
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	very good/very good/very good
Friction, typical lateral/vertical	less than 25mg/15mg
Bias compensation method	internal magnet
Bias force, rim/centre (set to 1.5g elliptical)	200mg/210mg
Downforce calibration error, 1g/2g	– 0.1g/ – 0.07g
Cue drift, 8mm ascent/descent	negligible 0.5 secs/1.5 secs
Arm resonances	average +
Subjective sound quality	average +
Lead capacitance/damping method	70pF/counterweight decoupling

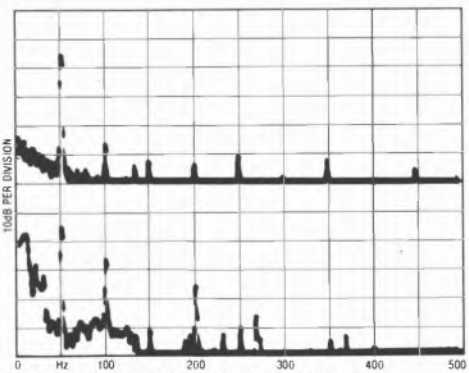
System as a whole

Size/clearance for lid rear	45(w) x 36(d) x 12.3(h)/7cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	good
Hum level/acoustic feedback	average – /fairly good
Vibration sensivity/shock resistance	average – /good
Estimated typical purchase price	£148

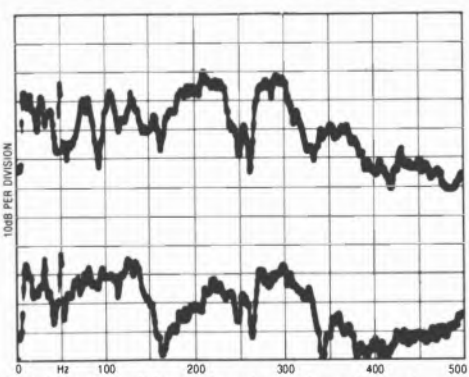
**worsened by unevenness in thick felt mat*



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, lid up (above) and down (below)

Charts above characterise general turntable behaviour. See text for commentary on these results.

BEST BUY

Rega RB300

Rega Research Ltd, Swaines Industrial Estate, Ashington Road, Rochford, Essex
Tel (0702) 33071

For most of these tests the new Rega *RB300* tonearm was fitted to a current-production *Planar 3* turntable, which is in fact the most usual combination and selling for just under £190. The arm can also be bought as a separate component (£90) and proved to be one of the most exciting introductions in this issue. Note that the original Rega tonearm is still available and is currently fitted to the *Planar 2*, the combination selling for around £115. We also subjected the *Planar 3* to a full retest, and comments on its sonic performance are included with this arm review. Very little change was recorded in the '*3* peformance, though the drive components did demonstrate some engineering improvement in terms of both quality and tolerances.

Getting back to the *RB300*, this Rega-made product uses a very rigid one-piece arm beam/headshell, which unusually is constructed from a hollow aluminium casting. No joins are present between cartridge platform and pivot. The bearings themselves are highly pre-loaded and yet mounted to such a high tolerance that friction is negligible while play is physically undetectable.

Rega's traditional magnetic frictionless bias compensator is employed, with a novel touch present in the design of the downforce mechanism. When set to zero, the carefully designed coil spring mechanism exerts a minus force of 3g so reducing the counterbalance requirements. Roy Gandy has aimed for the smallest possible counterweight in order to reduce its moment of inertia and consequently its effect on the dynamics of the rear section of the arm. To this end the counterweight is machined from a very dense tungsten alloy, permitting a still smaller counterweight diameter.

The bearing gimbal is itself a substantial casting and Roy has abandoned the usual adjustable vertical pillar design, regarding this a structural weakness. His alternative is a threaded stem and large locknut; vertical height adjustment only possible using various washers, this assuming that the arm/cartridge combination will in any case fit the chosen turntable. For example the arm was a mite too high for an EMT cartridge, though fine for an *Asak*, when mounted on a Linn deck; on the Lux *300*, the height was right for the EMT.

Lab report

Tests showed the *RB300* to have some of the finest bearings in the business; furthermore it was very competent in the important area of beam/headshell rigidity. Friction was very low in both planes, without a trace of play, and while biasing worked well, the calibrated figures were a little on the high side (by about 25%). Downforce calibration was accurate and cue operation fine. Geometric accuracy was to a high standard, while the effective mass was moderate at 10.5g, including the good-quality steel mounting hardware. A wide range of moving magnet and moving coil cartridges are judged suitable in the 8-22cu range.

Looking at the structural resonance response, the picture suggested good control and excellent rigidity. The 400Hz mode was probably the counterweight and was mild, while the first bending or torsional mode was deferred till to a remarkably high 1.5kHz — an

outstanding result. The treble was also remarkable for its absence of resonances after 4kHz.

Sound quality

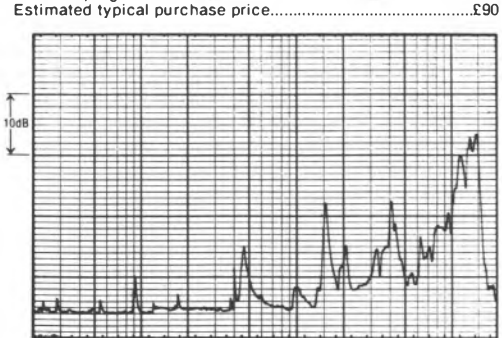
It was clear after only a few minutes audition, that the *RB300* was a top flight performer. Depending on the chosen player, it proved quite comfortable in the company of other reference tonearms in the £250-£400 range.

The sound was notably dry and neutral with excellent control throughout the range. It proved capable of making one 'reference' arm sound dull and another hard and brash; and while the latter comparison could be interpreted by some as a lack of 'life' in the *RB300*, personally, I do not believe this. Its transients were judged excellent, while it offered a very well-focused sound stage with first rate depth. Cartridges up to £800 were tried without any embarrassment. Its only significant failing was a slight muddling of detail on complex musical passages.

Conclusion

The *RB300* is an excellent product which Roy Gandy can be justly proud of. Despite its modest price it sets new standards in performance, and a Best Buy rating is obviously appropriate. In conjunction with the turntable it forms the new *Planar 3* combination, and its benefits were clearly apparent in the *Planar*.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	10-11g
Type/mass of headshell	non-detachable/ –
Geometric accuracy	very good
Adjustments provided	overhang/offset
Finish and engineering	very good/excellent
Ease of assembly/set-up/use	very good/excellent/ver good
Friction, typical lateral/vertical	15mg/15mg
Bias compensation method	magnetic
Bias force, rim/centre (set to 1.5g elliptical)	340mg/330mg
Downforce calibration error, 1g/2g	+ 0.05g/ + 0.03g
Cue drift, 8mm ascent/descent	negligible, 0.5 secs/3 secs
Arm resonances	see graph
Subjective sound quality	very good
Arm damping	none
Estimated typical purchase price	£90



Structural arm resonances, audio band

RECOMMENDED

Revolver

Sundown Electronic Engineering Ltd, 23 Austral Avenue, Woolston, Warrington WA1 4ND
Tel (See Corporation) (0925) 826223

The *Revolver* is a British designed and built motor unit produced by a company called The See Corporation, who were initially known for their oddly-named 'PIG' rubber record clamp. Another product of their is the Starmat — a record mat comprising a partially-conductive, impregnated disc of stiffened black felt. The turntable, not surprisingly, came fitted with both these items.

Essentially, the *Revolver* is a solid plinth design, founded on a Medite (MDF) board which is mounted on three rubber feet, one at the rear and the others at the front, these similar to those employed on the Rega models.

Some decoupling from the plinth-mounted motor and lid is provided by a secondary element, namely the top plate on which the arm and platter are fixed. This plate is marginally isolated via stiff foam rubber strips, these joining it to the plinth proper. The platter is rather light and cut from poorly-finished MDF. This contrasted strongly with the first-rate red hammer paintwork of the plinth itself (the *Revolver* is alternatively available in grey hammer finish), as well as its excellent moulded lid — here the purchaser certainly gets his money's worth.

The platter is driven at its periphery by a long rubber cord, end joined, which proved a little tricky to load, due to the large twist incorporated (this is deliberate, say the manufacturers). An endless belt will be used in future production. Motive power is from the usual double pulley mains synchronous motor.

A hidden feature of the upper plate is the rumble vibration canceller, which comprises a pair of lead weights mounted under the rear corners to avoid a coincident resonance and hence improve signal to noise ratio.

The main bearing is a simple design, with a steel shaft and brass sleeve, run 'wet' with a charge of oil supplied. The tolerance on our sample was very good with no significant

slack. For the tests it was factory-fitted with a Linn *LVX* arm, a combination which is available as a package for around £190; the *Revolver* is also supplied with Mission *774LC* arm.

Lab report

The *Revolver* ran fast, by a measured 0.4% on load — acceptable. Wow and flutter was a little below par at 0.18%, with both wow and flutter components in evidence. Slowing under load was however negligible — a good point. Platter mass was quite low, and the disc damping quite typical of the genre. Rumble was also below par at −62/−65dB, with 200Hz motor rumble apparent, a result which strictly speaking took it out of the true hi-fi category. Acoustic and isolation breakthrough were also poorer than averate, although shock resistance was quite good.

Sound quality

In view of some dealers' glowing reports we felt the sound quality to be just a little disappointing. It scored 'average plus', and was rescued largely by the competent performance of the chosen tonearm. The overall sound was nicely balanced however. Mild wow was occasionally heard, while neither pitch nor timing in music seemed too secure. The bass was free of boom or emphasis, but also lacked attack and weight, and consequently sounded a bit 'soft'. Stereo depth was good however, and had pleasant perspectives.

Conclusion

A good looking player, plinth and lid-wise, the *Revolver* was also competent as regards engineering build and performance. The sound was rated a little above average, and on a value for money basis does justify recommendation.

GENERAL DATA Motor unit

Motor Section

Type	plinth, belt-drive, synchronous
Platter mass/damping	1.0kg/fair
Finish and engineering	good
Type of mains lead/connecting lead	3-core
Speed options	manual change, 33⅓/45rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.18%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.15%/0.14%
Absolute speed error	+0.4%
Speed drift, 1 hour/load variation	negligible/−0.12%
Start-up time to audible stabilisation	2.0 secs
Rumble, DIN B wtd, L/R average (see spectrum)	62/65dB
Size (w x d x h)/clearance for lid rear	42 × 36 × 13/8.5cm
Ease of use	average
Typical acoustic breakthrough and resonances	average −
Subjective sound quality of complete system	average +
Hum level/acoustic feedback	fairly good/average −
Vibration sensitivity/shock resistance	fair/good
Estimated typical purchase price	£105

**measured on an early sample*

Revox B791

F W O Bauch Ltd, 49 Theobald Street, Borehamwood, Herts
Tel 01-953 0091

This turntable represents a development of the earlier *B795* previously covered in *HFC*; certain refinements have been added but basically the two reviews can be read in conjunction.

I was never quite happy with the choice of AKG/Revox cartridges that the company used to fit to their models, and noted that this new deck came with a Shure *M97* equivalent – an *HFC* Best Buy from an earlier 'Cartridges' issue. The *B791* sports an improved mat offering a flat disc contact and the digital readout of speed has returned, together with the push buttons for setting incremental variation in pitch.

The arm is a foolproof, servo-controlled assembly concealed beneath a cover, the whole forming a parallel tracking gantry which is swivelled over the record surface area once the disc has been placed on the platter. The arm is of very low mass, well suited to the high-compliance cartridge fitted, the latter carrying the Shure stabiliser which further aids subsonic resonance damping and improves shock immunity. Unfortunately by virtue of the fully powered but non-automatic arm operation, several measurement parameters were difficult to establish.

Lab report

Internal inspection revealed the usual high Revox standard of engineering and construction. The platter with the new mat weighed 2.6kg and was a strong and accurately machined alloy casting. Very little main bearing play was evident, though a minor low frequency rocking mode was detectable on the disc impulse response. Interestingly, the termination was not as favourable as might have been expected, since a delayed reflection of the leading impulse reappears about 30m sec later. In all respects wow and flutter was exemplary, and the powerful motor attained speed in 2.2 seconds with no overshoot or other undesirable characteristics. The rumble bridge could not be used for measurement, but checking with a test lacquer suggested that a better than 75dB result DIN B weighted was appropriate.

Acoustic breakthrough and vibration isolation results were good as while shock resistance was classed as very good, and a fine immunity to acoustic feedback was demonstrated. The arm appeared to perform well, judged by the fine tracking performance of the installed cartridge, but one weakness in conventional arm terms concerned the non-rigid nature of the arm pivots as well as the potentially resonant nature of its support; even more important were the group of counter balance springs — long coil types located near the cartridge. A resonance sweep taken with this arm on the earlier *B795* suggested that a fair number of serious resonances were present. For reference purposes a brief frequency sweep and separation curve was taken for the newer cartridge. From 30Hz to 5kHz the fre-

quency response met ±1dB limits, with a slight 1dB loss at higher frequencies. Separation was quite good at 30dB mid band and still measured 20dB, 10kHz; a smooth 'warm' sound quality was predicted from these results.

Sound quality

As an ensemble the *791* is most definitely a 'rich' sounding turntable with some mid-range 'thickening' and 'dominance'. Bass reproduction was well above average with promising depth and articulation and while the stereo images were quite well focussed, the treble lacked some detail, and depth effects were moderate. Overall the sound felt a little 'compressed' in terms of perceived dynamic range but on the other hand pitch stability was extremely good.

Conclusion

This latest Revox turntable gave a good account of itself and would not disgrace a complete Revox system. In comparative terms the value for money is only moderate, which bars recommendation — an audiophile would do better with a separate component turntable, and yet would lose the fine shock immunity, excellent motor drive and automated damage-proof tonearm/cartridge provided by this model.

GENERAL DATA Integrated turntable (inc. cartridge)

Motor Section

Type ..... powered arm, quartz direct-drive
Platter mass/damping ..... 2.6kg/average +
Finish and engineering ..... excellent/good
Type of mains/connecting leads ..... 2-core/phonos and earth
Speed options ..... variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2) ..... less than 0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)
less than 0.06%/0.05%
Absolute speed error ..... none
Speed drift, 1 hour/load variation ..... quartz-locked/none
Start-up time to audible stabilisation ..... 2.2 sec
Rumble, DIN B wtd L/R average (see spectrum)
better than −75dB

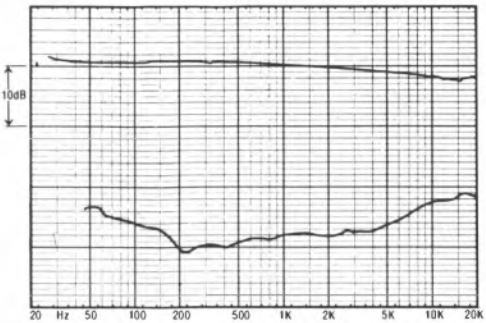
Arm Section

Approximate effective mass, inc screws, excl cartridge ... 3.0g
Type/mass of headshell ..... integrated
Geometric accuracy ..... excellent
Adjustments provided ..... none
Finish and engineering ..... very good/very good
Ease of assembly/setting-up/use
excellent/excellent/excellent
Friction, typical lateral/vertical ..... —/—
Bias compensation method ..... not required
Bias force, rim/centre (set to 1.5g elliptical) ..... N/A
Downforce calibration error, 1g/2g ..... —
Cue drift, 8mm ascent/descent ..... none, 0.2 secs/1.2 secs
Arm resonances ..... —
Subjective sound quality ..... —
Lead capacitance/damping method ..... —/none

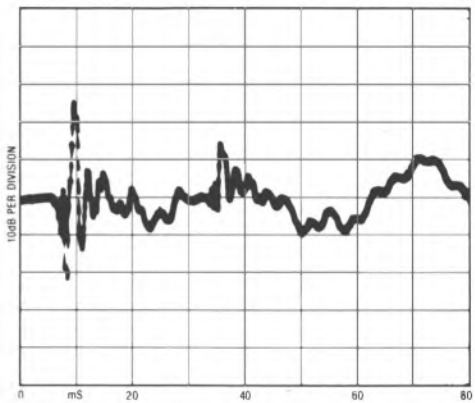
System as a whole

Size/clearance for lid rear ..... 45(w) x 40(d) x 14cm(h)/none
Ease of use ..... very good
Typical acoustic breakthrough and resonances ..... good
Subjective sound quality of complete system ..... good
Hum level/acoustic feedback ..... very good/good
Vibration sensivity/shock resistance ..... good/very good
Estimated typical purchase price £420

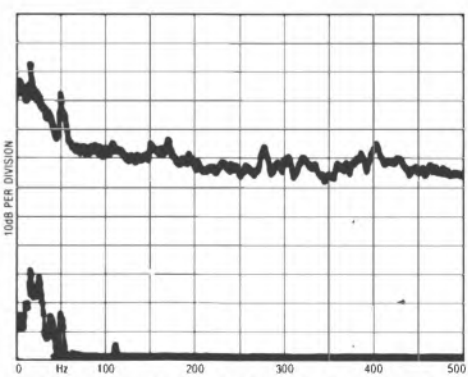
**limited by test lacquer used for measurement*



Frequency response and separation, cartridge



Disc impulse transmission showing damping



Breakthrough, acoustic (above) and vibration (below)

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

Rotel RP830

Rotel Hi-Fi Ltd, 2-4 Erica Road, Stacey Bushes, Milton Keynes, Bucks MK12 6HS
Tel (0908) 317707

Rotel have recently produced a new range of good value hi-fi components, offering an improved performance by comparison with many of their earlier efforts. The *RP830* is the less expensive of the two new Rotel turntables, sells for well under £100.

Compared with the solidly built *850*, the *830* is of considerably lighter construction. A rigid design, the composition wood plinth is mounted on fairly stiff rubber feet, but platter mass is fairly good at 1.9kg, and the main bearing is well toleranced, free from perceptible play. Belt-driven, the deck has a small synchronous motor with a two-speed pulley; speed change is by hand, requiring removal of the disc and platter mat.

The arm proved to be not too well adjusted, showing some bearing slackness. The lid was of the usual rather resonant variety, doing its best to upset the sound by communicating its unwanted energy to the stylus via the plinth.

Lab report

This manually operated deck produced very good speed characteristics. Wow and flutter was fine, while absolute speed was only slightly fast. Torque was ample, illustrated by the very mild 0.18% slowing under load, while start up was rapid 1.9 seconds.

Rumble was less inspiring, due to the deficient isolation of the drive motor from the plinth — DIN B rumble results were 65/67dB which is barely satisfactory. Spectrum analysis showed low-frequency noise vibration plus a spectrum of motor induced mains harmonics.

Charted for its isolation characteristics, the *830* was seen to perform badly in this respect. Isolation below 100Hz was marginal while the acoustic breakthrough above 200Hz was much worse than average.

Disc impulse damping was satisfactory, though the initial transient was followed by a low-frequency platter resonance (rocking) of reasonably rapid decay.

The arm showed some minor resonances at 170 and 230Hz but then 'broke' quite severely at 540Hz, this major transition likely to affect sound quality. Effective mass was measured at a medium high 13g, suited to the lower compliance cartridges and very low frictioin was noted. The bias compensation was effective, with satisfactory downforce calibation

Sound quality

Fairly good results were obtained on audition. In the bass there was a noticeable lack of definition with some boominess. The impression of stereo depth was rather limited in the stereo sound stage, while the mid

sounded somewhat brash and 'loud' with an 'echoey' after effect. Feedback margins were below average, and the lid was clearly a weakness, the sound improving when it was removed.

Conclusion

While Rotel have succeeded in hitting a particular price point with the *RP830*, the performance is not good enough for recommendation. The whole structure was too resonant for a clear transparent sound, and the rumble level was also higher than it should be. Despite all this, the *830* was certainly better than a number of similarly-priced decks from similar sources and is thus worth considering.

GENERAL DATA Integrated turntable

Motor Section

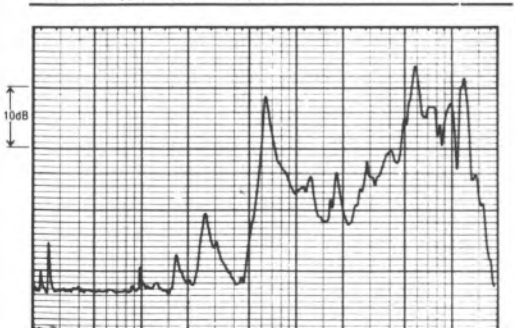
Type.....manual, belt-drive
Platter mass/damping.....1.9kg/very good
Finish and engineering.....very good/good
Type of mains lead/connecting lead.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.08%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz).....0.14%/0.09%
Absolute speed error.....0.45%
Speed drift, 1 hour/load variation.....synchronous/ – 0.18/
Start-up time to audible stabilisation.....1.9 secs
Rumble, DIN B wtd, L/R average (see spectrum)..... – 65/ – 67dB

Arm section

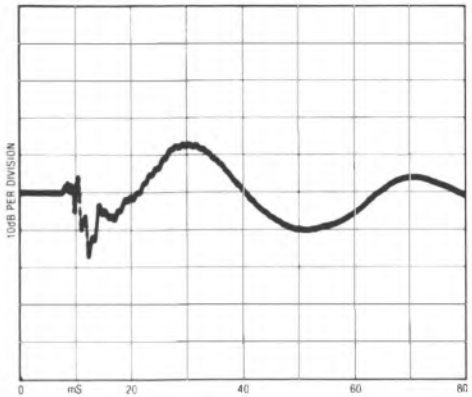
Approximate effective mass, inc screws, excl cartridge.....13g
Type/mass of headshell.....non-detachable/ –
Geometric accuracy.....very good
Adjustments provided.....tilt/overhang/offset
Finish and engineering.....very good
Ease of assembly/set-up/use.....very good
Friction, typical lateral/vertical.....<20mg/<20mg
Bias compensation method.....spring
Bias force, rim/centre (set to 1.5g elliptical).....250mg/170mg
Downforce calibration error, 1g/2g..... – 0.06g/ – 0.3g
Cue drift, 8mm ascent/descent.....average 1.5 secs/3.0 secs
Arm resonances.....average –
Subjective sound quality.....average –
Arm damping.....none

System as a whole

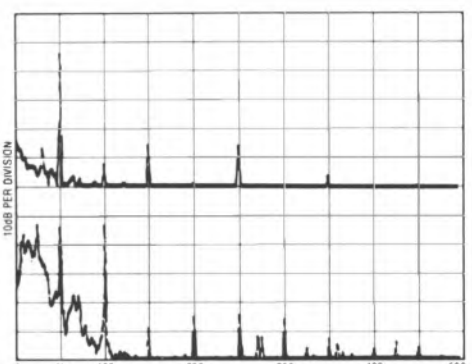
Size (w x d x h)/clearance for lid rear.....43.5 x 36 x 14cm/5cm
Ease of use.....fairly good
Typical acoustic breakthrough and resonances.....poor
Subjective sound quality of complete system.....average –
Hum level/acoustic feedback.....fair/average –
Vibration sensitivity/shock resistance.....average – /fairly good
Estimated typical purchase price.....£95



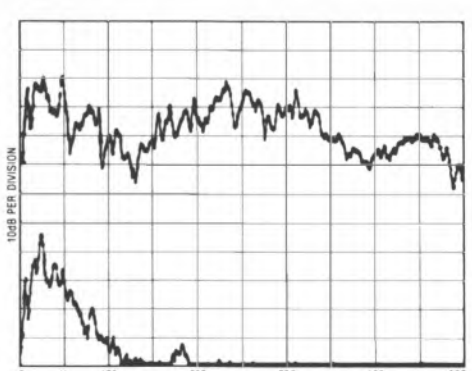
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Rotel RP850

Rotel Hi-Fi Ltd, 2-4 Erica Road, Stacey Bushes, Milton Keynes, Bucks MK12 6HS
Tel (0908) 317707

Outwardly quite conventional, the new *RP850* turntable from Rotel in fact shows much evidence of careful design, and attains correspondingly fine results. Priced at £140, it is actually a very different kind of product from the visually-similar but in reality much less competent *RP830*.

plinth which affords a good foundation for arm and platter. Supported on moderately-compliant feet, the deck is fitted with a rather resonant polystyrene lid, but Rotel were quick to point out that they recommend that critical listeners should leave it off during play. A fairly generous die-cast aluminium platter is employed, weighing 1.8kg, and the main bearing was well toleranced with negligible slack. A thick rubber mat covers the platter, helping to mask any effects of the two apertures provided in the platter surface for drive belt access. The player is powered by a large synchronous motor with a double crowned pulley. Speed changeover is by hand, only requiring the mat to be lifted for this operation.

The arm is rather better than those usually encountered on integrated players, having well adjusted slack-free bearings. The beam is of light alloy tube, while the adjustable die-cast metal headshell is clamped in position using a proper sleeve clamp with socket head bolt tightening. This arm is in the medium-to-high effective mass range, so cartridges with compliances of the order of 8-20cu should prove suitable.

Lab report

The motor proved to be well isolated from the vital vibration-sensitive points, this proven by the fine DIN B-weighted rumble result of −80dB. Spectral analysis of the rumble revealed a couple of harmless motor harmonics at 25Hz, and 200Hz, but electrical hum was fairly low.

A high-powered motor enables the player to reach rated speed in a fast 1.7 seconds, and its good torque was also shown by the very mild slowing under test loading, here measured at 0.2%. Consequently pitch stability was very good, while DIN peak wow and flutter was fine at 0.07% with equally promising results for flutter and wow when these were separately weighted.

Concerning its isolation performance, the *RP850* did fairly well on acoustic breakthrough, which was noticeably improved upon lid removal. The feet afforded some vibration isolation — poorer than most subchassis types, but, beneficially, of an even character. On the other hand, shock resistance was better than average.

The disc impulse response showed good initial damping followed by some low frequency platter ringing at 40Hz; this is likely to be a rocking mode.

Arm performance was above average, the unit appearing to be well aligned and adjusted. Charted for structural resonance, the arm showed a minor mode at 100 and 280Hz this probably due to the counterweight but the main break appeared at 1kHz and was rather severe. Good rigidity was indicated by this high resonance value. Arm adjustments included level, angle overhang and rotation. Friction was low at 25/10mg lateral/vertical, while the bias compensator offered appropriate values. Downforce error was minor, and the cue worked well.

Sound quality

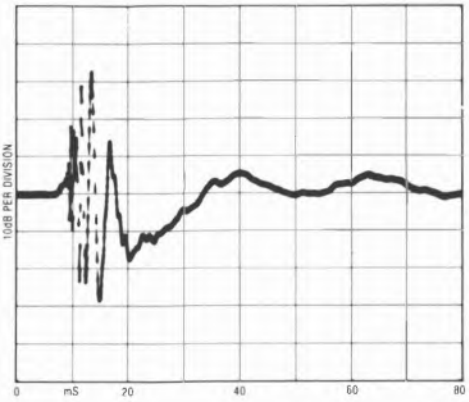
Initially tried with the lid on, the sound was more than satisfactory and improved still further when the lid was removed, when it gained an above average rating.

Pitch was secure and stable with inaudible wow or rumble, and tonally it seemed well balanced, with a clean detailed midrange plus good treble, with only slight imprecision heard as a touch of fizz. Bass was of reasonable definition, with some loss of attack noted as a rubbery quality, but it did at least show reason-

able tune playing ability here. Stereo was to a good standard with solid focusing and fair depth.

Conclusion

This surprising player offered a good all-round performance at a competitive price. The above average tonearm was good enough for some modest moving coil cartridges and complemented the deck well. Enthusiasts may run the deck with the lid off for the very best results but in any case, at £140, the *RP850* is clearly a strong contender in Rotel's new range, comfortably gaining our recommendation.



Disc impulse transmission showing damping

GENERAL DATA — Integrated turntable

Motor Section

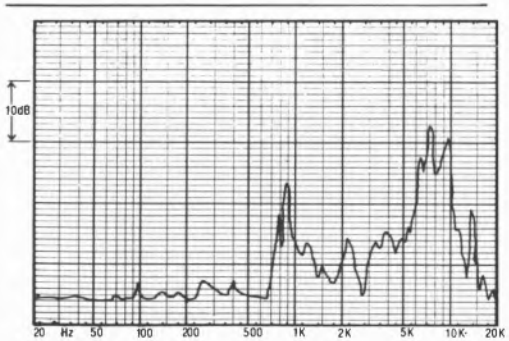
Type	manual, belt-drive
Platter mass/damping	1.8kg/fairly good
Finish and engineering	very good
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.07%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.05%/0.08%
Absolute speed error	+ 0.25/
Speed drift, 1 hour/load variation	<0.06%/ – 0.2%
Start-up time to audible stabilisation	1.7 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 79/ – 81dB

Arm section

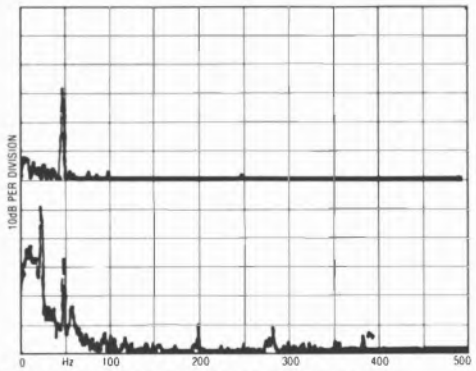
Approximate effective mass, inc screws, excl cartridge	13g
Type/mass of headshell	special detachable/9.5g
Geometric accuracy	very good
Adjustments provided	tilt/overhang/offset
Finish and engineering	good/very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	25mg/10mg
Bias compensation method	internal spring
Bias force, rim/centre (set to 1.5g elliptical)	190mg/225mg
Downforce calibration error, 1g/2g	– 0.05g/ – 0.04g
Cue drift, 8mm ascent/descent	negligible, 0.8 secs/1.8 secs
Arm resonances	see graph
Subjective sound quality	good
Arm damping	none

System as a whole

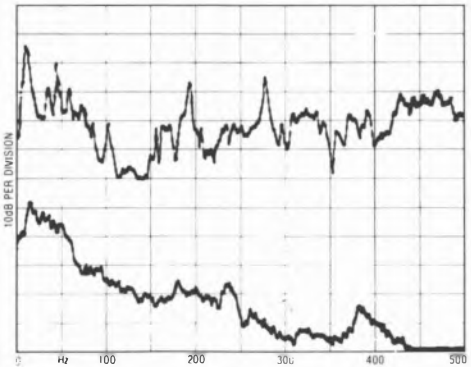
Size (w x d x h)/clearance for lid rear	43.5 x 37 x 14.5cm/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	good (lid off)
Hum level/acoustic feedback	very good/fairly good
Vibration sensitivity/shock resistance	fair/good
Estimated typical purchase price	£140



Structural arm resonances, audio band



Rumble, electrical (above) and total (below)



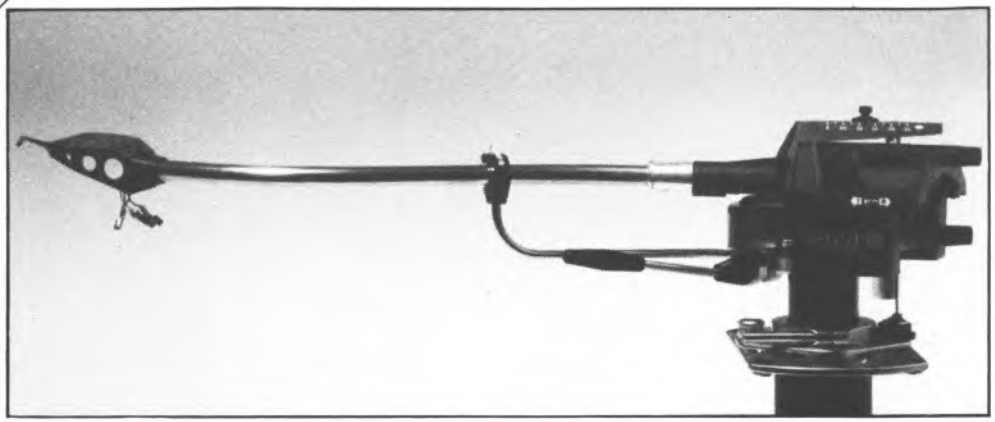
Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

SME 3009 Series III(S)

SME Ltd., Steyning, Sussex BN4 3GY.
Tel (0903) 814321



Features and design

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

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

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

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

The new black finished (B) versions of the arm also incorporated revised geometry. SME have increased the versatility and geometric performance by the simple expedient of adding some accessories to a new version of the carrier arm *CA1*. These include the established mastic mounting compound, to be placed between cartridge back and arm; a properly fitting type '3818' ballast weight which approximately doubles the

effective mass to 10g inclusive of screws, plus a return to aluminium mounting hardware. Carbon fibre reinforced nylon screws are also provided as standard, the final accessory being a revised two point alignment protractor to go with the new geometry, the latter a small revision to offset angle. This is necessary since the SME carrier has single hole fixings, and only overhang can be adjusted, this via the pillar base slide. The headshell has been slightly enlarged and strengthened to give more space for the deeper cartridges and a broader base for mounting.

Lab results

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

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

The resonance characteristics in the audio range were fairly well damped but very complex. The arm was retested with the ballast weight, this condition suitable for low to medium compliance cartridges, particularly moving coil types. On most mechanical and measured parameters the performance was very good. Bias compensation appears to have been reduced to more realistic levels compared with previous samples, but the cue descent rate remains a trifle slow.

The complexity of the arm resonance plot reflects the pivot design and the large number of attached mechanical components.

Sound quality

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

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

Conclusion

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

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

(Note: unfortunately the 'recommended' rating here may have to be withdrawn when the latest increase takes effect.)

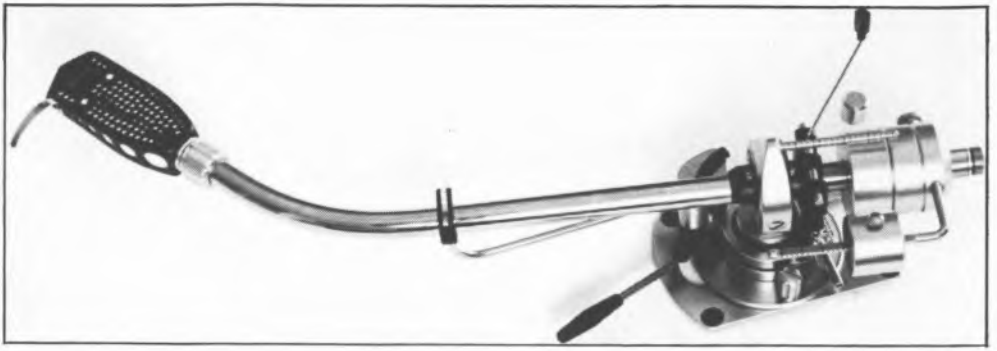
GENERAL DATA

	Tonearm
Approximate effective mass, inc screws, excl cartridge	5(*10)g
Type/mass of headshell	detachable carrier
Geometric accuracy	excellent
Adjustments provided	tilt/overhang/height
Finished and engineering	excellent/very good
Ease of assembly/setting-up/use	good/good/good
Friction, typical lateral/vertical	5mg/less than 5mg
Bias compensation method	thread and weight
Bias force, rim/centre (set to 1.5g elliptical)	150mg/150mg
Downforce calibration error, 1g/2g	-0.05g/none
Cue drift, 8mm ascent/descent	none, 0.9 secs/3.9 secs
Arm resonances	good
Subjective sound quality	good
Lead capacitance/damping method	280(*75)pF/none
Estimated typical purchase price	£120(III) £90(IIIS)

See text

SME 3009R

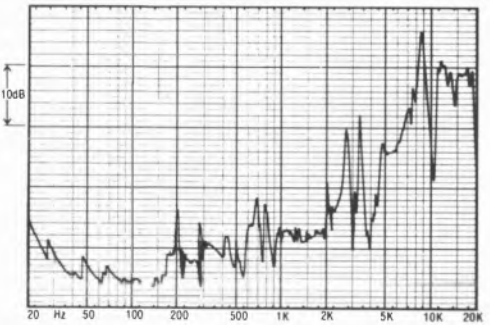
SME Ltd, Steyning, Sussex BN4 3GY
Tel (0903) 814321



With demand continuing for the earlier *3009 II Improved* arm series, *SME* have released a further version of the *3009* with a detachable headshell, this aimed at the lower compliance moving-coil cartridge users. Readers may recall that the original 'improvement' to the *3009*, undertaken about a decade ago concerned a mass reduction to achieve compatibility with the high compliance cartridges then in vogue. These developments finally culminated in the release of their low mass *Series III*.

Retracing their steps, SME have given the 'R' a reinforced headshell design of thicker aluminium, further revised to provide a better seating for the cartridge; it is now also fitted with a double locking pin to increase the rigidity of fixing to the arm tube. Currently, the latter is made from stainless steel rather than the original aluminium, and the first series *3009* counterweight assembly has been reintroduced, with a firmer mounting between weights and rear section, plus locking arrangements for the main and slider components. These changes have resulted in a doubling of price to the £190 level.

Inclusive of hardware, the estimated effective mass is 12g, suited to low-to-medium compliance cartridges in the 8-16cu range. Adjustments include vertical tilt (the slip action fixing here is none too tight) plus height and overhang, the latter via the famous SME base slider incorporated in the pillar.



Structural arm resonances, audio band

Lab report

The arm was excellently finished and built — comparable with the best in the world in this respect. The instructions were exemplary.

Arm geometry was judged to be excellent and is now optimised for 30cm LP records with a sensible two-point protractor to aid alignment. Friction was satisfactorily small while bias compensation values were close to that required if marginally low. Downforce was also precise, but cue descent slow, at 6.5 seconds.

Arm lead capacitance was high at 285 pF, this deliberately to match certain moving-magnet cartridges. A small ceramic capacitor lurks within the superb gold plated shells of the phono plugs on each cable, and snipping the leads and excising this possibly doubtful component provides a cable capacitance reduction to 75pF. A characteristic of SME cables is their relatively high stiffness which can cause difficulties when installing in sub-chassis turntables with compliant suspension; 'loop' lead dressing is often required to extract a good performance from the assembly.

Charted for resonances, the result was classed as above average, essentially on grounds of a uniform energy trend. Breaks were well damped (partly due to the rather non-rigid construction), and the headshell modes at 100 and 300Hz were well disguised and broken up as were the beam modes at

600-900HZ. Ringing was evident at around 3kHz, with another severe effect at 9kHz.

Sound quality

Auditioned in a Lux *PD300*, sound quality was rated as lying in the 'average' group. The tonal balance was fairly open, but the sound lacked precision and stereo focus was felt to be impaired throughout the frequency range. Stereo depth was compressed and the bass register, while fairly even, was found to be lacking in 'slam' and 'attack'. Some upper-mid hardness was also observed, particularly with moving-coil cartridges.

Conclusions

I regret to have to conclude this review without any recommendation for the *3009R*. I am certain that SME have the necessary engineering skill to produce a front-rank medium-mass tonearm at a realistic price, but personally I feel that revamping a long-discontinued product has not provided a viable answer in this case.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	12.0g
Type/mass of headshell	detachable (two locating pins)/8.5g
Geometric accuracy	very good
Adjustments provided	tilt/overhang/height
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	good/very good/very good
Friction, typical lateral/vertical	30mg/less than 5mg
Bias compensation method	thread and weight
Bias force, rim/centre (set to 1.5g elliptical)	150mg/150mg
Downforce calibration error, 1g/2g	none/none
Cue drift, 8mm ascent/descent	none, 0.8 secs/1.6 secs
Arm resonances	average +
Subjective sound quality	average
Lead capacitance/damping method	85pF/counterweight decoupling
Estimated typical purchase price	£190

SOTA Sapphire

SOTA UK Ltd, 41a The Grove, London N3 1QT
Tel 01-349 3799

Already achieving notable success on its home US market, this Californian-built model is now available here. Its UK price made is rather more realistic than some other imports by a large planned content of UK manufacture. However at close on £600 it remains one of the more expensive models on the market today, meeting competition such as Michell *Gyrodec*, Dais *'Heavy'* and the Oracle *Alexandria*.

The Sota is a massive subchassis design, the chassis built as a damped medite board forming the lower part of the deck. This damped panel is mass loaded at its corners by the tonearm, and by lead weights, to give a low centre of gravity. The platform in turn is hung on relatively small diameter coil springs and is thus gravity-stable. This assures a low suspension resonant frequency — in the 2 to 4Hz region — for all modes of vibration, this well clear of the likely arm/cartridge resonances.

There is a massive main bearing assembly, inverted so as to exploit the self stabilising action of the platter. A sapphire thrust disc is fitted, hence the turntable's name. The platter itself is a massive aluminium alloy casting finished in a gold colour, the profile chosen to minimise self-resonance. The motor is the well known Papst dc Hall-effect model, used in conjunction with an external power supply. The motor is coupled by a resilient precision belt looping the platter periphery. Immediately adjacent to the motor is a small control panel providing for fine variable speed control plus electronic switching between 33⅓ and 45rpm.

The subchassis is pre-loaded and balanced, and arms may be changed easily by removing a top mounting sub-board. Beneath this is a small tray which contains a measured quantity of lead shot, which can be varied to take up the mass difference between various arms, and so retain chassis balance without further adjustment.

At present a final method for arm lead dressing is still under consideration, and in any case, there is ample space for access without cable encumbrance.

The substantial plinth is made of solid oak, the mitred corners forming a design feature. The lid is low in resonance though not wholly to the expected standard, particularly through its use of apparently inexpensive friction loaded hinges.

Lab report

The supplied stroboscope disc was used to set the otherwise uncalibrated speed settings, which needed a mains powered lamp. After a half-hour warm up, the first measurement was combined wow and flutter, for which an excellent 0.06% was recorded. Unweighted flutter was at the limit of measurement though some wow was recorded at 0.15%; this is not uncomon for belt drive models. Drift was low, though the Sota showed some weakness with respect to torque.

Under the standard loading test, the deck slowed by nearly 0.5% and this would be considered serious if it were not for the weighty platter with its high rotational inertia. The flywheel effect will help to control short term load changes while speed recovery was free of overshoot, a favourable point.

DIN B weighted rumble was excellent at −80dB while spectral analysis showed a welcome absence of the usual motor and mains related harmonics, this helping to contribute to a 'clean' low level sound quality.

Using the mat and clamp, the disc impulse damping demonstrated a high level of dissipation of the vibration transient. Some mild low frequency ripple was evident which when analysed, resolved into a platter resonance at 580Hz, plus a subchassis flexure

continued on page 151

GENERAL DATA Motor unit (tested with Sumiko arm)

Motor Section

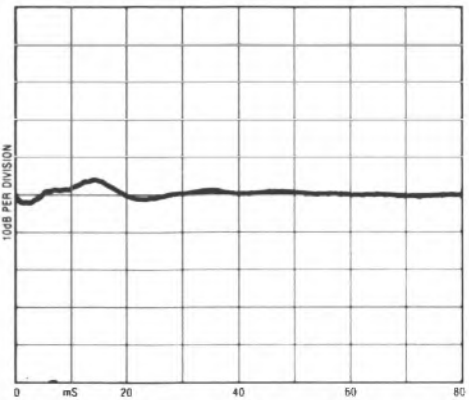
Type	belt-drive, subchassis
Platter mass/damping	5kg/very good
Finish and engineering	very good
Type of mains lead/connecting lead	remote transformer
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.06%
Wow and flutter (Iin peak wtd 0.2-6Hz/6-300Hz)	0.15%/0.05%
Absolute speed error	adjustable pitch
Speed drift, 1 hour/load variation	approx 0.1%/ −0.45%
Start-up time to audible stabilisation	4.7 secs
Rumble, DIN B wtd, L/R average (see spectrum)	− 81/ − 79dB

Arm section (Sumiko Premiere arm)

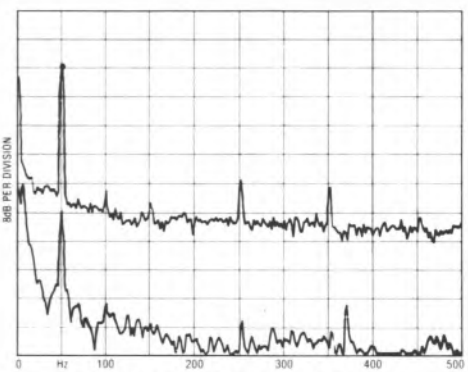
Approximate effective mass, inc screws, excl cartridge	16.5g
Type/mass of headshell	universal detachable/12g
Geometric accuracy	very good
Adjustments provided	height/overhang/offset/damping
Finish and engineering	excellent/very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	60mg/15mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	320mg/240mg
Downforce calibration error, 1g/2g	0.01g/0.015g
Cue drift, 8mm ascent/descent	negligible, 0.6 sec/1 sec
Arm resonances	see graph
Subjective sound quality	see text
Arm damping	optional lateral, by viscous fluid

System as a whole

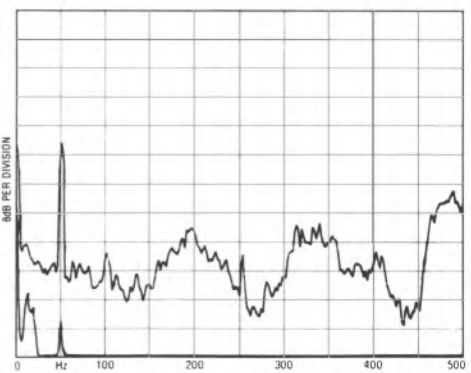
Size (w x d x h)/clearance for lid rear	50 x 43 x 20cm/7.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	excellent/excellent
Vibration sensitivity/shock resistance	excellent/very good
Estimated typical purchase price	£600 (without arm)



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

STD 305S(M)

Strathclyde Transcription Developments, Midton Road, Howwood, Renfrewshire PA9 1AQ.
Tel (05057) 5151

Features and design

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

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

Lab results

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

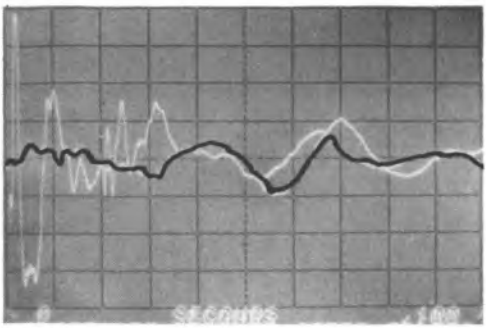
Sound quality

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

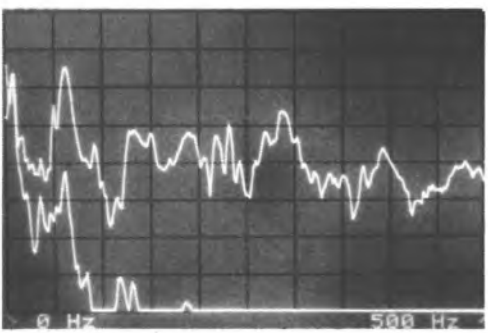
Conclusion

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

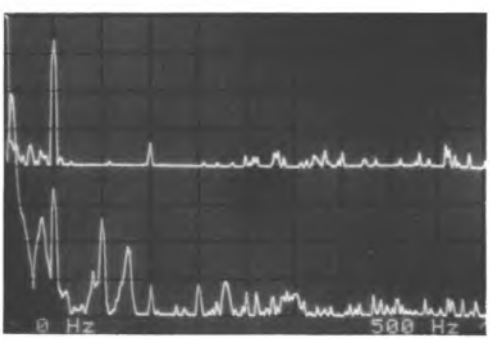
GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	2kg/good
Finish and engineering	good/good
Type of mains lead/connecting leads	2 core/—
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter(LIN peak wtd 0.2–6Hz/6–300Hz)	0.11%/<0.06%
Absolute speed error	+0.25%
Speed drift 1 hour/load variation	synchronous/−0.35%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	−75/−76dB
Size/clearance for lid rear	47.5(w) x 36.5(d) x 15.5(h)/6.5cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	very good/fairly good
Estimated typical purchase price	£170



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



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



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

at around 50Hz, both however quite well damped.

The Sota scored top marks for isolation, both vibrational and acoustic energy being well rejected, and this design should be highly uncritical of location. The chassis also demonstrated good dynamic behaviour with its frequency modes well separated from the cartridge resonance, and as such contributing to good stable tracking even under conditions of mild shock or footfall.

Sound quality

Using top class turntables as a basis for comparison, the Sota was also examined on its own merits, fitted with the Sumiko *Premiere* arm and *Talisman* cartridge supplied. We also tried the Zeta and Linn *Ittok* arms with *Asak* and EMT van den Hul cartridges.

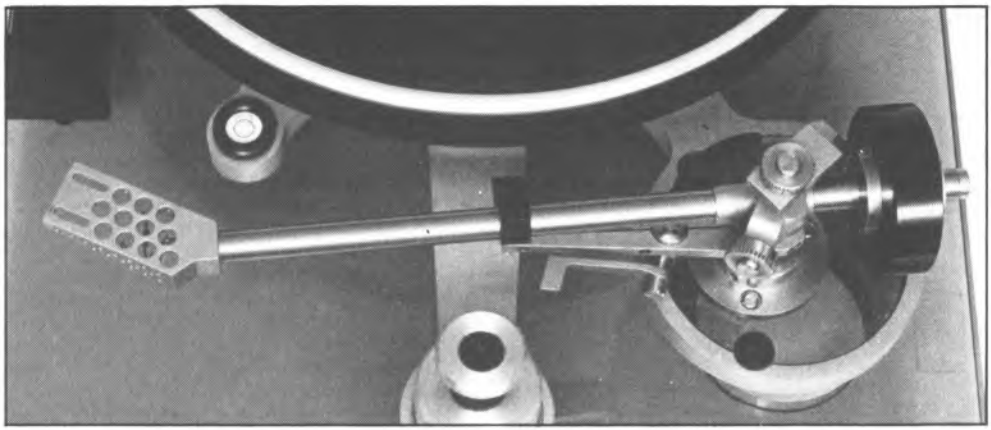
Initial impressions were encouraging, the player providing a stable and spacious stereo soundfield with good tonal neutrality. The frequency balance always sounded even and well controlled, while an air of restraint pervaded the reproduction. Stereo images were well presented with good depth ambience, and fine width of stereo stage. It felt 'relaxed', in fact almost too much so at times, as if some of the feeling of excitement present on some recordings had been diluted. One listener remarked that it was very hard to fault the Sota and yet he did not find the music it produced particularly involving. One area was finally identified namely the bass. While it was undoubtedly even, pretty tuneful and showed good low frequency extension, it also seemed 'slow'. The attack and rhythmic precision present on some tracks was softened and lost impact. We found use of the *Ittok* helped liven up the balance elsewhere in the frequency range, providing a good match for the deck but the 'lack of excitement' question was not wholly resolved.

Conclusion

At close on £600 the Sota Sapphire offered some impressive aspects in terms of both its engineering and performance, and is undoubtedly a fine product. However it is up against stiff competition from UK designs, many of which offer rather better value. It is certainly worth considering the *Sapphire;* indeed its particular balance of performance might prove correct for some systems, so our suggestion must be to consult your dealer, take advice on system matching and audition it for yourself.

Sumiko MDC800 'The Arm'

Absolute Sounds, 42 Parkside, London SW19.
Tel 01-947 5047



The legendary Breuer, a Swiss made exotic tonearm, was apparently only available in limited numbers for a short while. As a result the US agent commissioned an American made arm loosely based on the Swiss model.

Entitled by Sumiko *The Arm*, it is about three times the price of an *Ittok*, but the two have some features in common, since the *Ittok* also shares some of its design thinking with the Breuer. The similarities include the use of a rigid one-piece headshell firmly fixed to a large diameter pipe, plus a pre-loaded strong gimbal bearing assembly, a decoupled counterweight, spring operated downforce (and biasing) for optimum dynamic balance, and a three point pillar locking arrangement.

However, the *Ittok* uses six screws for the main tube joint, the Sumiko a thermally bonded interface, and while the decoupled *Ittok* counterweight demonstrates a pretty tight fit, that on the Sumiko is almost too loose for comfort, and incorporates a lead shot filling for energy absorption. The *Ittok* controls are calibrated *à la* Japanese, but not so the Sumiko (*à la* Breuer), which also demonstrated a rather low level of bias correction, the designer's philosphy favouring minimal correction.

The Arm's alloy tube has foam damping, and when physically handled appears to be a remarkably inert and strong structure. The headshell, a Breuer-like thin-wall multi-perforated component, is milled from a solid block to ensure the strongest link between itself and the main tube. The complete structure is finished in a high quality satin black.

A 13g effective mass was determined, similar to the *Ittok* and suited to cartridges in the 8-16cu range, particularly high performance moving-coils. The bias range was inadequate, as supplied only suiting a 0-1g cartridge downforce. Resetting the hairspring achieved an effective range of up to 1.8g. The maximum 'balanced' downforce available was just 1.35g, so we produced the higher figures necessary for *Asak* and *Koetsu* cartridges by forward-setting the main counterweight. It must be said that our sample was an ex-demonstration model drawn from very early production, and the problems we encountered will hopefully be untypical in normal production.

Lab results

An elaborate alignment jig in which the arm sits was provided to help cartridge fitting, and the geometric accuracy was certainly very good, despite the lack of vertical tilted adjustment (sacrificed in the interests of rigidity). The bias was at least in the right ratio as well as frictionless in operation, while bearing friction was also low, though a trace of play in the horizontal plane was detected on our sample. Cue descent was to slow at 4.5 seconds — one second is sufficient.

A singular lack of high Q resonances was evident from the audio range graph, and the main flexure in the region of 500-600Hz confirms the high rigidity; the energy trend was barely interrupted. Good damping was evident throughout.

For this edition we tested a later production tonearm with a tighter counterweight assem-

bly. Resonance behaviour was more energetic than before, with a noticeable mode at 3.3kHz. The energy trend now also showed a distinct step at 500Hz, with a less favourable appraisal in the light of this. Bias compensation was also improved.

Sound quality

As in previous auditions, the sound was smooth and relaxed. Bass definition, always good, was marginally improved with this production sample, and it demonstrated fine depth, neutrality and tunefulness. Slight stereo defocusing and mild coloration were both noted in the upper midrange, but by comparison with most other examples the sound quality was very good.

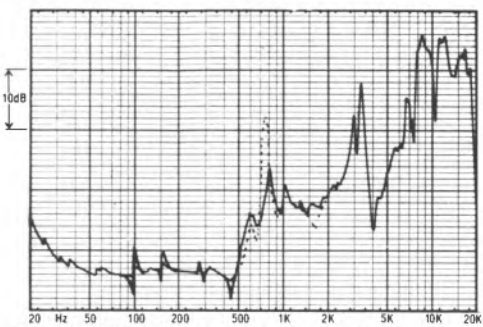
Conclusion

The *MDC800* once stood alone at this exalted quality standard and in that context the very high price did not seem so important. However since our original review, this arm has been joined by others of somewhat comparable quality, but at more realistic prices — so while the *'800* was never 'competitive', it is even less so now. I cannot argue with the performance, but feel that it is really too expensive at around the £800 level.

GENERAL DATA Tonearm

Arm Section

Approximate effective mass, inc screws, excl cartridge	13g
Type/mass of headshell	non-detachable
Geometric accuracy	excellent
Adjustments provided	overhang/offset/height
Finish and engineering	very good/very good
Ease of assembly/setting-up/use	very good/fair/good
Friction, typical lateral/vertical	less than 5mg/less than 5mg
Bias compensation method	internal coil spring
Bias force at centre, when at 150g at rim (uncalibrated)	190mg
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	none, 0.6 secs/1.9 secs
Arm resonances	good +
Subjective sound quality	very good
Lead capacitance/damping method	75pF/partial counterweight decoupling
Estimated typical purchase price	£795



Structural arm resonances, audio band

ORACLE ALEXANDRIA *continued*

0.25% slowing under load confirming this. Rumble was also excellent at better than −80dB DIN B weighted, while its spectrum analysis indicated that spurious vibrations were very low. Acoustic breakthrough was also very low, only slightly marred by a hint of sympathetic platter resonance. External vibration was well handled though this was not an exceptional result, and while the chassis dynamics were fine in the vertical plane, the design was rather stiff in rotation despite its 'hanging' suspension design. It was nonetheless superior to the *Delphi* in this respect.

Effective mass of the *Prelude* tonearm was noted at 9g including hardware, which is usefully below the current average of 13g for good designs. Friction was low in both planes, with minimal bearing play, but some rocking could be induced in the vertical plane due to pillar compliance. The geometry was fully up to standard, while the bias compensation covered a useful range and did not add additional friction. Tested for structural resonances, the main mode appeared at 500Hz with good control, this probably due to the torsional weakness mentioned previously. At higher frequencies however the behaviour was tidy, pointing to a neutral sound. The auto stop/lift device applied negligible extra forces to the cartridge over the final music bands.

Sound quality

On test the *Alexandria* gave a good account of itself. Favourable comments were made concerning its good pitch stability and subjective sense of rhythm. The bass had an even character with pleasing extension, while the mid showed good clarity plus substantial stereo depth but with a hint of clouding in the upper bass lower mid region.

The treble was open and clear, free of false emphasis, and overall the tonal balance was neutral with a low-coloration character. The arm proved pleasantly unobtrusive, and proved to be a good match for a number of good quality moving coil cartridges.

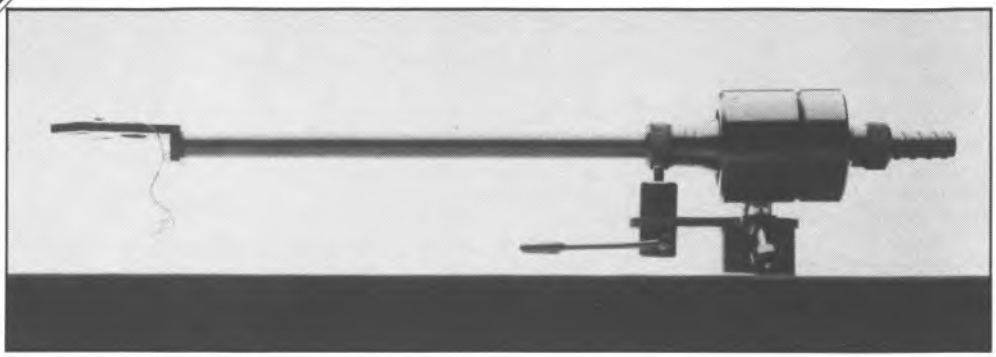
Conclusion

The *Alexandria* can hardly be classed as particualrly good value for money but it does offer a tidy, well designed and highly reliable package. This reliability includes its suspension alignment, which should remain stable for long periods. Taken as a whole its overall 'very good' performance qualifies it for recommendation despite its fairly high price.

RECOMMENDED

Syrinx LE1

Syrinx Precision Instruments Ltd, 82 Orchard Road, Edinburgh EH4 2HD
Tel 031-226 4109



The *LE1*, more poetically known as *Leone*, could be said to have grown out of the earlier lower-cost arm which Syrinx were producing in various forms for such manufacturers as Logic. When these ties fell through, the basic design was improved with added facilities, and the *LE1* is now in a slightly higher price category than before, retailing around the £100 mark. Early production samples gave rise to some concern as regards construction quality, and even now it is still worthwhile buying the arm from a dealer who can check that all is well before purchase. The main problem revolves around the bearings, which must be free of slack to give the optimum performance and which should not drift after assembly to a state where excessive friction occurs.

The *Leone* is particularly distinguished by its rotation facility where the whole arm tube screws into a robust threaded section at the pivots. Adjustment of overhang is also possible, and the final position is securely locked into place by a threaded sleeve acting as a locknut.

Of moderate mass, the alloy arm beam is fitted with a rigidly-fixed cartridge platform with a good mounting area. The pivot is a straighforward gimbal, set for negligible slack or play, and an *Ittok*-compatible pillar and mounting is used, this is a useful feature. Bias compensation is by thread and lever, and neither the contra-locking counterweight or the bias settings are calibrated.

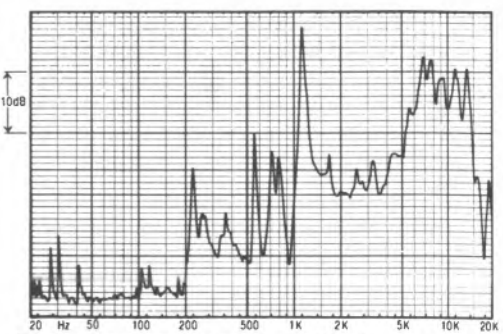
Lab report

Friction levels were satisfactory and certainly good enough for tracking levels down to 1.25g, within the probable range of use. With mounting hardware, the effective mass was about 11g, this putting the arm in the medium mass category and well-suited to cartridges in the 10-20cu range. Overall constructional integrity suggests compatibility with a wide spectrum of cartridges, moving-magnets as well as some of the less expensive moving coils. As is the designer's intension, the internal damping was very low with regard to structural resonances, these charted using an Osawa *60L* cartridge. Minor modes including the counterweight were seen between 200 and 800Hz, while fine rigidity was shown to be the location of the first major 'break', located at 1kHz. The overall energy trend was quite even and the treble range showed good control.

Sound quality

The *LE1* did have a distinctive sound, almost a 'crispness' in the midband which was not severe enough to warrant the term 'coloration'. Its hallmark was an above average level of clarity coupled with good stereo focus. The treble register was pretty good, even using the

continued overleaf



Structural arm resonances, audio band

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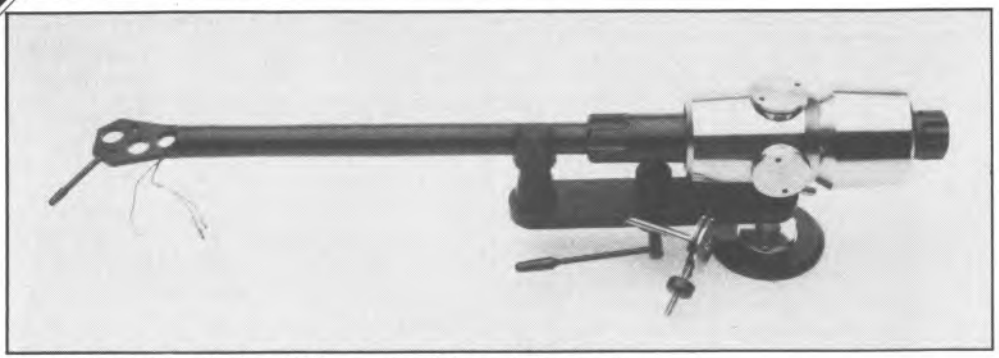
RECOMMENDED

Syrinx PU3

Syrinx Precision Instruments Ltd, 82 Orchard Road, Edinburgh EH4 2HD
Tel 031-226 4109



A development of the *PU2*, a promising tonearm which failed to fully convince me of its merits, the *PU3 Ipsissima* is similarly priced at the £300 level — but there is no comparison in respect of engineering or finish, the *3* being far superior to the earlier model.

Like the *LE1*, the *PU3*'s massive main beam may be rotated on a threaded fixing of very fine pitch. As the designer explained, the finer the pitch the greater the locking forces which may be obtained via the centre rotating sleeve. After adjustment, the *PU3* can certainly be set very firmly. A sensible cartridge platform is fitted, well reinforced and firmly bonded to the tube.

A massive gimbal bearing assembly is employed, with large precision ball races designed to accept a substantial pre-load. The pre-load assures a freedom from play with effective coupling from cartridge to mounting base. Best described as cigar shaped, the main beam is profiled to provide a defined resonance pattern chosen for optimum sound.

The polished counterweight moves on the threaded rear stem, and is locked in position by a contra-rotated inner sleeve.

A relatively large alloy plate forms the gantry for the arm rest and cue mechanism, but this was suspected of introducing a minor resonance in the 1kHz region. However, experiment showed that a small wood wedge between the extreme end of the gantry and the arm mounting board (if this is possible) could minimise this resonance effect.

Arm height is adjustable by means of a lock-nut on the threaded pillar, not as convenient as the side locking methods used by most arms. Neither downforce nor bias levels were calibrated.

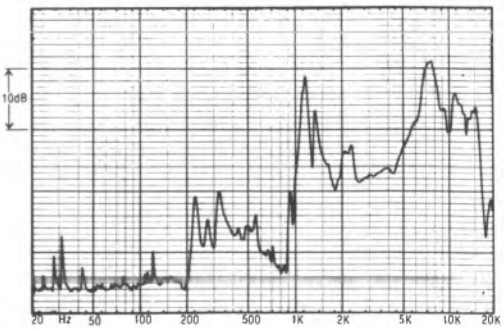
Lab report

Effective mass was found to be around 11g, including fixing hardware, this suited to a broad range of high quality modern cartridges from the Linn to the Koetsus. The geometric accuracy was high, and all the related adjustments were correct. The bearings were devoid of play at the expense of some friction, typically 70mg in both planes for our recent sample, and considered to be satisfactory.

Charted with a Osawa *60L* moving coil cartridge, the structural arm resonance graph presented an interesting picture. Minor counterweight modes were present from 200-400Hz, with the main resonance appearing at a high 1kHz, indicating fine main beam rigidity. The break in energy trend was fairly strong at 1kHz, but above this range the arm was notably well behaved. The main 1kHz resonance could however prove interesting in the context of the listening tests.

Sound quality

The *PU3* was judged to offer a considerable



Structural arm resonances, audio band

improvement over the *PU2*. Tracking stability was notably superior, if marginally behind that of the Zeta for example. The sound was characterised by a light-textured, delicately open quality with a sweet detailed treble capable of bringing out the best from the line-contact type cartridges. The mid was slightly 'nasal', but no more so than several competitors, though in our view this area did not benefit from the Pink Triangle and its alloy plate tonearm mounting. Perhaps a wooden board would provide a superior termination?

Conclusion

Syrinx have maintained a fully competitive standard with their *PU3 Ipsissima*. In the right turntable — the Sondek is one example — the *PU3* can provide a first-rate sound quality, with the finish and most technical aspects of commensurate quality. Taken overall, the *PU3* qualifies for recommendation.

GENERAL DATA	Tonearm
Arm section	
Approximate effective mass, inc screws, excl cartridge	11.0g
Type/mass of headshell	non-detachable/ –
Geometric accuracy	excellent
Adjustments provided	tilt/height/overhang/offset
Finish and engineering	excellent
Ease of assembly/set-up/use	good/good/average
Friction, typical lateral/vertical	70mg/70mg
Bias compensation method	thread and lever
Bias force, rim/centre (set to 1.5g elliptical)	uncalibrated
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	very good, 0.5 secs/2.0 secs
Arm resonances	average
Subjective sound quality	very good
Arm damping	none
Estimated typical purchase price	£290

SYRINX *continued*

more critical moving-coil cartridges such as the *TRAK*. We found the bass was also good, showing depth, firmness and good artication.

This arm could be aligned very precisely, to extract the maximum from the fitted cartridge. whether this was moving coil or moving magnet.

Conclusion

Given the reservation concerning the bearing variability between samples, the *LE1* was felt to offer considerable merit, its combination of good engineering plus fine sound quality winning it a recommendation.

GENERAL DATA	Tonearm
Approximate effective mass, inc screws, excl cartridge	11.0g
Type/mass of headshell	non-detachable/ –
Geometric accuracy	very good
Adjustments provided	height/tilt/overhang
Finish and engineering	very good
Ease of assembly/set-up/use	very good/very good/average +
Friction, typical lateral/vertical	40mg/60mg
Bias compensation method	thread and lever
Bias force, rim/centre (set to 1.5g elliptical)	uncalibrated
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	1.2 secs/3.5 secs
Arm resonances	average +
Subjective sound quality	good
Arm damping	none
Estimated typical purchase price	£108

RECOMMENDED

Technics SLQX200

Panasonic UK Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB
Tel (0753) 34522

This Technics turntable is available in two related forms, namely the basic *SLQ200* at £109 and the more elaborate *SLQX200* quartz-referenced model at £139. Both were tried but the *X* version is the subject of this review, since it proved to be the more promising of the two, mainly by its use of a form of spring-suspended subchassis which the cheaper variant does not have.

A semi-automatic mechanism is included, with auto return and switch-off. The chassis forms the bottom plate, this a reinforced and heavily mineral-loaded moulding. The platter weighs a modest 1.2kg, and comprises an aluminum casting with a thin flat rubber mat.

The main bearing is well toleranced with no play, this comment also applying to the tonearm bearings which were of unusual quality for the price. The arm is a low mass design with the *T4P* cartridge mounting system, and a modest Technics *P33* cartridge was ready fitted, although this could easily be upgraded if so desired. The mechanical fixing for the cartridge was very secure and guarantees good alignment.

Lab report

Predictably, this model gave very good results for DIN peak wow and flutter. Speed was accurate and the drift was below measurement limits. Torque was high as seen by the rapid overshoot-free start-up, while speed loss under load was zero, the player phase-locked to the quartz reference oscillator.

Rumble was excellent, measuring −79/−81dB, DIN B weighted. Spectrum analysis of rumble showed a trace of 100Hz vibration but little else of significance.

The disc impulse response was surprisingly good, with a excellently damped initial transient plus mild low frequency rining thereafter. The deck behaved well on acoustic isolation, deteriorating a little towards 50Hz. Vibration isolation was not up to that of the best subchassis types, but was nonetheless rather better than average.

A low-mass type, the tonearm was well suited to the *T4P* mounted cartridges, and in contrast to most *T4P* tonearms the bearings were free from slack or rattles.

Lateral friction was a little on the high side at 80mg, but satisfactory in view of the factory-set 1.5g downforce. Biasing was fairly good, if a trifle low at the rim. Other calibrations were satisfactory, and the arm's geometric alignment was outstanding.

Arm resonances were charted with the attached cartridge and present a remarkable picture. No significant resonances were visible at all! Admittedly the cartridge coupling factor was on the low side, but this result suggests that the arm has been computer modelled specifically to surpress resonances. The cartridge frequency response was measured and proved satisfactory.

Sound quality

With 300-450pF total loading, the player

acquitted itself very competently. It provided a tidy, focused sound with quite good bass and good general clarity while the treble was also above average, and the mid tonally quite neutral. Some stereo depth was also in evidence.

Conclusion

This model represents Technics at its best. The overall performance was fine, while the finish was excellent. The sound was also more than satisfactory and the deck proved tolerant of both siting and feedback. The standard of the *SL7* has been comfortably surpassed, and a recommendation is confidently awarded to this mainstream product.

GENERAL DATA Integrated turntable (inc cartridge)

Motor Section

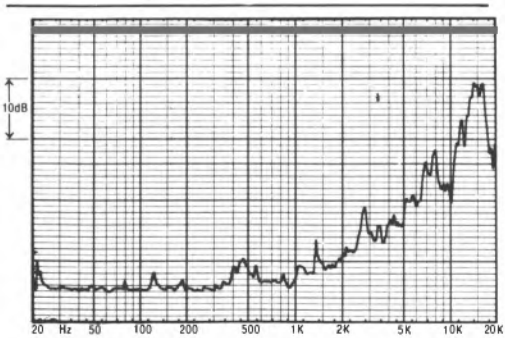
Type	semi-auto, quartz direct-drive, subchassis
Platter mass/damping	1.20kg/good
Finish and engineering	excellent/good
Type of mains lead/connecting lead	2-core/phonos and earth
Speed options	variable, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.6%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.06%
Absolute speed error	– 0.05%
Speed drift, 1 hour/load variation	<0.05%/none
Start-up time to audible stabilisation	2.0 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 79/ – 81dB

Arm section

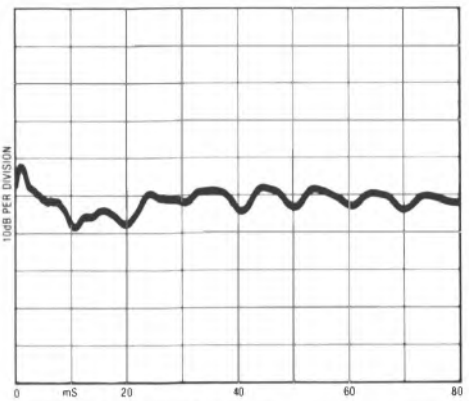
Approximate effective mass, inc screws, excl cartridge	7.5g
Type/mass of headshell	T4P mounting
Geometric accuracy	excellent
Adjustments provided	none
Finish and engineering	very good
Ease of assembly/set-up/use	very good
Friction, typical lateral/vertical	80mg/40mg
Bias compensation method	spring
Bias force, rim/centre (set to 1.5g elliptical)	140mg/240mg
Downforce calibration error, 1g/2g	– 0.125g/ – 0.35g
Cue drift, 8mm ascent/descent	2.3 secs/3.0 secs
Arm resonances	see graph
Subjective sound quality	see text
Arm damping	none

System as a whole

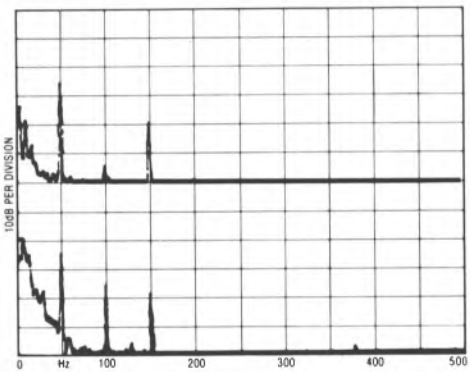
Size (w x d x h)/clearance for lid rear	43 x 38 x 10.5cm/3cm
Ease of use	very good
Typical acoustic breakthrough and resonances	average +
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	average + /fairly good
Estimated typical purchase price	£135



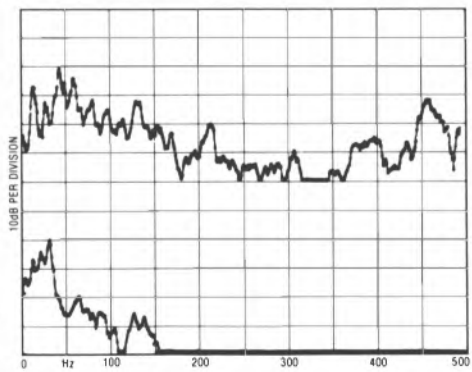
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Thorens TD166 II

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

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

The arm uses the Thorens detachable wand system offering a low effective mass in the region of 5-6g, and suited to medium to high compliance cartridges. Calibrated adjustment is provided for downforce and bias compensation while plinth mounted, shock-free cueing is built-in. Only manual operation is provided, and the plinth and hinged lid are rather resonant; in practice this is immaterial since the player components are isolated on the spring-suspended internal sub-chassis. A generous cast machined platter is fitted with a main bearing of satisfactory quality. Power is supplied by a slow-speed synchronous motor via a compliant belt. The old-style Thorens mat is used for this economy model, but it could easily be updated by a felt or other type.

Lab report

While a promising 2.5kg platter is fitted, the disc impulse response was uninspiring with considerable post impulse ringing; a good mat would help matters here considerably. Finish and engineering were generally quite good and two speeds are provided with a good mechanical changeover. Weighted wow and flutter was very good, though some mild pure wow was noted. The *166* ran 1.4% fast, which might just be noticed by a someone with absolute pitch acuity, but showing under load was negligible. Rumble was above average at – 72dB, DIN weighted, and nothing untoward was evident from the spectrum analysis. As it should, the *166* rated as good on both acoustic and vibration isolation, while hum levels were moderate, feedback resistance well above average, and shock resistance fairly good.

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

Sound quality

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

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

Conclusion

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

GENERAL DATA Integrated turntable

Motor Section

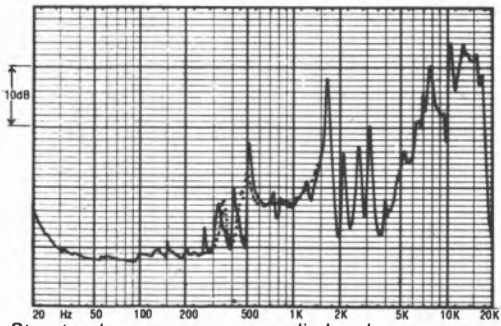
Type.....manual, belt-drive, synchronous motor, subchassis
Platter mass/damping.....2.5kg/poor
Finish and engineering.....good/good
Type of mains/connecting leads.....2-core/phonos and earth
Speed options.....33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2).....0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..0.15%/0.06%
Absolute speed error.....+1.4%
Speed drift, 1 hour/load variation.....synchronous/–0.18%
Start-up time to audible stabilisation.....3.5 secs
Rumble, DIN B wtd L/R average (see spectrum).....–72dB

Arm Section

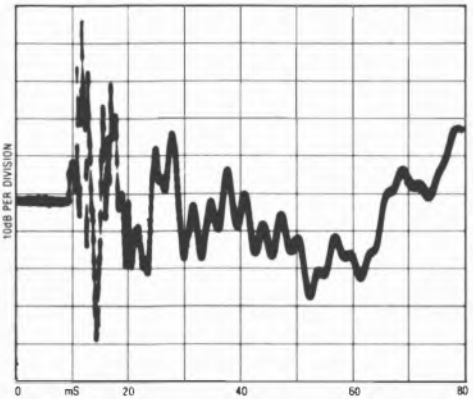
Approximate effective mass, inc screws, excl cartridge...6.0g
Type/mass of headshell.....detachable carrier
Geometric accuracy.....very good
Adjustments provided.....overhang/offset/height
Finish and engineering.....good/good
Ease of assembly/setting-up/use.....good/fair/very good
Friction, typical lateral/vertical.....less than 5mg/10mg
Bias compensation method.....pulley
Bias force, rim/centre (set to 1.5g elliptical).....150mg/150mg
Downforce calibration error, 1g/2g.....–0.2g/none
Cue drift, 8mm ascent/descent.....none, 0.8 secs/3.1 secs
Arm resonances.....*average +
Subjective sound quality.....average +
Lead capacitance/damping method
240pF/counterweight decoupling

System as a whole

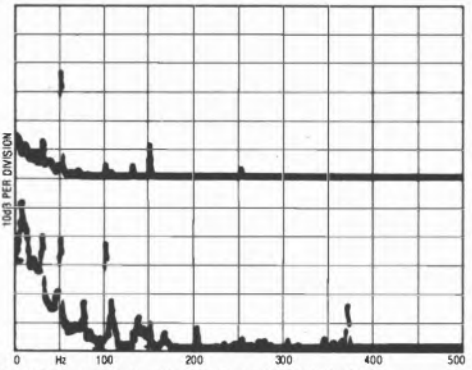
Size/clearance for lid rear.....43(w) x 35(d) x 15(h)/8.5cm
Ease of use.....very good
Typical acoustic breakthrough and resonances.....good
Subjective sound quality of complete system.....good +
Hum level/acoustic feedback.....very good/good
Vibration sensivity/shock resistance.....good +/fairly good
Estimated typical purchase price.....£115
**with fingerlift as supplied – see text*



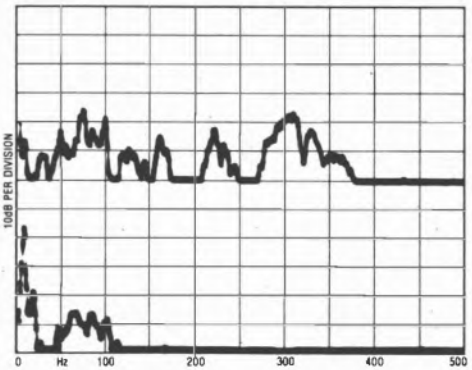
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

RECOMMENDED

Thorens TD147

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

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

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

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

Lab report

Weighing 3.5kg, the accurately-machined platter came fitted with a reasonably flat mat affording fairly good disc damping. The unit was well engineered and finished, with a substantial and well-toleranced main bearing. All readings for wow and flutter were to a good standard, the speed accuracy being satisfactory and the slowing under load of moderate proportion. Rumble was quite excellent at −80dB with the spectral analysis revealing very little spurious effects.

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

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

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

Sound quality

The sound was felt to present an improvement over the favourable level already established by the *166*, though not anything like as great an improvment as the 2:1 price increase might suggest. Characterised by a 'tuneful stability', the *147* gave good rendition of bass inform-

ation with considerable detail throughout the range. The arm could sound a trifle hard and brash at times, with fair depth but slightly vague stereo focus but the addition of a felt mat, deletion of the lift and packing the cartridge to an accurately set vertical tracking angle helped considerably, and almost took the sound into the uppermost category.

Conclusion

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

GENERAL DATA Integrated turntable

Motor Section

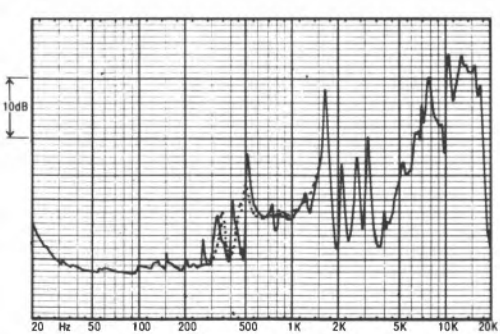
Type . . . auto-stop, belt-drive, synchronous motor, subchassis
Platter mass/damping 3.5kg/good
Finish and engineering . . . . . very good/very good
Type of mains/connecting leads
2-core, line transformer/phonos and earth
Speed options . . . . . 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2) 0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) . . 0.12%/0.05%
Absolute speed error . . . . . + 0.8%
Speed drift, 1 hour/load variation . . . . . synchronous/ – 0.25%
Start-up time to audible stabilisation . . . . . 4.3 secs
Rumble, DIN B wtd L/R average (see spectrum) . . . . . – 80dB

Arm Section

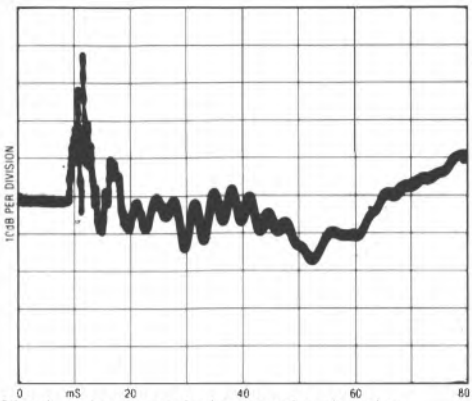
Approximate effective mass, inc screws, excl cartridge . . . 6.0g
Type/mass of headshell . . . . . detachable carrier
Geometric accuracy . . . . . very good
Adjustments provided . . . . . overhang/offset
Finish and engineering . . . . . very good/very good
Ease of assembly/setting-up/use . . . . . good/fair/very good
Friction, typical lateral/vertical 25mg/25mg
Bias compensation method . . . . . magnetic
Bias force, rim/centre (set to 1.5g elliptical) 150mg/150mg
Downforce calibration error, 1g/2g . . . . . + 0.2g/ + 0.05g
Cue drift, 8mm ascent/descent . . . negligible, 0.5 secs/0.9 secs
Arm resonances . . . . . average +
Subjective sound quality . . . . . average +
Lead capacitance/damping method 240pF/none

System as a whole

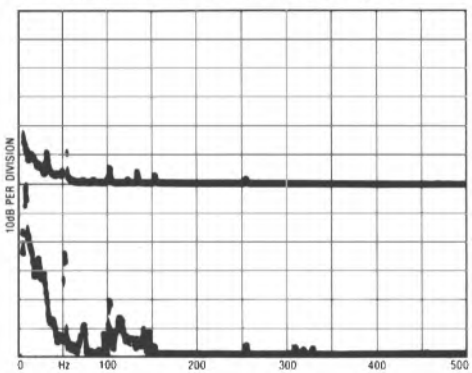
Size/clearance for lid rear . . . . . 44(w) x 36.5(d) x 17(h)/8.5cm
Ease of use . . . . . very good
Typical acoustic breakthrough and resonances . . . . . very good
Subjective sound quality of complete system . . . . . good + +
Hum level/acoustic feedback . . . . . very good/very good
Vibration sensivity/shock resistance . . . . . good + /fairly good
Estimated typical purchase price £240



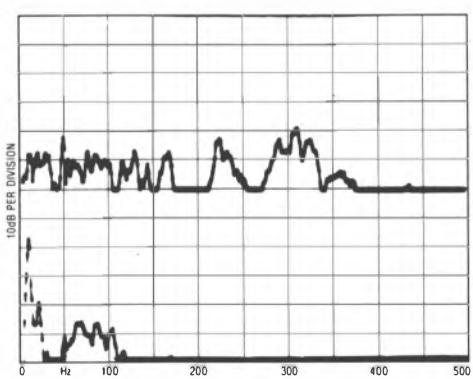
Structural arm resonances, audio band



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

Thorens TD126 Mk IV

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

Supplied over the years in various forms, and as reviewed last year had undergone several changes, not the least of which has been the official factory incorporation of an *SME III* tonearm, fitted with both manual and power cueing plus a sensor for auto lift and switch-off at end of side (for the arm data, see the separate SME review.) However not all the changes have been necessarily for the better: for example, the main bearing shaft on the version tested last year was smaller then before, measuring just 6.5mm in diameter. The servo time constants on the servo-controlled motor had been altered but the dynamic wow was still present, estimated at ±0.3%, spread over a rather long 3 seconds recovery time.

The full-size top deck plate forms the die-cast isolated chassis, mounted on coil springs, which are easily adjusted from below. The medium weight 2.6kg platter is belt driven at three adjustable speeds, with an illuminated stroboscope allowing speed reference to the main frequency. At last a mat with some degree of disc contact has been fitted, though this is of a rather hard synthetic rubber grade.

Lab results (Mk III)

The rumble results were poorer than before, though still averaging a good −73dB DIN B. However a significant 100Hz content at −65dB unweighted is shown on the spectrogram, plus certain other components. Steady state wow and flutter was excellent, but on last year's sample transient load changes resulted in poorer wow, which was also noted during start up. X10 scaling was possible for the disc impulse response, though the mat was not a star performer as the extended ringing shows. Although isolation and breakthrough were well above average, they were nonetheless not in the Walker class, for example.

Sound quality

The *126* has now emerged in a revised form, and this *MkIV* was assessed for this edition. After many years' battle, Thorens have at last conceded defeat concerning their 'overshooting' DC servo motors and have here reverted to a synthesised mains oscillator plus original synchronous motor drive. As a result dynamic wow has disappeared while the drive is once again both stable and powerful. Other improvements concern the return to the larger main bearing and the all metal platter, but the other chassis details are unaltered as are the facilities offered.

Reauditioned, the unit gave a fine wow-free performance. The bass was comparatively even and extended, while good stereo depth and ambience were apparent. Very good feedback immunity was also established.

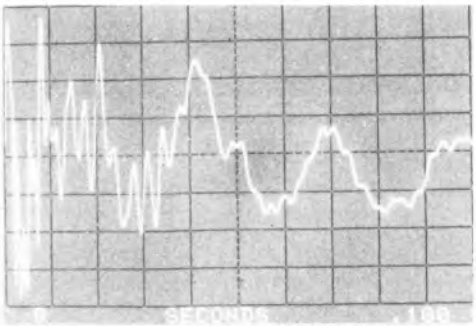
Conclusion

The *126*, reincarnated in synchronous drive

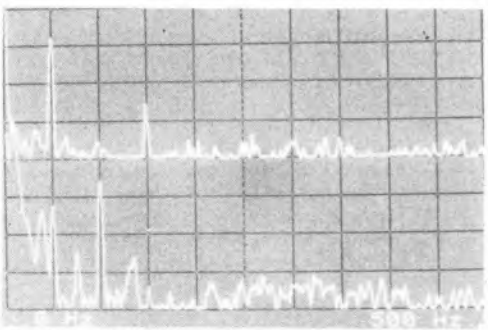
GENERAL DATA Motor Unit – integrated with SME III

Motor Section	
Type	belt drive
Platter mass/damping	2.5kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33/45/78rpm (variable)
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	<0.1%/<0.05%
Absolute speed error	+0.6% (requires adjustment)
Speed drift 1 hour/load variation	+0.25%/−0.07%
Start up time to audible stabilisation	4.5secs
Rumble: DIN B wtd L/R av (see spectrum)	−72/−74dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	5.0g
Type/mass of headshell	plug in arm tube/N/A
Geometric accuracy	excellent
Adjustments provided	overhang, tilt, arm height
Finish and engineering	excellent/very good
Ease of assembly/setting up/use	good/good/very good
Friction: typical lateral/vertical	less than 10mg/less than 10mg
Bias compensation method	suspended weight (pulley)
Bias force: rim/centre (set to 1.5g elliptical)	275mg/275mg
Downforce calibration error: 1g/2g	−0.12g/−0.18g
Cue drift/8mm ascent/descent	negligible/0.6sec/4.0secs
Arm resonances	good
Subjective sound quality	good +
Lead capacitance/damping method	optional to 300pF/variable fluid damping option
System as a whole	
Size/clearance for lid rear	50.3(w) x 38.8(d) x 17.0(h)/0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good +
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	very good/very good
Vibration sensitivity/shock resistance	good/very good
Estimated typical purchase price	£400

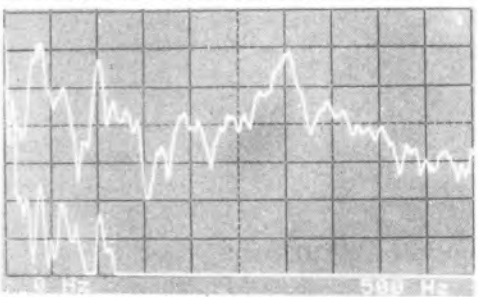
form, returns to the recommended listings as a versatile three-speed, full sub-chassis stalwart of respectably good sound quality. It is was easy to set up and align, and should give a long trouble free life.



Disc impulse transmission, magnified X10.



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

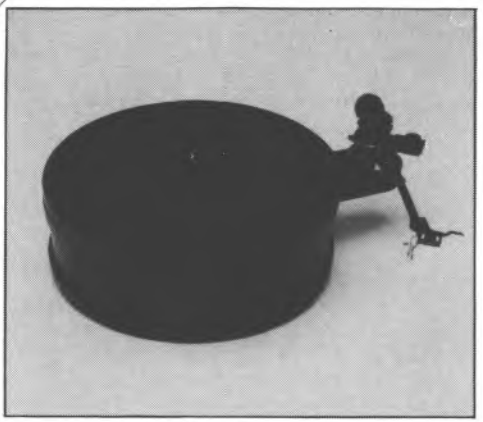


Breakthrough (0–500Hz lin): above, acoustic; below, vibration.

BEST BUY

Walker CJ61

C W & J Walker Ltd, Brentwood, Red Lane, Frodsham, Warrington WA6 6RA
Tel (0926) 33326



Possibly inspired by the drum-plinth *Systemdek*, Colin Walker has come up with a quite remarkable new turntable. If the purchaser is prepared to forego a cover, this model can offer a true floating subchassis, with a good-quality synchronous motor driving a substantial two part platter via a precision ground drive belt — all for under £90. It is likely that the factory-assembled package of a *CJ61* plus Mission *774LC* arm will retail in the region of £145, a price territory where a proper subchassis, with its attendant performance benefits, is still commonly omitted; only the B&O and NAD have it in the £100 price range.

The *61's* subchassis is of wood composition, as in the *CJ58*, and the properly-designed three-spring suspension can be easily aligned from below via the accessible bolts. Two speeds are provided, manually changed by lifting the belt, while the established Walker Tufnol platter has been retained, this a further major asset at this price level. A new thin felt mat is bonded to the platter. Finish is in satin black, practical and workmanlike.

Our pre-production sample came supplied with a rubber drive cord and gave just audible wow and flutter. During the project, it was however replaced by a full production model which was fitted with a trusty conventional belt drive.

Lab report

The first sample gave high wow and flutter results and this was queried with the designer. The other characteristics were however fine, and start-up was particularly quick. Torque was fine and rumble satisfactory, though affected by the presence of the high flutter, the spectrogram lowered by 20dB to allow recording of this trace. Note that the final sample gave rather better wow and flutter readings than those here, plus reduced rumble; clearly there are no problems on this score now.

Fine results were obtained for vibration isolation and acoustic energy was particularly well rejected. The disc impulse response was above average the initial transient being well handled with a low incidence of secondary ringing. A trace of a low frequency resonance may also be seen towards the end of the pulse recording.

Sound quality

Final auditioning on the second sample provided very good results, these in no way related to the low price! Sound quality was fully equal to that of a medium-range subchassis model and the *774* arm complemented it well.

Bass was pretty clean with surprising 'speed' and articulation. The midrange was free of hardness and yet was explicit with good resolution of detail, while the treble register remained in good tonal balance.

Stereo images were well focused, stable and exhibited good depth, while dynamics were well portrayed without undue forwardness.

Conclusion

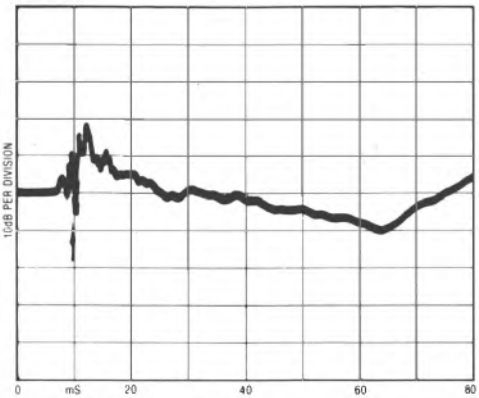
In its production form, this new Walker model has broken a price barrier for good subchassis motor units. Compatible with the Mission *774LC* tonearm, and arguably, with even better models as well, it offers a very good sound at a very modest price. Its fine value for money ensures it Best Buy status in this edition.

GENERAL DATA Motor unit

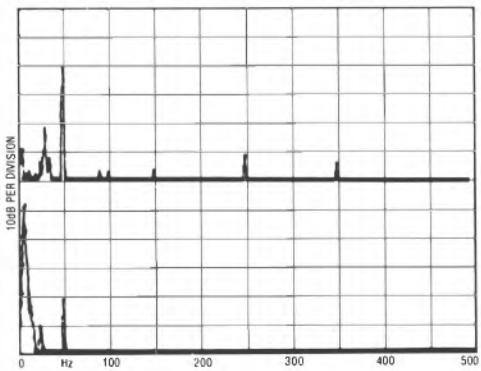
Motor Section

Type	belt drive, subchassis
Platter mass/damping	1.9kg/average +
Finish and engineering	adequate*/very good
Type of mains lead/connecting lead	2-core/ –
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.3g
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.25%/0.2%
Absolute speed error	0.25%
Speed drift, 1 hour/load variation	synchronous/ – 0.25%
Start-up time to audible stabilisation	1.5 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 74/ – 72dB
Size (w x d x h)/clearance for lid rear	41 x 31 x 14cm/none
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	fair/very good
Vibration sensitivity/shock resistance	good/fair
Estimated typical purchase price	£85

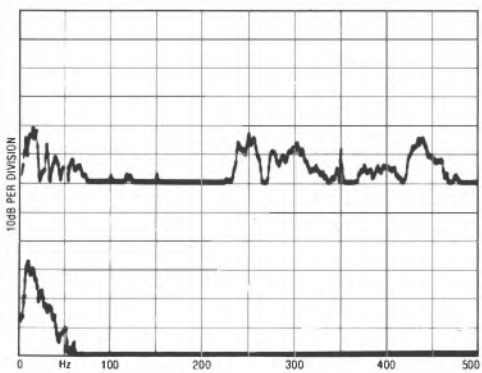
**Prototype review sample, not typical production*



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

BEST BUY

Walker CJ58

C W & J Walker Ltd, Brentwood, Red Lane, Frodsham, Warrington WA6 6RA
Tel (0926) 33326

Walker's first turntable design, the *CJ55*, did well in the last issue and indeed broke new ground by its use of predominantly natural materials such as wood, which was used even for the subchassis. It 'played safe' with a four point coil spring suspension which was effective enough. Colin Walker then devoted his attention to developing the *CJ58*, less expensive, still retaining the non-resonant Tufnol platter and associated drive system, but with notable economies in both construction and plinth finish. This time the price target was £115 or slightly lower, if possible.

The *'58* still has a fully suspended internal subchassis, now essentially formed from a single piece of wood rather than the previous fabricated platform. Three springs are used in a classic orientation, and indeed the dynamics of the new chassis are particularly good. No compromise has been made with regard to the main bearing, which remains closely toleranced and generous in depth.

Belt-driven from a synchronous motor, a two-piece platter is used, surmounted by a new very thin but high-density felt mat. The alignment nuts are easily accessible from below without need to remove the bottom cover, and current models are also fitted with a black veneer top panel, which is a great improvement over the early vinyl examples. The whole usually comes fitted with the Mission *774LC* tonearm and this package retails for around £180.

Lab report

After a short running-in period, the well toleranced main bearing provided very good results for rumble at −75dB DIN B, while spectrum analysis verified the good filtering of the motor vibration components. The spectral lines illustrated are electrical rather than mechanical breakthrough.

Wow and flutter was satisfactory at 0.15%, with some improvement after running in, and absolute speed was 0.40% slow which was slight enough. Good torque was shown by the mild slowing under load, measured at −0.25%. The start-up was quicker than average at 3.3 seconds. Speed stability was essentially that of a mains supply due to the use of a synchronous motor.

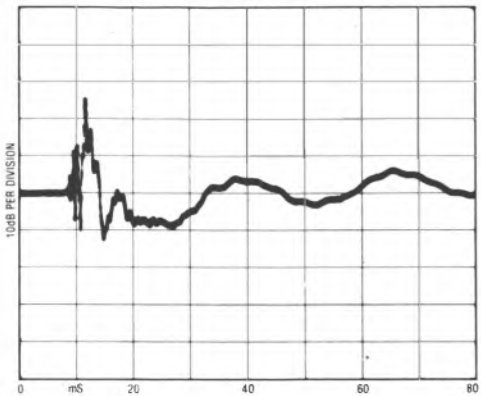
Subchassis resonances were slightly on the high side at 6, 6.9 and 7.5Hz and suggested that the cartridge compliance should be on the low side in order to provide a highish arm/cartridge resonance well clear of the subchassis frequencies.

The unit gave good results for both acoustic and vibration interference indicating a well designed suspension. Disc impulse responses were also well controlled with a fairly good leading edge response and subsequent damping.

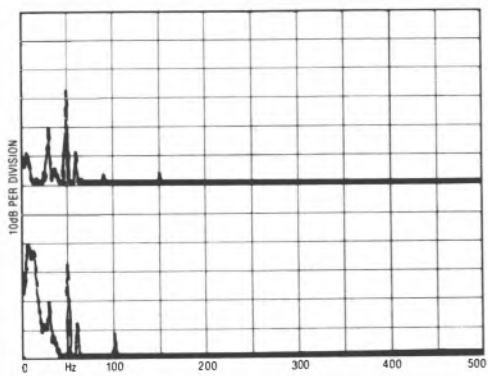
Sound quality

Auditioned using the latest bonded felt mat, the turntable sounded well balanced, with a decent bass register, the latter strong in terms of extension and articulation.

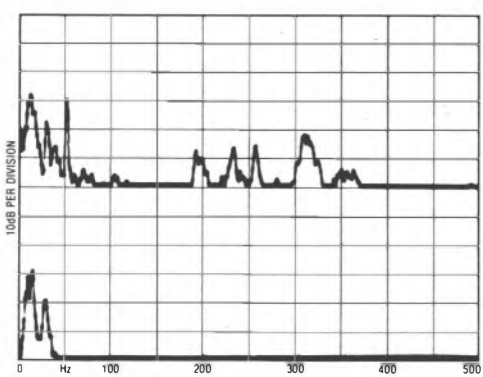
Stereo images showed better depth than usual, while the central focus was clear and



Disc impulse transmission showing damping



Rumble, electrical (above) and total (below)



Breakthrough, acoustic (above) and vibration (below)

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

stable. It was particularly good on transients and seemed to portray dynamics and subsequent silences well. It complemented the Mission arm, resulting in a well integrated and well balanced sound, and the Rega arm would be another strong contender.

Conclusion

In the space of a year and a half, Colin Walker has provided us with a superior turntable which costs 25% less than the original model. It is in fact one of the best sounding at under the £170 level, and certainly deserves a Best Buy rating.

GENERAL DATA Motor unit

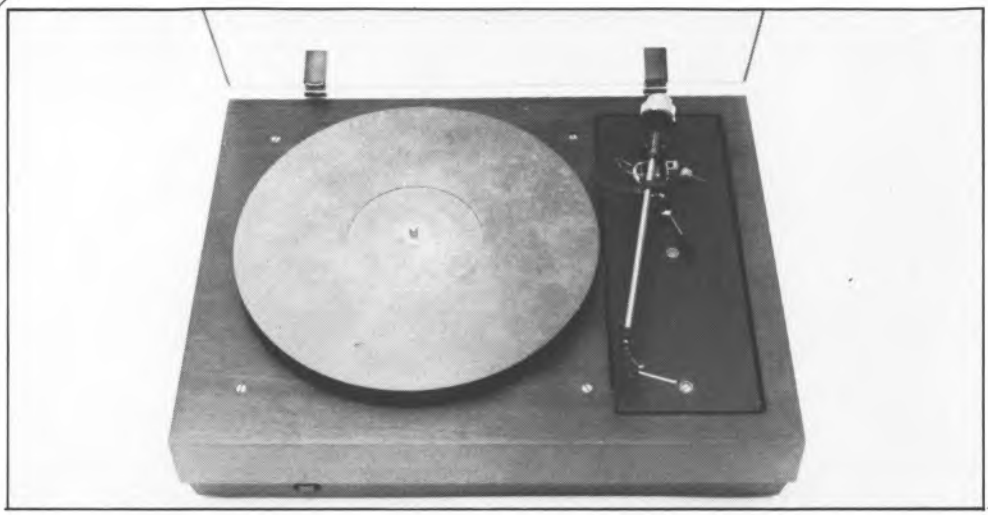
Motor Section

Type	belt drive, subchassis
Platter mass/damping	1.9kg/good +
Finish and engineering	fairly good/good +
Type of mains lead/connecting lead	2-core/ –
Speed options	manual change, 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.15%
Wow and flutter (lin peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.08%
Absolute speed error	– 0.5%
Speed drift, 1 hour/load variation	synchronous/ – 0.2%
Start-up time to audible stabilisation	3.3 secs
Rumble, DIN B wtd, L/R average (see spectrum)	– 77/ – 78dB
Size (w x d x h)/clearance for lid rear	48 x 38 x 15cm/5.5cm
Ease of use	average
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	good/very good
Vibration sensitivity/shock resistance	very good/fairly good
Estimated typical purchase price	£115
	(with Mission 774LC arm, £180)

RECOMMENDED

Walker CJ55

CW & J Walker Ltd., Brentwood, Red Lane, Frodsham, Warrington WA6 6RA.
Tel (0928) 33326



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

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

Lab results

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

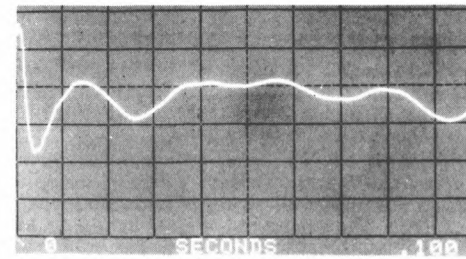
Sound quality

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

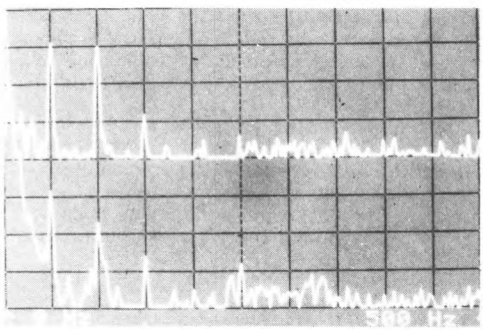
Conclusion

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

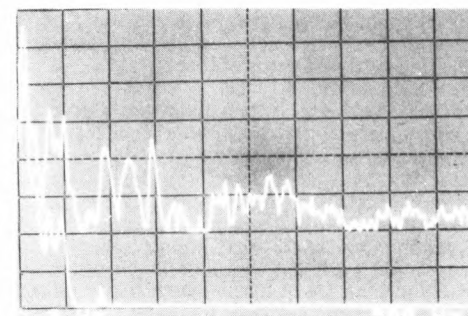
GENERAL DATA	Motor unit
Type	belt drive, subchassis
Platter damping	good
Finish and engineering	good
Type of mains/connecting leads	3-core/—
Speed options	manual change 33/45 rpm
Wow and flutter (DIN peak wtd, sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.11%/<0.05%
Absolute speed error	+ 0.2%
Speed drift, 1 hour/load variation	– 0.2%
Start-up time to audible stabilisation	4.5 secs
Rumble, DIN B wtd L/R average (see spectrum)	76/78dB
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good +
Hum level/acoustic feedback	very good/very good
Vibration sensivity/shock resistance	very good/fairly good
Estimated typical purchase price	£149



Disc impulse transmission, standard X1.



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



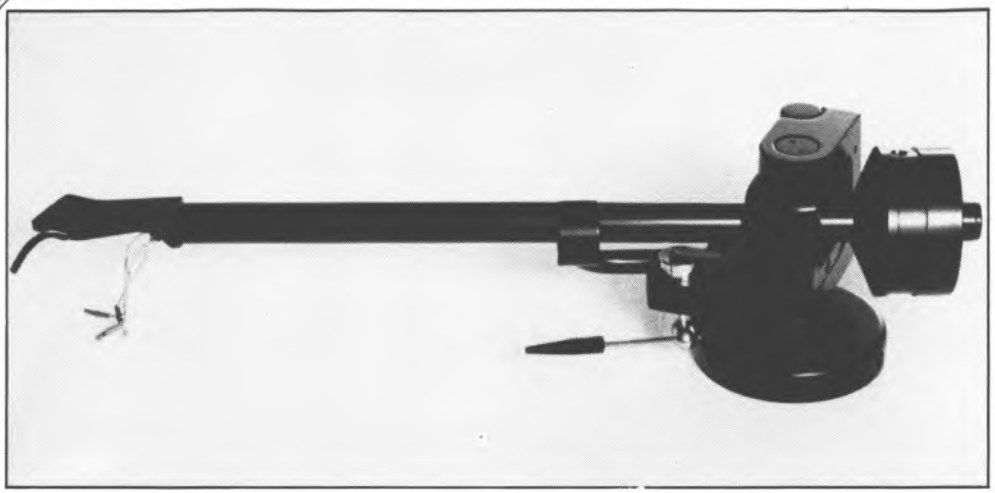
Breakthrough (0-500Hz lin); above, acoustic; below, vibration.

DEALER GUIDE

RECOMMENDED

Zeta

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



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

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

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

Geometrically, the offset is at 23.75 deg in order to bring the stylus tip into alignment with the arm beam centre line and to reduce torsional excitation. Heavily gold-plated professional connectors are used for the arm cable which has fine phono plugs at the other extremity, these also gold plated. The cable was judged to be reasonably compliant and offered a low 100pF lead capacitance.

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

Lab report

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

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

Sound quality

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

Conclusion

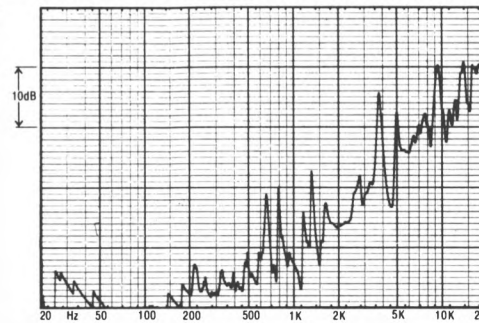
Here is another UK-built, front-rank audiophile product. Its constructional quality, finish and sound were all first rate and would satisfy the most discerning of purchasers, and while a high price must be paid for this, for many the results will justify the outlay.

Unfortunately latest samples still show some bearing quality variation.

GENERAL DATA Tonearm

Arm Section

Approximate effective mass, inc screws, excl cartridge	16.0g
Type/mass of headshell	non-detachable
Geometric accuracy	excellent
Adjustments provided	height/overhang/offset
Finish and engineering	excellent/very good
Ease of assembly/setting-up/use	good/good/good
Friction, typical lateral/vertical	25mg/25mg
Bias compensation method	internal spring
Bias force, rim/centre (set to click-stop position	200mg/200mg
Downforce calibration error, 1g/2g	uncalibrated
Cue drift, 8mm ascent/descent	slight, 0.7 secs/1.9 secs
Arm resonances	very good
Subjective sound quality	very good
Lead capacitance/damping method	100pF/none
Estimated typical purchase price	£399



Structural arm resonances, audio band

SUMMARY REVIEWS

Models covered in this section have been tested in previous issues, but space does not permit us to include the review in full reprinted form. Although some of the products here are officially discontinued, these should still be available, often at attractive prices.

ADC ALT-1
This low-cost tonearm, sourced in Japan, was at one time very popular among turntable manufacturers, and in fact the design was a forerunner of the much more highly-developed *Basik* arms, which are made to Linn specification in Japan. Of about 8.5g effective mass, it will suit most medium compliance cartridges, but does not give a good sound by modern standards. Failings included a treble 'brashness' or 'brittleness' and lack of stereo precision, not helped by slack bearing adjustment.

Aiwa LX100
This slick drawer-loading turntable was supplied complete with Ortofon *LM5* cartridge and produced a fairly well-balanced and pleasant sound quality with good feedback resistance, though this was not enough to make it good value at the original price of £150.

Ariston RD1 Superieur
Despite the retention of the *RD11* title, the *Superieur* owes relatively little to the original Ariston *RD11* designs. This well-built subchassiis turntable is belt driven from a small DC servo-motor. When reviewed in the last edition, the *Superieur* gained 'good' rating for sound quality, but there were subjective reservations including a hint of pitch instability, with a slightly 'distant' sound character. Easy to set up, the *Superieur* was thought worth considering.

B&O 1700
Predecessor of the *1800* and *RX1*, this model achieved a recommendation last time round.

B&O 8002
This model gained a recommendation in the last issue, combining elegance with good sound quality, admittedly at a fairly high price. The belt-drive *6002* is fundamentally similar.

Dunlop Systemdek II
This first 'drum' turntable from Dunlop is now effectively replaced by the conventional-plinth *Systemdek IIX*, while the *IIS* represents a high performance version, retaining the original style of construction. Both are reviewed fully in this issue.

Dunlop Systemdek III
This classic subchassis turntable is characterised by its composite steel and wood plinth, finished in tough Nextel paint. Despite the III designation, it is in fact a refined version of the original *Systemdek* design and not related directly to the *II* models. When reviewed, it was felt to be a fine turntable and still competitively priced; nonetheless, it has now been somewhat overshadowed by more recent Dunlop introductions. Easy to set up, the well-finished *III* is largely uncritical of arm choice.

Dynavector DV501
Developed from the even more elaborate *505*, this unusual arm pivots laterally at the conventional place, but the front section of its beam carries a smaller secondary arm pivoting in the vertical direction. This means that effective mass is 50g in the lateral plane, and 20g in the vertical. The secondary 'front' arm carries the IEC/SME-type headshell, which itself weighs 15g. The arm's complicated non-rigid structure was reflected in poor resonant behaviour and sound quality was disappointing; and at 1kg it is still too heavy for satisfactory fitting to many subchassis designs.

Decca International
With moderate 12g effective mass, this unipivot design gives a rather 'rich' tonal balance, with some bass muddling and mid-forwardness; it could be a good match for Decca's individual-sounding cartridges, but constructional quality is not good by modern standards. Out of production, but still available from some outlets.

Fidelity Research FR64S and FR64S
These beautifully-made tonearms are both capable of extremely good results, and are probably best suited to the high-mass type of turntable such as the big Luxman. The *FR64S* has an effective mass of 35g, suiting cartridges of not more than 10cu, while the *FX*, at 20g, is more widely compatible. On test the *FX* sounded a little more secure in terms of focus and image stability, while on audition the *S*

was found a little 'cleaner' and with greater bass 'weight'.

Hadcock GH220SS
Just missing a recommendation when tested a couple of issues ago, the stainless-steel *220SS* arm scored above average in listening tests, and demonstrated better image stability and focus than the Hadcock unipivot *228* design.

Infinity Black Widow
Exceptionally low mass, gained at the expense of structural rigidity, made this arm suitable for very high-compliance cartridges. Generally good engineering quality in other respects ensured above average sound quality, though the price made it uncompetitive.

Mayware III
Whie this earlier version of the Mayware arm received a recommendation when tested a couple of issues ago, the importer has subsequently declined to submit current samples for review, and we are unable to confirm that the arm still holds its own against improved competition.

Michell Marble Electronic
This massive and impressive-looking design needed careful siting for optimum results, and even then did not shake off a 'softness' and lack of definition in the bass register.

Mission 774
A classic low-mass tonearm, the original Mission tonearm has shown an ability to provide a consistently good standard of reproduction with a wide range of motor units. Although the 5.5g effective mass allows use with high-compliance cartridges, the high rigidity of the arm makes it moving-coil compatible too. Unfortunately, the latest sample we tried had an unsatisfactory counterweight, and the fine sonic standard of earlier production models was not maintained.

Sansui SR222 Mk IV
This model was intended as an updated version of the simple but effective *SR222 Mk II*, which at one time was an extremely big seller in the budget turntable market. However, the *IV* sounded somewhat muddled, with some 'graininess' in the treble, and boom in the bass, making it less than good value at £90. Incidentally, there never was an 'SR222 Mk III'.

Sansui XRQ7
This substantial-looking direct-drive player contains a secondary rotor beneath the main one, rotating in the opposite direction to cancel unwanted vibration components. Despite this 'silent synchromotor', rumble readings could have been better. Acoustic breakthrough was disappointing, while the arm was of mediocre quality and rather heavy.

SME 3009 II Improved
The classic low-mass SME arm design still rated as 'worth considering' when last tested two editions ago, particularly in 'non-detachable' form. The *Improved* designation refers to a reduction in mass applied to the design in the early '70s, the higher-mass *3009R* (see full review) being virtually a return to a pre-*Improved* version! Nonetheless, the *Improved* remains a well-built and finished product which may be available at an attractive price. Sound quality was characterised as somewhat brash and lacking in bass definition.

Stax UA7
These beautifully finished arms are available with either aluminium or carbon fibre tubes, though there was little to choose between these options, both having a highish 16g effective mass. Rigidity limitations at the unipivot and double universal connections limit the model's competitiveness at its highish price.

Technics SL7
Like the innovative *SL10*, the *SL7* was a substantially-built 'jacket-size' linear-tracker, combining convenience with quite good sound. Comparison with recent models showed that its £220 price is harder to justify now in sound quality terms, but the *SL7* nonetheless remains one of the worthier products in this category, and superior to more lightly-constructed types, including Technics' own.

Thorens TD160BC and TD160S
Long established as the standard Thorens motor unit, the *160BC* was also made available, with many detail refinements, as the *160S*. Both models have been recommended in the past and although now overshadowed by others if viewed in strict value terms, do nonetheless offer substantial engineering quality for the money.

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CONCLUSIONS

This past year has been a period more of consolidation than of innovation in the turntable and tonearm field. While some significant new products have emerged, many existing models have undergone further refinement. These merited careful reassessment.

A few outstanding new entries have emerged in this edition, these largely the work of British companies, with products such as the Walker *58* and *61* motor units, the Dunlop Systemdek *IIX* motor and the Rega *RB300* arm.

This time, Japanese effort, so far as quality analogue systems were concerned, was conspicious by its absence. Companies like Audio Technica had scaled down their product range and had no new entries; Fidelity Research have apparently fallen by the wayside, and the Japanese majors have all but withdrawn from the quality end of the market. For example, Technics, market leader in integrated turntables, only submitted two models (usually more than five are offered) of which only one proved worthy, by *HFC* performance standards, of a full test.

Despite the present unprofitability of CD player production, it is here that Japanese companies have chosen to concentrate most effort. The big brand names are reflected in the players reviewed, though the machines are still pretty expensive. It has been estimated that the average (in terms of market sales) hi-fi turntable costs £150 inclusive of cartridge, while the average CD player price is around the £400 mark. CD is thus some distance from the mass market as yet, and the big producers seem happy to neglect the sub-£300 turntable market for the time being — that is, neglect it in terms of quality, for there are still many 'average' products around. Analysis of sales appears to show that most money is being spent on racked or stacked systems where the turntable forms a small and ill-considered part — very few are up to *HFC* requirements.

Of the few turntables submitted by the major companies, most were acoustically weak, with flashy features such as parallel tracking arms or quartz drive motors. The former if taken as a group showed no advantage over the conventional radial pivoted tonearm types, and if anything, were usually inferior.

It is also clear that hi-fi sales are still under great economic pressure and that this has greatly distorted the turntable market. Sales of the best of the £400 'classic' motor units remain fairly healthy, but the less expensive models appear to be faring less well, until lower price categories are reached — say £280 or under, inclusive of tonearm. The same pattern may be perceived in the case of speakers where the bulk of sales are in the range above £400 or below £150 a pair; and indeed with amplifiers, where the £100-£200 category dominates, with a sprinkling of much more expensive models at £700 plus.

A major difficulty with the more exotic analogue components is the need to provide assessments of components as independent entities; this task is severely complicated by the need to evaluate particular audio components in conjunction with others. It is not always easy to separate the sound of one component from another, and it is therefore helpful when a component such as a tonearm appears on a number of motor units. Then it becomes simpler to separate the tonearm contribution from that of its mounting. When in doubt, components must be swapped about to bring out matching problems and while we can ofer some examples, our experience must not be taken as the final word on matching possibilities — good dealers can offer sound advice here.

From our tests, the Mission *774LC* arm emerged as a competent all rounder; it appeared to be quite uncritical of the turntables it was fitted to, and made the best of most of them. As it costs around £70 it was thought broadly compatible with motor units from £85 to £225.

We continued to get good results from the existing Linn *LVX*, which we understand is soon to be supplemented by a new dedicated moving-coil model. Good examples of the Syrinx *LE1* arm were impressive and would suit quite expensive turntables in the £200-£400 region, while the Rega *RB300* was in a class of its own. If treated as an economy tonearm it will suit a wide number of decks, but if taken more seriously, we felt that it was perfectly capable of doing real justice to some of the best players made. For example, while it was impressive on the Linn ultimately we felt the bass sound of the combination did not quite gell, and with the Rega arm, we preferred other motor units on sound or value grounds. The Heybrook and AR are obvious choices for the Rega as regards value for money, while the Pink Triangle, Lux *PD300* and Oracle are possibilities.

CONCLUSIONS

Synrinx's *PU3* Ipsissima arm proved a promising if costly introduction and proved capable of good results with some motor units, notably the Linn. Although our sample happened to be supplied on a Pink Triangle, in fact this combination did not sound too good — an interaction with the Triangle's metal arm mounting plate was suspect here. Perhaps solid wood might prove the answer?

While mechanically difficult to install and set up, the Helius *Orion* continued to give a high standard of sound quality in a range of players, from the Linn to the Pink Triangle, and indeed, even in the exotic Audio Labor from Germany, which we were able to try out but not to test fully.

The Linn *Ittok* continued to score highly when used on the *LP12*, and while this arm can be readily fitted to a number of other players, it is hard to clearly identify one which provides such good mounting pillar termination as well as a performance closely compatible in other respects. Surprisingly perhaps, another player in which the *Ittok* sounded 'tidy' and well balanced was the Elite *Rock*.

System combinations

As regards systems, the Linn *LP12/Ittok/Asak* in our opinion continues to offer an enviable overall performance. As such the £900 asking price for the combination is comparatively reasonable, for it is possible to assemble systems of well-regarded alternative components but costing as much as £2000 but which will offer only a very small if indeed any improvement over the Linn combination.

In the turntable submitted for this issue Pink Triangle have finally overcome our last minor objection concerning torque and pitch stability, and accordingly we feel that the Triangle most certainly can be regarded as a solid £400 worth. It offers a neutral disc support and easy two speed switching. Suitable arms which come to mind are Rega, Alphason, Zeta and Orion.

This year we have reviewed the much-hailed Sota turntable from the States — one which promised to take on all comers. It was clearly a strong performer, indeed highly competitive on its home market, but here in the UK the strength of home-grown opposition, as well as its upmarket price told against it. The verdict was that it was a worthy turntable, if a little overpriced, but was not the all conquering hero that the US reviews might lead us to believe.

A quiet 'sleeper' came from Canada — the new Oracle *Alexandria*. It showed no particular strength in any one department which possibly explains our approval, since it also showed no significant weaknesses. It came ready assembled with a matching tonearm, and was excellently packed and finished. The *Alexandria* required no alignment, and gave us a well balanced performance. Our liking for this product increased as the review programme proceeded.

The AR turntable eventually sailed through all the tests and scored high ratings — this after a shaky start due to the poor tolerance of its main bearing on our early samples. AR's return to the turntable market is warmly appreciated, as long as future production maintains good tolerancing on the main bearing. (*We are assured by AR that it will — Ed.*)

Nakamichi put in a surprising appearance with their automatic record-centring *Dragon CT*. Leaving aside considerations of the value of the record wow correcting feature (the importance of this must vary from purchaser to purchaser), it did prove to be well designed in most other respects, such as acoustic and vibration isolation, and will prove capable of satisfying critical users, albeit at a price.

Thorens are accorded a rather low key view in this issue, entirely because they intend to present a new range of turntables later on this year, using a spring suspension and a new subchassis machined from a wood composition material.

Design factors

In practice the most important factor appears to be the design of the plinth or chassis, and not, as one might expect, the type of motor drive or arm. While high performance versions of the latter components are the subject of much research and costly fine tolerance manufacture, aspects of the plinth/chassis design are relatively simple and inexpensive to execute, moreover, the successful elements have been known for years. It thus remains a continued mystery why so few manufacturers have paid any attention to chassis design.

Importance of isolation

Analysis of the recommended models shows that no fewer than twenty contain some elements of an effective spring isolation system in their plinth or chassis. In its simplest form, the key to an accurate subjective performance

(assuming of course that both the arm and motor are sufficiently good) can be taken as a minimum of three steel coil springs. All that is required is for the parts associated with the record, namely the platter, arm, and connecting chassis, to be spring suspended at some suitable infrasonic low frequency, thus isolating the record from all the resonances and colorations present in the room, as well as in the lid, the plinth proper and not least of all, in the shelf on which the deck is mounted.

Influence of technology

While 'high technology' designs can achieve a good subjective performance, unless an effective isolation system is incorporated, the top grade subjective ranking cannot be attained, as once the obvious problems of wow and flutter, rumble and rigidity have been solved, those that remain relate to acoustic feedback margins and shelf-borne vibration coupling. No quantity of carbon fibre, quartz oscillators, stroboscopes, automatic mechanisms, synthesisers and the like can subjectively make up for inferior isolation.

Performance balance

The typical turntable represents a complex balance of many subjectively important factors. On the motor side, if wow and flutter is severe this may be a problem, particularly the insidious dynamic or programme wow, which can occur with both direct drive and belt drive decks when subjected to the differential drag caused by recorded modulation variations. Aurally excessive wow is interpreted as an uncertainty of pitch and a subtle unstable 'floating' effect, but it is of course acknowledged that many discs themselves have permanent wow, due to a displaced centre hole, mild warps or even wow in the original record cutting lathe. For example, it has been shown that many of the studio disc lathes in use suffer from significant programme or dynamic wow, and the interested reader may hae noticed that some direct cut and 'super cut' records boast the use of cutting lathes fitted with low wow motors from such manufacturers as JVC and Technics. Poor flutter is less obvious subjectively, tending to produce a coarsening of the tonal quality together with a masking of detail, and can in fact be mistaken for other effects.

Rumble can appear in many forms, constituting as it does the unwanted noise, generally of mechanical origin, that is produced by the turntable. Hum from poorly mounted mains transformers is a common source, though the serious grinding and bumping noise from a poor platter main bearing are rarely encountered with modern designs. Motor vibration is more common: for example, as a result of out of balance rotation forces in belt drive systems, and in direct drives from the power pulses as the magnetic poles are energised during rotation. If severe, periodic rumble can be heard as a hum or drone on quiet recorded passages, while conversely pole switching rumble is often subjectively free of a recognisable tone, and can be detected as a mild clouding of detail in the programme. A number of direct drive motors did not produce particularly clean rumble spectra, but equally important, many belt drives exhibited motor vibration breakthrough. However, both systems are potentially capable of excellent results, as the figures for the recommended models amply illustrate.

Platters and mats

Platter mass is important in terms of the ability to soak up unwanted vibration in the motor and disc (the latter containing acoustic breakthrough plus stylus reaction induced resonances) as well as for adequate inertia to flywheel momentarily through load changes. Some turntables have very light platters — under 0.8kg including the mat — and are clearly more susceptible to resonances than the average 1.5kg platter would be. In general improvements were subjectively apparent with higher masses up to 4 and 5kg, as found on the top class subchassis designs. The mat was also important and ideally should offer a hard flat surface for record support. Many are either too soft, frail or poorly designed for adequate record contact, though it should be stressed that unless the existing mat is particularly poor, with the 'typical' turntable it will exert only a small influence on the final sound quality. However, when one is dealing with the finest systems where motor and tonearm colorations are acceptably low, the coloration from a poorly supported disc can audibly contribute to some 30-40% of the total player coloration, and materially affect frequency balance, stereo image depth, and transient quality, particularly at low frequencies.

Despite its (relatively mild) absorption of leading transients the felt mat is proving to be

increasingly popular. In its favour is its ability to 'liven up' a turntable while at the same time providing sufficient control for a good overall result. It still suits the Linn *LP12* well, and in a recently-tried thinner and stiffer form, a number of other players also benefitted from it, including Mission and Walker models.

Sound Tables

We did try some experiments with a turntable accessory, namely a stand called the Sound Table. It would be inappropriate to make too much of the effects, but it was clear that with some turntables that had less than perfect vibration isolation, the Sound Table provided some interesting benefits. A small additional improvement, varying from deck to deck, resulted from the use of the *Prop*, a high-stiffness board produced by Pink Triangle as a substitute for the usual Sound Table top. This had more effect on other designs actually than on Pink Triangle's own well-isolated model! I would suggest that these items would be best offered by dealers on a sale-or-return basis.

Tonearm factors

The tonearm remains a critical component in the composition of an analogue disc player. The basic factors of structural resonance, effective mass and mechanical integrity are crucial — but others are perhaps less well explored or exploited. For example, in past issues we have described the Audio Technica 'DTs' system, where the tonearm geometry was developed to maximise the tracking performance.

At first sight one would not expect a well-adjusted tonearm to have much effect on tracking, but in some cases it does. With the more mechanically lively moving coil cartridges such as the Asak, Koetsu and EMT, the choice of tonearm can affect the tracking. This may be judged from such blatant failures as stylus clicking on peak musical transients at the chosen or recommended downforce, or alternatively a feeling of 'insecurity' which develops during the auditioning. The cartridge may appear to sound less 'decisive' in one arm as compared with another even though the arm tonal characteristics may be quite similar. As Roy Gandy of Rega put it to me recently, the dynamic behaviour of tonearms is little understood. In his *RB300* design, Roy has gone to great pains to minimise the unwanted interaction of the counterweight on its section of arm stem, preferring the behaviour to be dominated by the constant nature of the main arm beam, and to this end, the counterweight is as small and as concentrated as possible. In principle this helps it to merge with the pivot structure rather than act as a separate seismic mass. The sound quality of the tonearm may vary with cartridge mass due to the change in resonance resulting from moving the counterweight to achieve balance; in theory at least, only one cartridge mass will be optimum for a given tonearm, and will usually result in a counterweight position as close as possible to the pivots.

Details such as this and the specific relationship between stylus tip and the position of the vertical bearing do all affect sound quality and tracking, being some of the more subtle aspects of tonearm operation.

Audio band resonances

The resonance data in the audio band continued to show the weakness of the detachable headshell designs, with the exception of a few carefully executed types with a splined collet type fixing. Mismatch and flexture at the socket/plug join produced serious resonance problems quite low in the band — generally around 200Hz. Counterweights are often decoupled on a guesswork basis, and the conventional rubber bush types are frequently betrayed by a fairly severe resonance in the 30-90Hz region, with consequences as regards bass coloration. A decoupled counterweight can be successfully taken out of the picture by effective absorption (*eg* Mission *774*), but if rigidly coupled can induce upper range resonances above 100Hz (*eg* Syrinx *PU2*, SME *3009 III*), with some attendant effect on the lower midband coloration. Some models also show a neglect of torsional strength in the main beam, this arguably the most important mode. This results in audio resonances at frequencies octaves below that where they might be expected from a simple inspection of the rigidity against bending.

The mean energy level on the published arm resonance graph indicates the consistency of the reflected mass at the cartridge over the frequency range. Two distinct classes of breakup can be identified: the preferred behaviour is the one where the energy trend is more or less undisturbed in level or shape by the inevitable resonance modes, implying no great discontinuities in effective mass (*eg*

Alphason *HR100*), less desirable behaviour produces severe jumps in the energy trend, implying that the effective mass is discontinuous with frequency.

While the dominant structural resonances tend to occupy the range below 3kHz, the arms are by no means dead at higher frequencies, and show dramatic differences in resonant behaviour. Taking into account the rising trend, some reveal that the cartridge can produce a more or less uniform energy output over the final octaves above 5kHz (*eg* the Mission *774*), while others clearly show a different and less uniform trend as regards both balance and resonance distribution (*eg* Dual *505* series and Michell *Focus*).

Lead capacitance

While of negligible importance where moving-coil models are concerned, lead capacitance is vital with many moving magnet models. Taking as an example of nominal amplifier input capacitance of 50pF, by adding the range of recorded lead capacitances, variations from 125 to 350pF result. The maximum value is too much for some cartridge models, resulting in a drop of several dB in the upper treble, with other cartridges the minimum value is insufficient to produce a flat response (*eg* some Ortofon and a number of Shure models). Ironically the overall sound quality of such cartridges can be more affected by electrical capacitance matching than by anything else, though fortunately it can be fairly easy to overcome, either by simply adding capacitor 'plugs' or variable matching units at the amplifier input, or (rather more difficult) where a reduction is required by shortening or replacing the audio cable.

Lateral geometry

The lateral geometry of tonearms is still a problematic area, with most models lacking sensible instruction for cartridge fixing, and the manufacturers generally not supplying any form of protractor. Several accessories for correct alignment are available: for example, readers should try the excellent alignment protractor made by Elite Electronics or use our own two point gauge (see *Technical Introduction*). Models with supplied cartridges all too frequently arrived poorly set up. A 3mm overhang error or equivalent 3° lateral misalignment can increase groove distortion at the inner radii from an ideal maximum of 0.6% to almost 2%, as well as degrading stereo separation.

Vertical geometry

On balance, the vertical geometry is less critical, though it is still preferable to align the cartridge back parallel with the disc. Comparatively few arms provide a variable height facility to achieve this. Even fewer allow for 'tilt' which aligns the cartridge when viewed from the front so as to be truly vertical relative to the disc surface. Those enthusiasts with access to test records will know that fully calibrated geometric adjustment with a given cartridge can improve distortion and separation by up to 20%, and it might be worth dealers providing such a service.

Effective mass

While the majority of arms are of quite high effective mass — typically 15-20g with a few up to 35g — a welcome number of medium and low mass models are appearing, and several are included in this issue. At the high end of the medium mass rangeis the *Ittok*, which is compatible with 5-10g weight cartridges in the 10-20cu range. Very low mass arms, several of which have been appearing on integrated players such as those from Marantz and Rotel, are happy with low mass cartridges with compliances of up 40cu. However, the average 15-20g mass of most arms restricts the allowable compliance range to preferably 6-12cu. Mass/ compliance matching is particularly relevant with the suspended subchassis motor units, where the suspended resonance is quite lively, and typically in the 3-7Hz range. The arm/ cartridge resonance should be sensibly higher than this, and hence low mass arms are often fitted, unless a good low compliance cartridge is available.

Isolation problems

With the exception of one or two mechanically inert models, and of course the suspended subchassis types, many decks in this issue failed to block effectively external acoustic and vibrational energy. The tinted covers fitted are generally moulded in polystyrene or related plastics, noted for their highly resonant properties, and while most decks show different feedback resistances depending on whether the lid is up or down, nearly all gave a significantly better feedback margin with the lid removed entirely!

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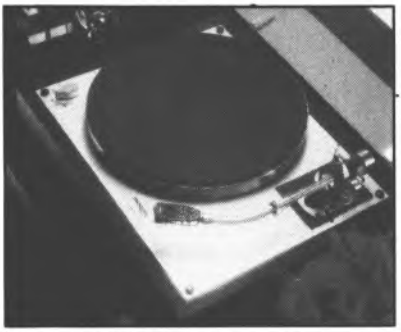

TD160S

Clearly the top turntable group on our test.
Martin Colloms HI FI CHOICE

TD160BC

Very good value is offered and a strong recommendation holds.
Martin Colloms HI FI CHOICE

TD147

The sound was felt to present an improvement over the favourable level already established by the TD 166
Martin Colloms HI FI CHOICE
Performance such as to qualify this model for Hi Fi systems of refinement.
Clem Brown HI FI FOR PLEASURE

TD 166

Used as supplied the sound quality was rather special for the price.
The TD 166 is unhesitatingly recommended.
Martin Colloms HI FI CHOICE

Turntables & Tonearms.

CAMBRASOUND LIMITED
(Sole UK Distributor) Britannia Road, Waltham Cross, Herts EN8 7EF
Tel: Waltham Cross 716666

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BEST BUYS AND RECOMMENDATIONS

Here we have attempted to summarise the strong points of those models we have selected as 'Best Buy', 'Recommended' and 'Worth Considering', though it should be noted that these are only summaries, and for the full picture, readers should refer back to the reviews themselves.

In previous *Turntables* editions we have not awarded 'Best Buy' ratings to turntables and tonearms. This was largely because the best products fell somewhat short of the ideal while being very expensive, and the best of the cheaper models showed sufficient shortcomings to mute our enthusiasm.

With this edition, though, a few outstanding examples have emerged, offering such good value that a 'Best Buy' category can be applied with confidence; but this is only appropriate to relatively inexpensive items.

In the 'Recommended' category are those products which we consider to offer a combination of generally good value plus fine performance — as price increases, so does the importance of absolute performance, while 'value' becomes a less relevant consideration.

Other products may still be above average in performance but are considered less strong on value for money — these we have listed as 'Worth Considering', and in some cases they may offer special features not found elsewhere.

These listings are of course *only* a guide — in any given individual situation, the choice of overall system and the mix of specific components may prove of greater significance than the rating of any individual component. Price is a major consideration when making the judgements summarised here, so the comments and indeed the ratings may need re-interpretation in the light of price fluctuations, be they up or down, or in view of the prevailing conditions in markets other than the UK.

INTEGRATED TURNTABLES: BEST BUYS

Acoustic Research with arm (£220)
This player gave a very good performance for the price though we still had slight doubts concerning main bearing quality.

Dual 505 (£95)
This well-balanced player includes a competent cartridge and offered a good all-round performance free of the need for fussy setting up. Very good value.

Logic Tempo Synchronous/Datum arm (£190)
An unusual manual player, the sound quality was pleasing while the technical performance was to a high standard.

Walker CJ58/Mission 774LC arm (£190)
This combination provided very good.sound for the money, with no omission of essential qualities.

Walker CJ61/Mission 774LC arm (£155)
Another factory-fitted Walker combination, this one was even better value but lacked a dust cover. A remarkable price for a genuine subchassis model.

INTEGRATED TURNTABLES: RECOMMENDED

Bang & Olufsen 1800/RX1 (£115)
This player has continued to uphold B&O's good reputation in this inexpensive sector of the market. An attractive all-rounder, it also includes a decent cartridge.

Linn Sondek LP12/LVX (£480)
With this good but modestly-priced tonearm (currently under improvement) the *LP12* makes a good combination at under £500.

Linn Sondek LP12/Ittok (£680)
This is the classic top-line Linn combination, which is deservedly popular.

Logic Tempo Electronic/Datum arm (£225)
This combination produced a fine overall performance with particularly good arm and player matching in the mid treble range.

Michell Focus/Mission 774LC (£248)
Factory-fitted with the *774LC,* this uit has an excellent finish coupled with a generally good performance, which has been further improved this year.

Mission Cambridge 775LCT (£165)
The 'front end' of the Mission £500 disc-playing system did well in our tests and represents good value. No setting up is required for this simple but effective design.

NAD 5120 (£99)
Recently improved by a better arm, a reduction in price as well as the inclusion of an approved Ortofon cartridge, the NAD comfortably qualifies for recommendation.

Oracle Alexandria (£800)
An upmarket player which was easy to set up and use, the *Alexandria* is also well engineered and finished, with a performance to match.

Rega Planar 3/RB300 (£188)
The *Planar 3* has been retained in the recommended listings due to its upgrading resulting from the inclusion of the excellent

BEST BUYS AND RECOMMENDATIONS

RB300 tonearm. Some critical listeners may defect a trace of wow.

Rotel RP850 (£140)
This substantially-built conventional player has an above-average arm, and offers good value for money.

Technics SLQX200 (£130)
A rare survivor from the Japanese contingent, this Technics passed the tests, demonstrating excellent motor and arm performance, as well as an above-average sonic performance. A basic-quality cartridge is included.

Thorens TD166 II (£149)
This turntable provided a remarkably good performance for the price and is therefore confidently recommended.

Thorens TD147 (£288)
With the use of a well-suspended subchassis this upmarket Thorens turntable has a fully-installed low-mass tonearm with plinth control cueing and auto-stop facilities. The sound quality was fine for the price. As we go to press, a completely new Thorens range is promised, but as yet unseen.

INTEGRATED TURNTABLES: WORTH CONSIDERING

Integrated players which were rated as worth considering includeed the **Dual CS514** (£70); **JVC LL1** (£125); **Lux PD370** (£260); **Nakamichi Dragon CT** (£900); **Rotel RP830** (£95); **Sansui SR222 Mk IV** (£90); and **Technics SL7** (£220).

MOTOR UNITS: BEST BUYS

Acoustic Research (£160)
Assuming a good bearing this is a very fine motor unit.

Dunlop Systemdek IIX (£115)
A well finished subchassis motor of fine performance.

Logic Tempo Synchronous (£120)
An unusual belt-drive player of good tonearm matching ability.

Walker CJ58 (£115)
A fully equipped subchassis player of 'musical' sound.

Walker CJ61 (£85)
A 'bare bones' player which nonetheless offers a full subchassis performance.

MOTOR UNITS: RECOMMENDED

Ariston RD80 (£180)
Reassessed for this issue, the *RD80* remains in our view Ariston's leading product.

Dunlop Systemdek IIS (£225)
Heavily upgraded, this new version of the *II* gaven an outstanding performance for the price and is firmly recommended.

Elite Rock II (£280)
An unusual design with an effective arm damper incorporated, which worked well. Note that the lid is supplied as an extra.

Heybrook TT2 (£225)
A well-finished classic of fine performance and offering good engineering value.

Linn Sondek LP12 (£408)
Offering continuing refinement, the Sondek still dominates the field.

Logic Tempo Electronic (£160)
Another British design with fine sound quality, having a high-performance electronic drive.

Lux PD300 (£395)
Revised for this issue, this excellently engineered turntable offers a vacuum platter plus a fair chassis and is still the Japanese 'reference'.

Michell Gyrodec (£595)
This visually-engineered turntable has been

improved; it now provides good speed characteristics and is thus recommended.

Pink Triangle (£398)
With better torque, the *Triangle* now comfortably attains full recommendation.

Revolver (£103)
This attractive motor unit, usually supplied with *LVX* arm, offers good value.

Walker CJ55 (£149)
Overshadowed by the *'61* and the *'58*, the earlier *'55* continues to offer good value.

Thorens TD160 Super (£160); **TD160BC** (£110)
Both these Thorens motor units offer excellent value, the *Super* providing lower coloration.

MOTOR UNITS:
WORTH CONSIDERING
These include: **Ariston Superieur** (£380); **Dais** (£399) and **Dais 'Heavy'** (£480); **Lux PD310** (£560); **Oracle Delphi** (£897); **Sota Sapphire** (£600); and **STD 305M** and **305S** at £130 and £169, if available.

TONEARMS:
BEST BUYS

Rega RB300 (£90)
This inexpensive arm is superbly engineered and finished and offers a very good all round performance.

TONEARMS:
RECOMMENDED

Alphason HR100S (£295)
A moderate mass arm with fine bearings, the Alphason has a musical, easy sound which merits continued recommendation.

Audio Technica AT1503 III (£155)
Now in limited supply, this is the lone survivor of the detachable headshell brigade.

Helius Orion (£395)
With the other Helius models under revision, the Orion remains a recommended arm of fine lab and acoustic performance.

Linn Basik LVX (£75)
Still recommended, the *LVX* has undergone detail improvements recently.

Linn Ittok LVII (£260)
A definitive tonearm with a very good all-round performance as well as good calibration. If well matched to the player and cartridge, this is a front-line product.

Logic Datum (£79)
Currently on good form, the *Datum* is a worthy member of the new breed of British tonearms available at realistic prices.

Mission 774LC (£69)
Sourced in Japan, this well-made moderate-mass tonearm has done very well both as a separate component and as a factory-fitted arm on various manufacturers' turntables.

Mission 774SM (£230)
Continuing to set a high standard the *SM* warrants recommendation.

Syrinx LE1 (£108)
The *LE1* is an above-average performer, with versatile geometry, selling at a realistic price.

Syrinx PU3 (£291)
This well finished arm is versatile and represents a great step forward from the *PU2*.

Zeta (£395)
Built to higher tolerances than before, the current *Zeta* offers improved sound quality and must be recommended despite the sizeable price and some doubts as to consistency between samples.

TONEARMS:
WORTH CONSIDERING
Included here are: **Audio Technica AT1120** (£120); **Grace G707** (£144); **Mission 774**, in this lower category due to changes to the counter-weight damping in current production (£199); **SME Series III S**, now at a rather higher price of £136; **Sumiko MDC 800** (£994).

SUGGESTED PLAYER COMBINATIONS
In addition to the integrated players noted earlier, we suggest the following possible turntable and arm combination which according to our tests should give good results. This is not claimed to be a comprehensive listing; and on matching questions it is obviously worth taking the advice of a competent dealer.

Lux PD300/Zeta	£800
Pink Triangle/Orion	£800
Pink Triangle/Alphason	£700
Linn LP12/Alphason	£700
AR/Rega RB300	£250
Heybrook TTS/Rega RB300	£315
Dunlop Systemdek/Rega RB300	£315
Dais/Zeta	£800-£900
Walker CJ58/Rega RB300	£205
Michell Gyrodec/Helius Orion	£999
Dunlop Systemdek/Mission 774LC	£185
Thorens 160/Linn LVX	£290
Elite Rock/Linn Ittok	£500
Oracle Delphi/Syrinx PU3	£1200
Linn LP12/Syrinx PU3	£700
Michell Gyrodec/Syrinx PU3	£890
Heybrook TT2/Syrinx LE1	£350

OVERALL COMPARISON CHART:
TURNTABLES & TONEARMS

	Type	Technical motor p'formance	Vibration and acoustic isolation	Arm effective mass (g)	Arm resonance p'formance	Arm bias and friction	Arm lead cap. pF	Ease of setting up	General engineering quality	General sound quality	Typical price (£)
Acoustic Research	motor b.d.	v. good	v. good	—	—	—	—	good	v. good	v. good	165
Alphason HR100S	arm	—	—	10	v. good	v. good	95	good	excellent	v. good	285
Ariston RD80/Opus arm	manual b.d.	v. good	—	11.5	average +	average +	—	good	good +	good +	280
Audio-Technica AT1120	arm	—	—	5 (d)	average +	v. good	85	v. good	v. good	good	120
Audio-Technica AT1503 III	arm	—	—	20 (d)	good	v. good	95	v. good	v. good	good +	160
Bang & Olufsen Beogram 1800	auto b.d.	v. good	good +	3.0	average –	average +	—	v. good	average +	average +	110
Dais/Dais 'Heavy'	motor b.d.	v. good	excellent	—	—	—	—	average	excellent	v. good	399/480
Dual CS514	auto ret. b.d.	poor	poor	9.5	average –	average	—	v. good	average	average –	70
Dual CS505	auto ret. b.d. (c)	good	good	10.0	average –	v. good	—	v. good	good	good	90
Dunlop Systemdek IIX	motor b.d.	v. good	v. good	—	—	—	—	good	v. good	good +	115
Dunlop Systemdek IIS	motor b.d.	v. good	excellent	—	—	—	—	average +	v. good	v. good	225
Dynavector DV501	arm	—	—	25/50	poor	good	125	average	good	average +	286
Elite Townshend Rock II	motor b.d.	v. good	good	—	—	—	—	good	v. good	v. good	280
Grace G707	arm	—	—	7	average +	good	—	v. good	v. good	good +	165
Helius Standard	arm	—	—	12	average +	good	70	average	v. good	good +	200
Helius Orion	arm	—	—	12	good	excellent	73	average	excellent	v. good	425
Heybrook TT2 II	motor b.d.	excellent	v. good	—	—	—	—	good	v. good	v. good	225
JVC QL-A200	auto q.d.d. (c)	v. good	poor	10.5	poor	poor	—	v. good	aveage	average –	90
JVC LL1	auto b.d. (lin) (c)	average	average –	4	—	average	—	excellent	average –	average –	125
JVC QLY5F	auto q.d.d.	excellent	average –	17 (d)	aveage +	good	95	v. good	v. good	average	255
Linn Sondek LP12	motor b.d.	excellent	v. good	—	—	—	—	average –	excellent	excellent	408
Linn LVX	arm	—	—	12.5	good	good	100	v. good	v. good	good +	74
Linn Ittok LVII	arm	—	—	13.5	v. good	excellent	100	v. good	excellent	v. good	291
Logic Tempo Electronic	motor b.d.	v. good	good +	—	—	—	—	good	v. good	good +	160
Logic DM101	motor b.d.	v. good	excellent	—	—	—	—	aveage +	excellent	v. good	379
Logic Datum	arm	—	—	16.5	good	good	—	good	v. good	good +	75
Lux PD290	auto stop q.d.d.	average +	poor	10.5	average –	average	—	good	average +	average –	145
Lux PD370	manual q.d.d.	v. good	average +	13	average +	average	150	good	v. good	good	260
Lux PD300	motor q.b.d.	excellent	v. good	—	—	—	—	good	excellent	v. good	375
Lux PD310	motor q.b.d.	v. good	good	—	—	—	—	good	excellent	good +	560
Marantz TT530CT	auto d.d. (lin) (c)	average –	poor	5	good	N/A	—	excellent	average	poor	129
Marantz Esotec TT1000	motor q.d.d.	excellent	good	—	—	—	—	good	excellent	good +	999

Michell Focus One	motor b.d.	v. good	good	good	—	—	—	good	v. good	good	135
Michell Gyrodec	motor b.d.	excellent	excellent	—	—	—	—	good +	excellent	v. good	595
Mission Cambridge 775LCT	manual b.d.	v. good	average −	12	average +	good	—	v. good	good	good	99/165
Mission 775S	manual b.d.	good +	good	5.5	average +	excellent	—	v. good	v. good	average +	300
Mission 774LC	arm	—	—	12	average +	good	—	v. good	v. good	good	69
Mission 774	arm	—	—	5.5	average +	excellent	—	average	v. good	good	199
Mission 774SM	arm	—	—	16	v. good	v. good	85	average +	v. good	v. good	239
NAD 5120	auto stop b.d (c)	average −	good	9	poor	poor	—	v. good	average +	average +	99
Nackamichi Dragon CT	auto ret. q.d.d.	excellent	v. good	18	average	good	—	v. good	excellent	good +	900
Oracle Alexandria	auto lift b.d.	excellent	v. good	9	average +	v. good	—	v. good	excellent	v. good	820
Oracle Delphi	motor b.d.	v. good	v. good	—	—	—	—	average +	excellent	v. good	897
Philips F7230	auto b.d. (c)	average	poor	6	average −	average +	—	excellent	average −	poor	90
Philips F7430	auto b.d. (lin) (c)	average −	average −	5	average −	N/A	—	excellent	average	average −	130
Pioneer PL88F	auto q.d.d.	excellent	average +	—	average −	good	—	excellent	v. good	average	300
Pink Triangle	motor b.d.	excellent	—	—	—	—	—	excellent	v. good	excellent	398
Rega Planar 3	manual b.d.	good	average	10.5	v. good	v. good	—	v. good	v. good	good	188
Rega RB300	arm	—	—	10.5	v. good	v. good	—	v. good	excellent	v. good	90
Revolver	motor b.d.	good	average −	—	—	—	—	v. good	good	average +	105
Revox B791	auto ret. q.d.d.	excellent	average −	3	—	v. good	—	—	excellent	good	425
Rotel RP830	manual b.d.	average	poor	13	average −	v. good	—	v. good	good	average −	95
Rotel RP850	manual b.d.	excellent	average +	13	average −	v. good	—	v. good	v. good	good	140
SME Series III	arm	—	—	5	good	v. good	280/75	v. good	v. good	good	136
SME 3009R	arm	—	—	12	average +	v. good	280/75	v. good	v. good	average	190
SOTA/Sumiko Premier	motor b.d./arm	v. good	excellent	16.5	average	good	—	v. good	v. good	v. good	600/850
STD 305M/305S	motor b.d.	v. good	v. good	—	—	—	—	average	good	good +	139/169
Sumiko MDC800 The Arm	arm	—	—	15	good +	v. good	75	average	v. good	v. good	994
Synrinx LE1	arm	—	—	11	average +	good	—	good	v good	good	108
Syrinx PU3	arm	—	—	11	average	average	—	good	excellent	v. good	291
Technics SLQX200	auto ret. q.d.d. (c)	excellent	average +	7.5	v. good	average +	—	excellent	v. good	good	135
Technics SL7	auto q.d.d.	excellent	good	3	average +	v. good	—	excellent	v.good	average	219
Thorens TD166 II	manual b.d.	good	good +	6	average +	v. good	240	good	good	good +	149
Thorens TD160BC III	motor b.d.	v. good	good +	—	—	—	—	average −	good	good +	175
Thorens TD147	auto stop b.d.	excellent	good +	6	averae +	v. good	240	good	v. good	good +	280
Thorens TD126 MkIV	motor b.d.	v. good	good +	—	—	—	—	good	v. good	good +	330
Walker CJ81	motor b.d.	good	v. good	—	—	—	—	good	good	good +	85
Walker CJ58	motor b.d.	v. good	v. good	—	—	—	—	good	good +	v. good	115
Walker CJ55	motor b.d.	v. good	v. good	—	—	—	—	good	v. good	good +	149
Zeta	arm	—	—	16	v. good	v. good	100	average	v. good	v. good	390

Notes:
'motor' indicates turntable only, without arm
'b.d.' — belt drive, 'd.d.' — direct drive, 'q' — quartz
'(c)' — with cartridge, '(d)' — damping
All prices are typical retail prices including VAT

THE *Ultimate Room*

(ask for Neil Hollings or Dean Ralphson)

ACOUSTIC RESEARCH

Recommended Arms: Linn LVX or AR's own

HEYBROOK TT2 II

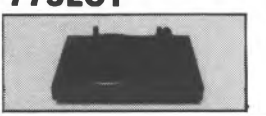
Recommended Arms: Heybrook, Mission 774L C or Helius Scorpio

250 STATION ROAD

LOGIC TEMPO ELECTRONIC

Recommended Arms: Datum Mission 774LC o r Helius Scorpio

MISSION CAMBRIDGE 775LCT



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It was originally intended to review turntable mats as a separate part of this issue, but closer investigation showed that relative judgments were impossible, because mat characteristics so often formed an integral part of a particular system; thus the substitution of a nominally 'superior' mat was no guarantee of improved sound quality.

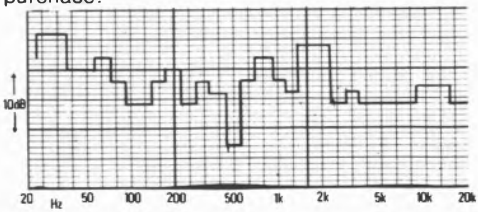
However a test was devised to analyse the frequency absorption properties of mats and so plot these graphically in a comparative fashion, thus permitting discussion of their differences and providing a data base with which to correlate subjective impressions. This test involved a normal standard record with a cartridge resting on the outer third of the radius, subjected to a nominally flat pink noise sound field, covering 30Hz to 20kHz. The cartridge output was equalised to the RIAA spec and plotted.

The reference curve (1) is that of the disc unsupported – that is lifted some 5mm clear of a metal platter by a thick washer at the spindle. The record was then tried on a number of available mat types, ranging from untreated plain metal to plate glass, felt, suede, and finally both hard and soft rubber. The effect of a typical label clamp was also checked.

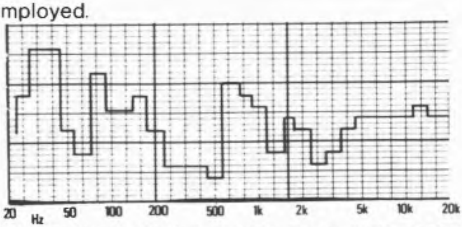
We found that thedifferences were surprisingly large. For example, as compared with light felt, the glass mat offered a typical 15dB of energy reduction over four octaves from 25Hz. Of course such differences will be diluted in a system context, as the mat's contribution to the overall sound quality and balance is probably only around 20% for a top class system, falling to as little as 5% for an average set up. In the latter instance, inherent colorations due to arm, plinth and lid will dominate the result.

Take the case of the Sondek and its well known felt mat. Suppose a system had been constructed around it whereby the mat, player, arm, cartridge, amplifier and speaker were all complementary and produced a satisfying sound balance. The substitution of the soft composition *'Dumpa'* mat would produce a change in sound quality but not necessarily for the better, despite a measured improvement in the 1kHz-4kHz as well as 50-500Hz band. Two reasons for this suggest themselves. The *'Dumpa'* (3) curve is notably uniform in overall distribution, but with the bass hump exaggerated at 30-45Hz, and with the prominence at 600-850kHz potentially audible as an increase in coloration. From the complete system viewpoint, however, the removal of any energy and coloration in areas of the response which previously formed part of the entire system balance could well result in a perceived deterioration of the balance, unless other parts of the system can compensate.

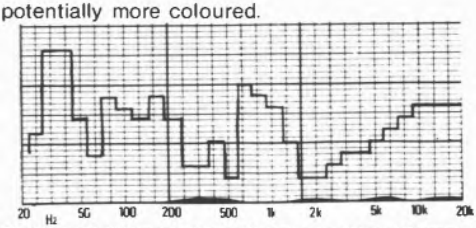
Perhaps dealers who stock and sell the more expensive 'special' mats (one glass mat currently costs around £50) could keep a loan stock and allow customers to try several at home before purchase?



1) The reference trace forthe unsupported record was taken and provides a nominal energy level at 64dB (all figures 'A' weighted.) In the circumstances the spectrum was remarkably even, although high 'Q' resonances were averaged and moderated by the ⅓-octave analysis employed.

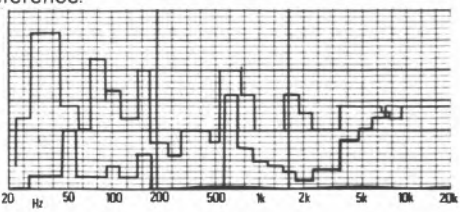


2) Placement of the record on a plain metal platter (the top surface of a *DQX 1000* without a 'label depression') provided a 6.8dB energy reduction, as well as improvements in the 1.2 to 5.0kHz range. However contact was clearly imperfect, with the bass damping uneven and potentially more coloured.

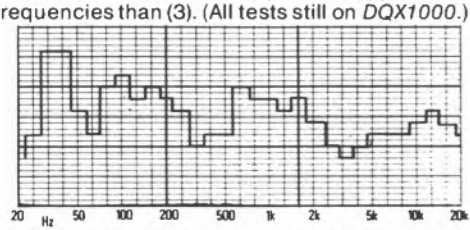


3) The addition of the soft composition *'Dumpa'* mat further improved the upper mid damping, although many of the mats used here were unable to deal with the 630Hz mode, which is thought to relate to the player or arm itself. Improved damping at low frequencies if anything

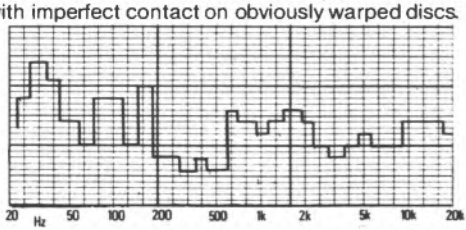
further accentuated the 30-40Hz lift, while the overall noise level was 9.5dB down on the reference.



4) This comprised the original Linn type of radially ribbed rubber mat, as also used in Rega players for example, and here placed on top of a 10mm thick glass Rega platter. The reduction was 6.8dB with less absorption at upper bass frequencies than (3). (All tests still on *DQX1000*.)

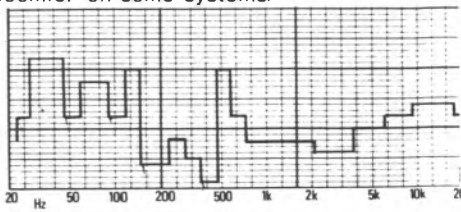


5) This strikingly good absorption result was achieved using a nominal glass mat, in this case a 10mm thick Rega platter, which approximates to the glass mats currently available. A reduction of 12dB was attained, with the 'A' weighting clearly not showing the full benefit at low frequencies. Compared with the rubber mat (4) the following improvements in ⅓-octave bands were noted, namely 12dB at 25Hz; 24dB at 30 and 40Hz; 4dB at 50Hz; 20dB at 80Hz and typically 10dB at higher frequencies of up to 2.5kHz. Disc support and contact was quite good, and the absorption was clearly less effective with imperfect contact on obviously warped discs.



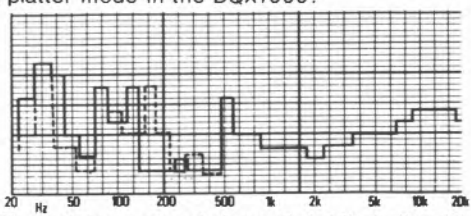
6) A Linn felt mat showed a fairly even 'neutral' character but with less effective absorption at 5.7dB.

7) The older 'Lux' mat – a thin suede covering on medium hard rubber composition – demonstrated quite good control and absorption in the mid and treble with an 8dB reduction, but by comparison with (6) it had little effect on the bass. Matched subjectively with (6), it could sound richer, even 'boomier' on some systems.



8) A medium hard rubber (Ariston but similar to the *Avon*) gave a promising 10dB reduction with good effects in the upper mid and treble. The bass range was quite even although no better controlled, and with token losses at 25Hz and 160Hz.

9) A heavier rubber mat (*SE22*) gave a similar result to (8), namely a 10.6dB loss, although this time with better control at 630Hz; perhaps this is a platter mode in the *DQX1000?*



10) Applying a record clamp (J. A. Mitchell) to (9) produced no change in the 'A' weighted level, but provided improvements of −6dB at 25Hz −12dB at 40Hz, and −2dB at 50 and 63Hz, as well as some changes from 80–300Hz. Under certain circumstances one might expect to benefit from a clamp, particularly with a disc warp in the right direction, but a 'reverse' warp could only be dealt with by the highly costly Trio rim clamp system.

PLATTERMATS UPDATED

The tests described above were applied to mats available at the time of the last issue; despite interesting results, we decided not to repeat them. Perhaps the main problem is that the mat cannot truly be isolated from the playing system in which it is used. Furthermore the new disc impulse transmission response test carries a

good deal of the mat termination and absorbtion data, which is probably more relevant than the earlier acoustic damping responses.

The role of the plattermat is complex, defying simple analysis. High disc damping over restricted areas of the frequency range may not indicate a good end result on a complete player. For example, the Linn felt mat provides a more limited absorbtion of acoustic and impulse energy than many others, but does so in a rather well distributed manner. Discs played on felt mats generally have a characteristic sound: a touch of mid-forwardness described by some as 'vinyl shout', plus a degree of treble 'brightness'; with some neutrally balanced turntables, their use will obviously prove detrimental.

Certain hard synthetic composition mats, as currently used by Thorens for example, can produce poor results. Not only is absorption low, but it is also unevenly distributed; in the case of the Thorens turntables this imparted an obvious 'hardness' to the reproduced sound.

Different mats will produce different effects. The Linn player has certain serious weaknesses from a coloration viewpoint, namely an intrinsic touch of bass forwardness, mild upper midrange hardness and a slightly downtitled system response with increasing frequency, all of which is somewhat exposed by a neutral type of absorbtive mat such as the *Audio Ref*. However, the felt mat provides sufficient mid-forwardness to balance the bass and upper-mid levels, and sufficient mid-treble 'openess' to liven up the balance and give a subjectively even result.

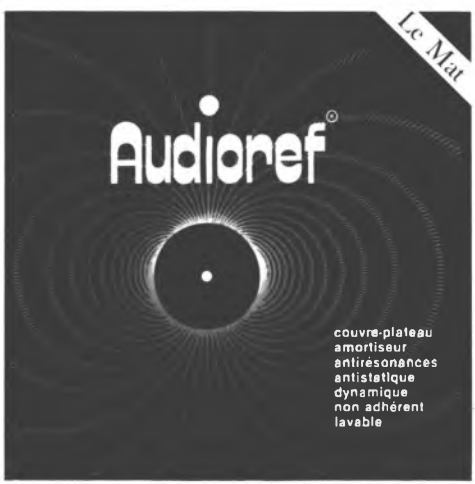
In many cases where the mat sound was in question, substitution of an *Audio Ref* or occasionally an Avon mat considerably ameliorated the problems; so far these have been the best balanced 'all rounders'. Some interesting 'mats' were tried, including the amazingly effective integral suction platter of the two Lux models, which showed exemplary impulse termination. Very good results were obtained from other hard mats including the stainless steel of the Trio *LO7D*, and the acrylic integral plattermat of the Pink Triangle: specifically designed with effective record termination in mind, fine results confirm the design theory. The glass mat on the Marantz *TT1000* was also notably successful. In fact glass mats are available as accessories from several sources, GA's *Soundisc* being one of the least expensive. Michell's luxury version has a damping laminate between double glass plates, and due to its low resonance properties such a mat can make a definite improvement to the sound of turntables with flimsy platters. However with hard mats such as these there is the possibility of mild record damage due to microgrit becoming impressed into the disc underside; both the mats and the record therefore require scrupulous cleanliness.

An interesting mat system on the Oracle combined a highly damped 'tacky' type of mat (carbon fibre loaded to increase its rigidity) with a special stress clamp which forced the discs into full contact with the platter, even badly warped samples. The results were consistently good, and were only bettered on grounds of sheer absorption by the Lux suction models.

Conclusion

It seems fairly obvious that mats are little problem with the most expensive turntables, where designers will have sought to optimise conditions. The greatest opportunity for mat substitution lies in the budget to middle range, where the standard item is often found wanting (though less often than of yore).

However due to the varying frequency balance and coloration contribution of different mats, one type may only be optimal for a limited number of turntables. Fortunately mats are comparatively inexpensive, so experimenting with alternatives should not prove exhorbitant. I sometimes vary the mat with the cartridge: for example, on the *Sondek* felt seems best for the *Asak*, while the *Audio Ref* suits the Koetsu better.



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COMPACT DISC: INTRODUCTION

Though still in its early days, Compact Disc is the only new 'sound carrier' or hi-fi medium to emerge since the Compact Cassette. More important, it is the first since the introduction of stereo to offer a definite promise of inherently better sound in the home.

Developed by Philips with collaboration from Sony, Compact Disc is technically a bigger change from conventional LPs than LPs were from 78s — even if the user benefits are not so startling. The 120mm diameter Compact Disc can accommodate at least one hour of continous music, with claimed superiority in both sound quality and durability. No doubt the early Philips' advertising claim that CD gave 'perfect sound forever' is now deeply regretted; CD does give benefits, but the discs aren't perfect nor are they indestructible.

Compact Disc (or Digital Audio Disc, DAD) is a reproduction system which uses Pulse Code Modulation to store the musical information in digital form. PCM is already used for relay transmission of radio broadcasts by the BBC, and in digital tape recording systems.

The information an audio recording system has to store and later reproduce is really just a constantly-changing voltage level. In the reproduction chain, this electrical signal is used to recreate the constantly-changing air pressure which we hear as sound. An analogue recording system — conventional disc or tape — tries to capture the electrical waveform directly, but cannot produce a perfect analogue of the complex music waveforms which are produced by a microphone. There is always distortion, produced by the recording medium's inability to react fast enough and fully enough to the incredibly fast changes in level found in the signal. Also, the system adds its own unwanted noise to the recording.

Digital recording promises to overcome all these problems. Instead of trying to produce a direct analogue of the musical waveform the digital recorder samples the waveform at very frequent intervals, and the level of the signal at any point in time is recorded in the form of a binary number. If the sampling is rapid enough, these numbers can then be decoded to give a constant stream of level readings which will accurately represent the signal that was fed in.

Sampling takes place at the rate of 44.1 thousand times a second, which is theoretically sufficient to reproduce musical waveforms containing frequencies up to 20kHz. Each sample is encoded as a binary word of 16 bits, which means that the number of different levels that can be recorded is 2 to the power of 16 — a lot! Mathematically it can be shown that this will give a signal-to-noise ratio of 96dB, which is far in excess of that offered by conventional media, unless exotic noise reduction-systems (with their own undesirable side-effects) are used. In practice, CD players may give less than full 16-bit resolution.

The disc itself consists of a metalised reflective layer embedded in clear plastic. The 'bits' are represented as incredibly small pits in the reflected layer, which are read by a very accurately-aligned low-power laser focused on them — the laser simply needs to detect the presence or absence of pits. Marks on the surface of the plastic will be out of focus and ignored, while error correction will cope with fairly large imperfections in the disc.

In our tests, error correction capability was measured by means of a test disc which has a graded series of 'gaps' in the recording.

Most players use a single D/A convertor which is shared between the channels, switching between them at a supersonic frequency (this is the same principle as multiplex stereo radio reception). As a result, one channel is delayed by a few microseconds with respect to the other. This might seem an undesirable compromise, but so far, no effect on sound quality has been found to be attributable to time-shared convertors, except when the two channels are combined in mono. The delay is reflected in our tests by channel phase difference.

Comparison of CD with analogue is dealt with in the *Technical Introduction;* suffice it to say here that while CD can represent an obvious improvement if compared with a typical 'rack system' or other poor-to-mid-fi LP-playing system, when CD is pitted against the best that analogue can do the results tend to be far from clear-cut. Although the CD system has often been criticised for its very finality (in contrast with analogue, where we can go on improving the playback system for some time before limitations of the disc itself prevent further progress), the fact remains that some CD players have shown an improvement over the first generation of players. It remains to be seen whether this really will be sufficient to firmly establish the system.

Steve Harris

Denon DCD1800

Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks
Tel (0753) 888447

We were lucky to get this machine for test as early samples were in short supply; furthermore, it would appear that even when the machine is generally available, the quota for the UK market will be comparatively small.

Denon's first CD player was a branded version of the Hitachi *DA1000* and was not sold in the UK. The *1800* reviewed here is considered to be second generation, and is built by Denon themselves, with a number of technical features aimed at improving the sound quality; or as Denon would say, to bring it closer to reproducing the sound of Denon's digital masters.

A sizeable unit, with the ubiquitous drawer loading system, the *1800* is expected to sell for a little under £500 which is now a pretty high price for a model not equipped with remote control.

The digital readout is comprehensive, in the manner of the Sony *701ES*, showing much data about the inserted disc and its contents. It displays track number, index number, playing time, elapsed time, and the track numbers which have been programmed; further mode indicators show play, pause, intro, program, repeat, A-B, disc set, next number, key in and program call functions.

Up to 15 selections may be programmed in any order, with cueing to the Sony pattern, having audible monitoring of short bursts of the cued signal.

On the technical side, Denon describe the use of a 'Super Linear' D/A convertor. Denon note that a harsh sound can be produced at the crossover switching point from binary 0 to 1, and adverse effects are also noted on high frequency imaging particularly on quiet passages. To counter this a Denon-developed convertor adds a conversion/error correction unit to a high-precision 16 bit D/A convertor. The corrector is actually a supplemental D/A convertor which compensates the main output by adding or subtracting current as required to produce the corrected and proper output level. The overall convertor, time shared between the two channels, is followed by an 11-pole thick-film active filter, and specially good components have been used in the analogue output stages.

The laser drive is more like the Philips system and is constructed of precision castings using a fixed pivot point for the laser arm rather than the parallel carriage used by most other manufacturers. A headphone socket with a level control is included, and a remote control is optional.

Lab report

The player exhibited excellent channel balance with an extraordinarily uniform response, to lab test equipment standard. Separation was fine at 90dB plus, and while total harmonic distortion was good, it was not as low as with some of the other models; however at signal levels rather below peak, a good standard was set. Taken down to – 90dB, the convertor error was low at + 1dB.

High frequency intermodulation was fine, the output measuring the standard 2 volts at a fixed level, and a moderate output impedance. The de-emphasis worked correctly but the track access time was on the slow side, though not as slow as the Philips/Marantz. The Denon emitted a slight high pitched whine, which could be heard at low listening levels if the player was sufficiently close to the listener.

Error correction was sufficient to pass the minimum 'Red Book' standard; in fact the 700μm gap was passed. The surface 'error' dot gave trouble beyond 300μm, so in this respect the *DCD1800* was below average and could be tripped up by some of the poorer pressings. Signal to noise ratios were fine, close to the theoretical limit, while spurious harmonic tones were well filtered — better than 100dB down.

Sound quality

The Denon played our music records without noticeable errors. The sound was described as a little above average but in our view did not fulfil the promise made in the accompanying literature. Some forwardness and hardness was noted in the midrange, with a feeling of mild dynamic compression coupled with some loss of subject stereo depth. The bass also did not show the full attack and articulation we knew was possible. In the treble the results were a little better, but some sharpness and brightness were noted on the test marking sheets.

Conclusion

With its average sound quality, below average error correction and above average price, the *DCD1800* is in our view not very competitive. While not a bad player, it does not qualify for recommendation.

GENERAL — Compact Disc Player

Channel balance
At 20Hz ..... <0.1dB
At 1kHz ..... <0.1dB
At 20kHz 0.15dB

Stereo separation
At 20Hz 95dB
At 1kHz 95dB
At 20kHz 90dB

Channel phase difference
At 20Hz ..... —
At 1kHZ ..... —
At 20kHz ..... —

Total harmonic distortion at 0dB
At 20Hz ..... – 93dB
At 1kHz ..... – 90dB
At 20kHz ..... 82dB *

Total harmonic distortion at – 10dB
20Hz-20kHz ..... – 85dB

Total harmonic distortion at – 60dB
20Hz-20kHz ..... – 40dB

Total harmonic distortion at – 80dB
20Hz-20kHz 20dB

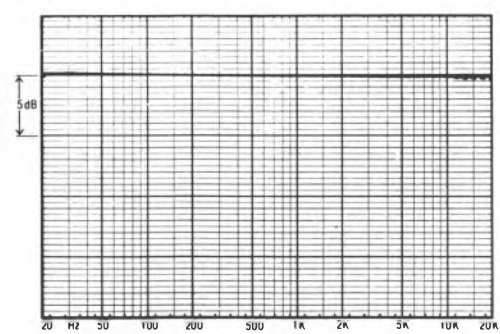
Intermodulation distortion
at 0dB, 19kHz/20kHz ..... – 85dB
At – 10dB, 19kHz/20kHz ..... > – 85dB

Frequency response
Left channel ..... ±0.15dB
Right channel ..... ±0.15dB

Signal to noise ration
No emphasis, 20Hz-20kHz unweighted ..... – 94dB
No emphasis, CCIR ARM, 1kHz ref ..... – 92.5dB

Output level, 0dB
Left channel 2.032V
Right channel 2.033V

Output impedance ..... —
De-emphasis ..... correct
Track access time ..... 9.5 secs
Error correction capability ..... 700μm gap, 300μm dot
Mechanical noise ..... mild whine
Spurii up to 100kHz ..... > – 100dB
Resolution at – 90dB ..... + 1dB
Headphone socket ..... yes
Estimated typical purchase price £495
including noise



Frequency response; dotted trace is right channel

Hitachi DA800

Hitachi Sales UK Ltd, Hitachi House, Station Road, Hayes, Middlesex
Tel 01-848 8787

Hitachi was one of the first CD player manufacturers and rushed a model into production early in 1983. This was the *DA1000* which appeared in full-page colour adverts in a number of newspapers; unfortunately the review machines, drawn from the first 100 or so UK models, had a distortion fault due to poor D/A conversion. This was corrected fairly quickly and the machine then gave a good error correction performance as well as normally low distortion. Available stock of this machine is now being sold off at attractive prices.

Its replacement is the second-generation *DA800*, costing a little under £400. A low-profile deck, it is a drawer loader whose styling and finish bears a close resemblance to that of the Sony machines. It is quite well equipped, for example with a headphone socket and volume control, this also controlling the single pair of phono output sockets at the rear.

The *800* proved easy to operate with a numeric key entry array facilitating easy entry of tracks, or programmed track combinations of up to a total of fifteen. The fluorescent display includes readout of track number, index number and elapsed time, while the total number of tracks is shown once the disc is inserted, together with the total playing time. As on the Sony *101*, an antishock switch is provided at the rear for conditions of strong vibration, but some impairment of absolute error correction will occur with this switch on. The cue facility also has the popular audible-music function, allowing rapid access to the desired passages.

Inside, the player is well constructed, and uses a standard 16-bit D/A convertor with the usual nine-pole 'brickwall' output filter. Full error correction ICs are also fitted, and the machine benefits from the recent LSI develop-

ments which have helped simplify its construction.

Lab report

The *DA800* demonstrated a very uniform response with just the merest hint of measured treble loss on one channel above 10kHz, and this only 0.4dB. Channel balance was very good — in fact superior to an earlier sample. Separation was also very good, throughout the frequency range, and in employing a shared D/A convertor, the channels showed a relative phase shift amounting to 87° at 20kHz, a trifle higher than usual but considered to be of little consequence.

Total harmonic distortion was very low at mid frequencies — it was 105dB down at full level. The – 79dB distortion/noise recorded at 30kHz (0dB level was still good, and good distortion results were also obtained at lower modulation levels. Taken in conjunction with the + 3.5dB amplitude error at a – 90dB record level, this suggests 15-15½ bit resolution.

The two-tone high frequency intermodulation was slightly high at 0dB, improving to a very good – 96dB at 10dB down. The output was 2.5V, higher than the normal 2V, and a bit confusing for easy A/B testing! The output impedance was very low at 30ohms, well suited for direct drive to a power amplifier. Track access was rapid at four seconds, while the mechanical noise was comparatively low. Fine error correction was also shown, the machine dealing confidently with the worst the test disc could offer. Signal to noise ratios were fine and spurious outputs well suppressed, measuring – 110dB or better up to the 100kHz limit of analysis.

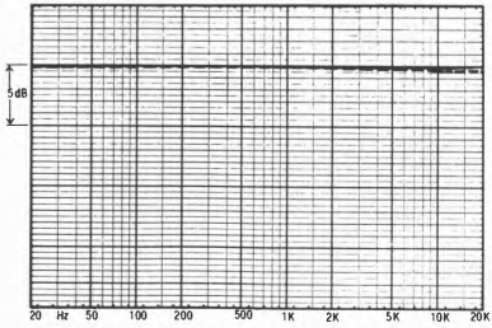
Sound quality

The *DA800* performed to the usual confident CD standard, on the listening tests. The typical CD qualities were well in evidence, but as auditioning proceeded, our notes established that its performance was around the average mark. Compared with the best players, it showed a mild loss of definition, some lack of stereo depth and a touch of hardness, while the treble was a little brighter and more forward than the frequency response suggests.

Conclusion

The *DA800* is a well equipped player of competent overall performance. An average product at an average price, it does not come into the recommended category, though a lower selling price could suggest a revision of this rating.

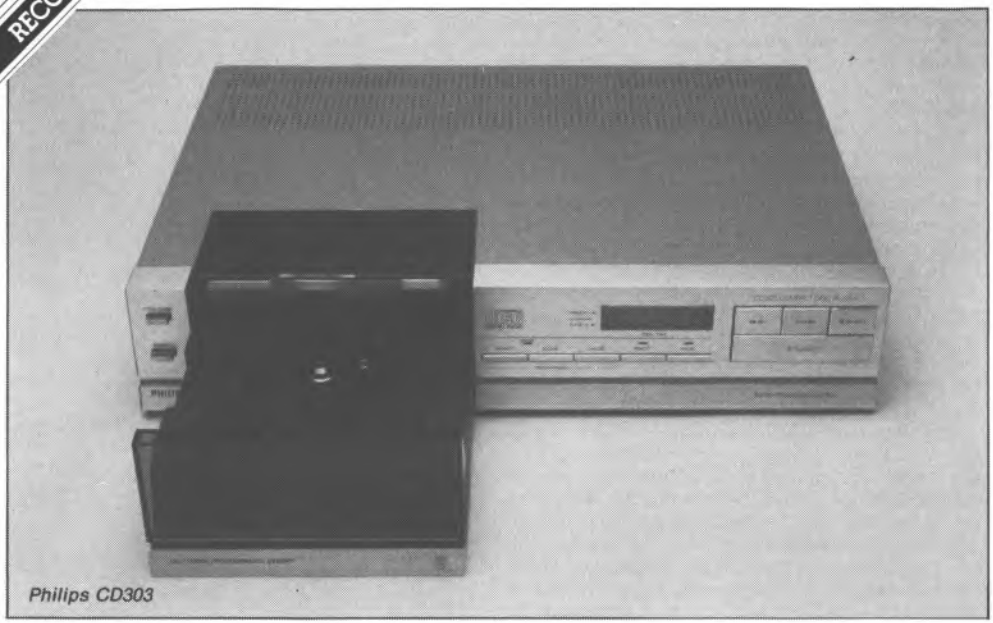
GENERAL DATA	Compact Disc Player
Channel balance	
At 20Hz	<0.1dB
At 1kHz	<0.1dB
At 20kHz	0.4dB
Stereo separation	
At 20Hz	96dB
At 1kHz	95dB
At 20kHz	91dB
Channel phase difference	
At 20Hz	2°
At 1kHZ	5°
At 20kHz	87°
Total harmonic distortion at 0dB	
At 20Hz	– 130dB
At 1kHz	– 015dB
At 20kHz	– 79dB
Total harmonic distortion at – 10dB	
20Hz-20kHz	– 92dB
Total harmonic distortion at – 60dB	
20Hz-20kHz	– 43dB
Total harmonic distortion at – 80dB	
20Hz-20kHz	– 24dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	– 86dB
At – 10dB, 19kHz/20kHz	– 96dB
Frequency response	
Left channel	+ 0, – 0.4dB
Right channel	+ 0, – 0.15dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	– 98dB
No emphasis, CCIR ARM, 1kHz ref	– 92dB
Output level, 0dB	
Left channel	2.42V
Right channel	2.45V
Output impedance	120 ohms
De-emphasis	correct
Track access time	4 secs
Error correction capability	900μm gap, 800μm dot
Mechanical noise	fairly low
Spurii up to 100kHz	< – 106dB
Resolution at – 90dB	+ 3.5dB
Headphone socket	yes
Estimated typical purchase price	£399



Frequency response; dotted trace is right channel

BEST BUY
RECOMMENDED

Marantz CD63, CD73 and Philips CD100, CD101, CD202, CD303



Philips CD303

Five Philips and Marantz models are covered in this review, as all come from the same stable, namely Philips in Holland. As Marantz is now owned by the Dutch company, some common models are only to be expected, especially in the case of an advanced product as a CD player, with its special laser and integrated circuit technology.

This group of models do show an essential similarity internally, both as regards engineering and circuitry. The measured performances are also close, but not identical, the differences mainly due to the use of different circuit boards in the top-loader and drawer-loader designs.

Prices range from about £320 up to the £400 level, depending on brand and model, the cheapest being the very compact top loading *CD100* and its gold-tinted alternative the *CD63*. These are both basic machines without remote control, headphone socket or display facilities, while the *CD202* is a rack-width top loader. Next come the drawer loaders, namely the *CD303* and the *CD73*, the latter a rather flashy alternative with much better labelling for the controls. However, Philips have the edge with the *CD303*, which adds limited data display to their old *300* design.

The Philips/Marantz players have tended to show a distinct lead in terms of sound quality, this maintained over their first launch year, and current machines are in fact marginally superior to the first output. This has helped offset the lack of facilities which would otherwise make them below average value.

All of these machines do have a memory, allowing entry of up to 15 tracks in a user-defined 'programme'. Number entry is by means of a single key which is repeatedly pressed to total the numbers. All the machines have a 'first generation' laser head, which is fine on optial grounds but makes for rather slow access between tracks, and this can be frustrating.

Excepting the *303* with its time readout, the maximum track number which can be displayed is 15, and greater numbers must be accessed by counting additional slow depressions of the play/next button. Index points are neither accessed nor displayed, and the popular 'audible music cue' facility is also omitted.

Only the Marantz *73* has a limited wired remote control on offer, but this costs some £60 extra.

Marantz Audio UK Ltd, Harmondsworth, Middlesex
Philips Electrical Ltd, Croydon, Surrey

Lab performance

Specific details of the lab performance is shown in the relevant tables and this description is therefore intended to cover the overall results, and not specific machines. Signal-to-noise ratios were especially good on measurement, but the linearity/resolution tests suggest just a normal result. It is believed that the Philips machines are effectively muted at very low signal levels, and that this result is an idiosyncrasy of the oversampling technique used. In fact, the use of oversampling is a significant difference between the Philips models and most other players; with the Philips oversampling technique, the data stream is multipled by 4, D/A converted in two separate 14 bit decoders, and filtered high in the frequency range, using digital methods. The final analogue output filtering is by means of a comparatively gentle three pole Bessel filter. To get realistic noise and distortion measurements a 20Hz-20kHz filter is required due to the higher than usual spurii from 22kHz-44kHz.

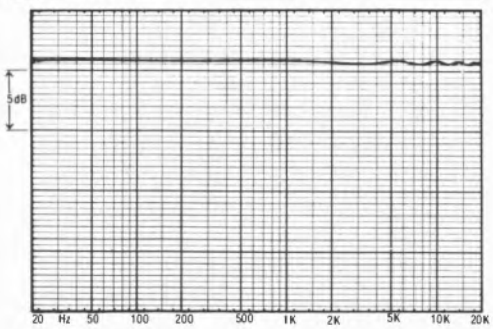
Frequency response on all models was very good, the digital filtering characterised by the very mild response ripple above 2.5kHz. The total deviation with within 0.5dB. Channel balance was excellent on all machines while phase difference between channels was virtually zero, thanks to the double convertors. Harmonic distortion was low, in general little worse than most of the so-called 16 bit models, and this performance was maintained to low signal levels. The amplitude error at – 90dB was around or slightly better than average. High frequency intermodulation was about the average at – 85dB, while the signal output was to the 2 volt standard from a low source impedance, ideally suited to passive controls and the like; but note that some of the Philips models have fitted phono cables with rather tatty, tinned phono plugs. Marantz have gold plated phono sockets. All the players tended to warm up and emit a noticeable 'hot electrical' smell!

As has been noted, track access speed was pretty poor, with 17 to 20 seconds needed to reach our 15th test track (not music tracks). The players were pretty quiet, especially the drawer loaders. Error correcton was very good, as it has been from the start with the Philips machines.

The recorded signal to noise ratio are in my view fictitious and not representative of the

continued overleaf

GENERAL DATA	Philips CD-303
Channel balance	
At 20Hz	excellent
At 1kHz	excellent
At 20kHz	excellent
Stereo separation	
At 20Hz	102dB
At 1kHz	101dB
At 20kHz	81dB
Channel phase difference	
At 20Hz	0.1°
At 1kHZ	0°
At 20kHz	0°
Total harmonic distortion at 0dB	
At 20Hz	– 103dB
At 1kHz	– 102dB
At 20kHz	– 83dB
Total harmonic distortion at – 10dB	
20Hz-20kHz	– 85dB
Total harmonic distortion at – 60dB	
20Hz-20kHz	– 38dB
Total harmonic distortion at – 80dB	
20Hz-20kHz	– 22dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	– 80dB
At – 10dB, 19kHz/20kHz	– 85dB
Frequency response	
Left channel	+ 0.15, – 0.25dB
Right channel	+ 0.15, – 0.25dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	– 96dB
No emphasis, CCIR ARM, 1kHz ref	– 100dB
Output level, 0dB	
Left channel	2.06V
Right channel	2.06V
Output impedance	42 ohms
De-emphasis	correct
Track access time	20 secs
Error correction capability	900μm gap, 800μm dot
Mechanical noise	low
Spurii up to 100kHz	– 104dB
Resolution at – 90dB	+ 2.5dB
Headphone socket	no
Estimated typical purchase price	£430



Frequency response, Philips CD303

Philips CD202

low-level signal to noise performance. Different figures were obtained from different players — for example, 100 to 103dB CCIR ARM, and 96 to 105dB unweighted (20Hz-20kHz). Spurii were well rejected apart from a component close to 20kHz — the 38kHz signal for example, was down at – 106dB.

Sound quality

These players have consistently provided an above average, 'musical' level of reproduction. Their quality was maintained over the whole frequency range, from bass to treble. The mid was airy and spacious with good depth rendition while stereo images were very stable and well focused.

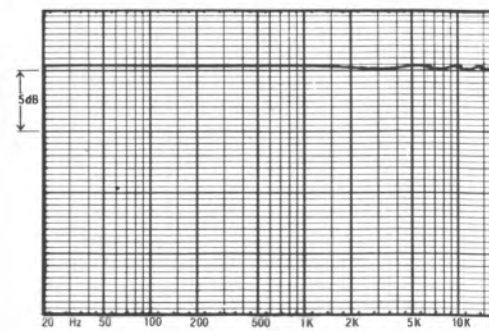
When compared with the latest and best CD players such as the Yamaha *CDX1*, the Philips models now show a mild degree of depth compression in the stereo, coupled with a degree of thiness and 'hardness' in the upper mid, this noticeable, for example, on string tone. By normal standard, the difference is not very great but where critical A/B tests are made there is no doubt that it is there.

Conclusion

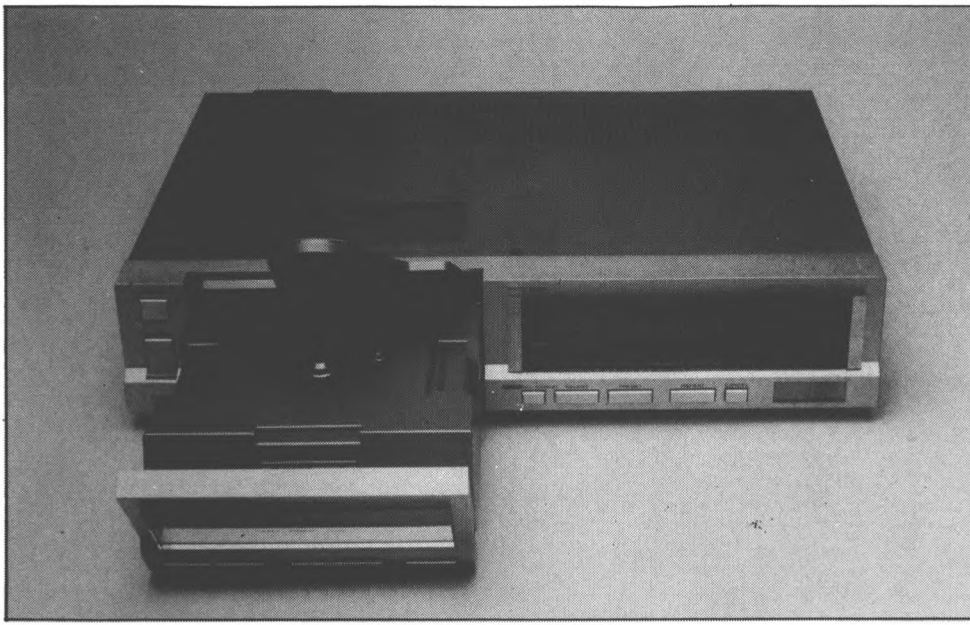
In our view the Philips/Marantz players can longer claim to the top position on grounds of sound quality, but they still remain above average in this respect. As their prices are currently below average this would seem to indicate good value, but against this must be set their lack of facilities. Recommendations are nonetheless appropriate for this group of machines, in particular for the smallest models the Philips *CD100* and the Marantz equivalent model *CD63*, which represent the best value for money of the bunch. The Marantz *CD73* does offer drawer loading, while the Philips *CD202* and *CD303* both have the addition of a digital time readout.

GENERAL DATA	Philips CD100
Channel balance	
At 20Hz	excellent
At 1kHz	excellent
At 20kHz	excellent
Stereo separation	
At 20Hz	101dB
At 1kHz	100dB
At 20kHz	82dB
Channel phase difference	
At 20Hz	0.1°
At 1kHZ	0°
At 20kHz	0°
Total harmonic distortion at 0dB	
At 20Hz	– 102dB
At 1kHz	– 100dB
At 20kHz	– 85dB
Total harmonic distortion at – 10dB	
20Hz-20kHz	– 87dB
Total harmonic distortion at – 60dB	
20Hz-20kHz	– 39dB
Total harmonic distortion at – 80dB	
20Hz-20kHz	– 20dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	– 85dB
At – 10dB, 19kHz/20kHz	– 83dB
Frequency response	
Left channel	+ 0.15, – 0.25dB
Right channel	+ 0.15, – 0.25dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	> – 105dB
No emphasis, CCIR ARM, 1kHz ref	> – 100dB
Output level, 0dB	
Left channel	2.07V
Right channel	2.07V
Output impedance	40 ohms
De-emphasis	correct
Track access time	17 secs
Error correction capability	900μm gap, 800μm dot
Mechanical noise	fairly quiet
Spurii up to 100kHz	– 105dB
Resolution at – 90dB	+ 0.5dB
Headphone socket	no
Estimated typical purchase price	£329

See conclusions for more information.



Frequency response, Philips CD100



Marantz CD73 — this was the first drawer-loading player to emerge from the Philips/Marantz stable, and has no direct equivalent in the Philips-branded range

NAD 5200

NAD Ltd, Cousteau House, Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 27737

NAD's CD player has been long awaited, for this company's products have the reputation of good performance allied with good value; it was with special interest therefore that we tested this new machine. Styled in traditional NAD fashion, the *5200* is nicely presented without unnecessary complications. A drawer-loader, it has a very clear digital display and a simple, easy to use control panel.

The *5200* is actually built for NAD by Toshiba, although at first sight the contrast with the current Toshiba-branded model could not be greater. Further work showed the two machines actually to have a fair deal in common and in fact we found the main structure of both to be identical. However, there are differences, notably in the audio boards where NAD have employed their own specifications. These include the omission of the headphone facility as well as the variable level control and associated output, which has meant simpler wiring as well as an improvement to the grounding, which could affect the sound.

Less fortunate is the omission of the Toshiba's useful infra-red wireless remote control. Strangely, with this left out, the NAD still sells for a marginally higher price than the Toshiba. Presumably this reflects the present state of CD manufacture, where the consumer price is somewhat arbitrary, the generally accepted view being that CD production is still uneconomic at present.

The NAD does have the usual track access facilities, with audible music cue on slow scan, but it does not have proper indexing access, nor any facility to pre-programme a track selection and store in memory. No repeat play is included either.

Lab performance

Channel balance was very good, and showed

good consistency over the frequency range. Frequency responses were very flat at +0.1, −0.2dB and barely moved a pen width on our 0.5dB per minor division high-resolution reponse graph. Channel separation was also very good, though as expected, the channel showed an increasing phase shift with rising frequency from 4° at 1kHz to a maximum of 82° at 20kHz.

Total harmonic distortion at peak level was poorer than usual, at around 88dB 1kHz, and nearer −80dB at the band edges. Some improvement was noted at −10dB and this was maintained throughout the remaining dynamic range down to −80dB. The amplitude error at −90dB was also quite small. High frequency intermodulation was fine at −10dB increasing at 0dB to −86dB. The output was close to the nominal 2V from a low source impedance, and so is suitable for passive control units.

The de-emphasis control was fine (internal automatic switching) while track access was very quick noted at 3.6 seconds for a 15 track scan of the tests disc. Mechanical noise was quite low.

NAD (or Toshiba) have not skimped on the error correction and it passed the maximum error bands with ease. The signal to noise ratios were quite good, at 95dB unweighted and 89dB CCIR ARM weighted.

Spurious signals were well rejected at −110dB, which was rather better than the Toshiba managed. The NAD distortion performance was also a little better.

Sound quality

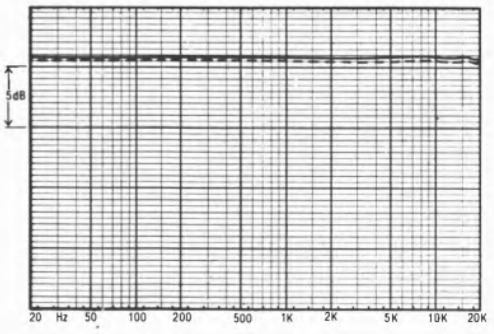
Listening tests showed that the NAD did indeed have the edge over the Toshiba although it must be admitted that in absolute terms the differences were small.

The NAD gave a clear firm impression with clean solid bass and above average treble. The mid was well focussed while the stereo soundage showed pleasing scale and depth. Marginally behind the Philips standard, the NAD gave a slightly less relaxed quality, with some reduction in stereo depth, but no error problems were shown up.

Conclusion

NAD's version of the Toshiba player was slightly superior, both sonically and technically, but the difference was in our view nothing like enough to justify the major loss of facilities compared with the Toshiba, especially the remote control and headphone outlet. At a price nearer £300, the NAD would do well but at £399 it can hardly be said to offer good value for money.

GENERAL DATA	Compact Disc Player
Channel balance	
At 20Hz	0.25dB
At 1kHz	0.3dB
At 20kHz	0.35dB
Stereo separation	
At 20Hz	98dB
At 1kHz	99dB
At 20kHz	78dB
Channel phase difference	
At 20Hz	1°
At 1kHZ	4°
At 20kHz	82°
Total harmonic distortion at 0dB	
At 20Hz	−82dB
At 1kHz	−88dB
At 20kHz	−82dB
Total harmonic distortion at −10dB	
20Hz-20kHz	−100dB
Total harmonic distortion at −60dB	
20Hz-20kHz	−50dB
Total harmonic distortion at −80dB	
20Hz-20kHz	−25dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	−106dB
At −10dB, 19kHz/20kHz	−96dB
Frequency response	
Left channel	+0.1, −0.2dB
Right channel	+0.1, −0.2dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	−95dB
No emphasis, CCIR ARM, 1kHz ref	−89dB
Output level, 0dB	
Left channel	2.09V
Right channel	2.02V
Output impedance	130 ohms
De-emphasis	correct
Track access time	3.6 secs
Error correction capability	.900μm gap, 800μm dot
Mechanical noise	low (noisy drawer)
Spurii up to 100kHz	> −110dB
Resolution at −90dB	−1.3dB
Headphone socket	no
Estimated typical purchase price	£399



Frequency response; dotted trace is right channel

RECOMMENDED

Pioneer PD-70

Pioneer High Fidelity (GB) Ltd, Field Way, Greenford, Middlesex
Tel 01-575 5757

Pioneer's first CD Player was based on an early Kyocera design but the new *P-D70* is a so-called second generation type. It is quite a wide machine, but slim in profile, and in conjunction with its sliding-drawer disc loading, is a candidate for stacking systems as well as for free standing use.

Frontal appearance is bright, the pale gold satin alloy metalwork contrasting with the fluorescent display area. It does not use a numeric keyboard; instead, track numbr entry is via multiple key depressions. Among its many facilities, full programming is possible for tracks up to a total of 15 in any order, while sub-indexes may be accessed by number and time. The repeat facility extends notably to programmed selections which is useful for listening tests!

The search key can access complete tracks on a rapid-seek basis, or can scan at a lower speed, within a track. In the latter mode, an audible cue output is produced in short bursts to assist the location of the required place.

Three modes are possible for the digital display. First there is track and timing, second the indexing number and third the total and remaining time reading. Three modes are also present for the two-channel bar-graph level display, and comprise 'off' (most relaxing!); 'binary', a busy display of dubious value, representing the binary coded music data; and finally 'peak' — a normal metered display of programme volume which is potentially useful for monitoring output level in connection with tape dubbing.

Output is fixed and is via gold-plated phono sockets. A front panel headphone socket is also fitted, this offering good sound quality and provided with its own slider type volume control.

In operation, the drawer will shut when 'play' or 'shut' are depressed, but the mechanism was found a bit slow. The optical transport was however quick, while track access was pretty rapid. Mechanical noise was fairly low A wired remote control is available as an optional extra, and a DIN socket to accept this is provided on the rear panel.

Internally, the mains wiring is not shrouded, but otherwise the construction is to a high standard. The audio board uses a single D/A convertor, followed by a multipole modular

filters with the ubiquitous 5534 audio integrated circuit used for the output amplifier. High quality components are used, and the circuits are isolated and powered by a number of regulators 'full depth' error correction ICs are also fitted.

Lab performance

Performing well in the laboratory the Pioneer gave near perfect channel balance with excellent frequency responses, namely +0.2, −0.6dB worst case, 20Hz to 20kHz, with no emphasis in any band.

Channel separation was also excellent. Due to the use of a shared convertor, a mild phase difference between channels appeared with increasing frequency, reaching 77° at 20kHz, this for the moment at least considered harmless. At full output distortion was very low and well below 100dB or 0.001%, rising to a very good −93dB at 20kHz. No discontinuities were present judging by the correct distortion performance at lower signal levels, and even at −80dB the distortion harmonics were held to 24dB down. High frequency intermodulation was fine.

Output was fixed to close accuracy at a nominal 2V rms, and the output impedance was a usefully-low 200 ohms, well suited to passive control units.

The de-emphasis worked correctly, while track access was rapid at a rated 5 seconds, the machine proving pretty quiet mechanically. Spurious signals were fine at −107dB, and below, and the signal to noise ratio was fully to standard at 92dB CCIR ARM (1kHz) or 97dB 20-20kHz unweighted.

Error correction was excellent, with fairly good immunity to shock, and ultimate linearity tests gave a +4dB error at −90dB, indicating a 15 to 15½ bit performance.

Sound quality

Undoubtedly this was one of the best CD players in the group. It certainly sounded like a second generation machine, showing particular strength in the bass and treble, both of which were of very good quality. The mid had only a hint of hardness and a slight loss of depth, while stereo images were superbly stable, with excellent focus and fine perspectives.

Conclusion

Acquitting itself well in the lab and offering a very good all round performance, coupled with a comprehensive set of facilities, the *P-D70* was a strong contender. Recommendation was certain, and a Best Buy rating may be justified if the price holds to the £400 level.

GENERAL DATA — Compact Disc Player

Channel balance
At 20Hz 0.1dB
At 1kHz 0.05dB
At 20kHz 0.1dB

Stereo separation
At 20Hz 100dB
At 1kHz 101dB
At 20kHz 93dB

Channel phase difference
At 20Hz ..... 0°
At 1kHz ..... 3°
At 20kHz ..... 77°

Total harmonic distortion at 0dB
At 20Hz ..... −105dB
At 1kHz ..... −105dB
At 20kHz ..... > −95dB

Total harmonic distortion at −10dB
20Hz-20kHz ..... −84dB

Total harmonic distortion at −60dB
20Hz-20kHz ..... −42dB

Total harmonic distortion at −80dB
20Hz-20kHz ..... −24dB

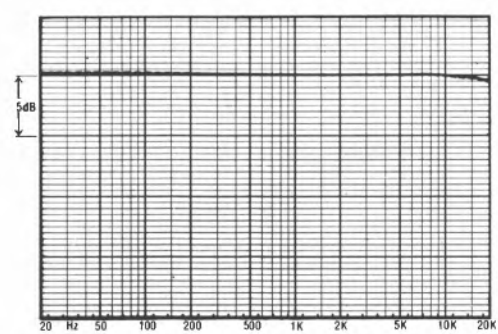
Intermodulation distortion
at 0dB, 19kHz/20kHz ..... > −85dB
At −10dB, 19kHz/20kHz ..... > −90dB

Frequency response
Left channel ..... +0.2, −0.6dB
Right channel ..... +0.15, −0.5dB

Signal to noise ration
No emphasis, 20Hz-20kHz unweighted ..... −97dB
No emphasis, CCIR ARM, 1kHz ref ..... −92dB

Output level, 0dB
Left channel 2.062V
Right channel 2.051V

Output impedance ..... 200 ohms
De-emphasis ..... correct
Track access time ..... 5 secs
Error correction capability ..... 900μm gap, 800μm dot
Mechanical noise ..... fairly low
Spurii up to 100kHz ..... −103dB
Resolution at −90dB ..... +4dB
Headphone socket ..... yes
Estimated typical purchase price £500



Frequency response; dotted trace is right channel

RECOMMENDED

Sony CD-P101

Sony (UK) Ltd, Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

Subjected to only a brief assessment in the last issue, the *101* is continuing in production and is Sony's best CD sales performer to date. Setting a pattern for most other players, it is a relatively compact drawer loader with fast track access and excellent cueing facilities. It was also the first machine to include an infra red wireless remote control, this carrying a convenient numeric keyboard for rapid entry of track number, a feature absent from the player itself. One other thing it lacks is the ability to store track sequences for pre-programming; practically everything else is provided though, from the comprehensive digital display to the excellent two-speed music cueing. Fast track access buttons give rapid entry of the desired track numbers, and it reaches those tracks almost as quickly as the numbers are entered!

An audible beep is emitted when the controller is used, but this may be muted via rear panel switch if so desired. A headphone socket is fitted on the front panel with a variable level control. Output terminals are all gold plated and carry a fixed level of nominally 2 volts rms.

Internally the *101* is well made with excellent mechanical components plus well laid out and labelled printed circuit boards. Electronics are straightforward, the machine using a single Sony D/A convertor, time shared between the two channels. After the sample and hold and de-glitching stages, the signal passes through a 9-pole modular 'brickwall' filter to delete spurious signals above 20kHz from the output. Conventional analogue electronics follow the filter, and the output impedance is higher than average though still low enough for passive volume control use.

Lab performance

The *101* gave a mild and just audibly noticeable 0.8dB channel imbalance due to Sony's

omission of an internal 'balance' setting. Channel separation was very good at typically 100dB mid band, reducing to a still good 85dB at 20kHz. The shared convertor resulted in an interchannel phase difference amounting to 77° by 20kHz, which at present is considered harmless except where the two channels are mixed in mono — in which case some loss of brightness will be heard in 'centre stage' in-phase treble signals.

Total harmonic distortion was low although it worsened at 20Hz and 20kHz, but the figures were nonetheless still good. Fine convertor linearity was shown by the correctly-graded distortion figures obtained at successively lower signal levels though the 3.5dB amplitude error at −90dB signal level was poorer than average. The intermodulation results were very good, if not quite as good as for the best examples.

Frequency response was flat mid-band, and met close ±0.2, −0.45dB limits from 20Hz to 20kHz. Tonally speaking, the player showed a marginal bass lift and a slightly premature treble rolloff. Output level was close to the nominal 2V, measured at 1.95V and 1.85V for left and right channels respectively. The output impedance was noted at 440 ohms and the de-emphasis switching was fine. Test track access was a fast 4.8 seconds and apart from a slight clicking on some discs it was pretty quiet mechancially.

Error correction has been much improved by comparision with the earliest samples, and our 800μm 'dot' as well as the 800μm 'gap' were well handled on the test disc.

Signal to noise ratio was virtually to full 16 bit spec., measuring 97dB unweighted and 92dB CCIR ARM (1kHz), while spurious signals were also very well filtered.

GENERAL DATA — Compact Disc Player

Channel balance
At 20Hz 0.8dB
At 1kHz 0.8dB
At 20kHz 0.9dB

Stereo separation
At 20Hz 110dB
At 1kHz 100dB
At 20kHz 85dB

Channel phase difference
At 20Hz ..... 0°
At 1kHZ ..... 5°
At 20kHz ..... 77°

Total harmonic distortion at 0dB
At 20Hz ..... −89dB
At 1kHz ..... −103dB
At 20kHz ..... −81dB

Total harmonic distortion at −10dB
20Hz-20kHz 93dB

Total harmonic distortion at −60dB
20Hz-20kHz ..... −42dB

Total harmonic distortion at −80dB
20Hz-20kHz ..... −24dB

Intermodulation distortion
at 0dB, 19kHz/20kHz ..... −90dB
At −10dB, 19kHz/20kHz ..... −87dB

Frequency response
Left channel ..... +0.2, −0.45dB
Right channel ..... +0.2, −0.45dB

Signal to noise ration
No emphasis, 20Hz-20kHz unweighted ..... −97dB
No emphasis, CCIR ARM, 1kHz ref ..... −92dB

Output level, 0dB
Left channel 1.95V
Right channel 1.85V

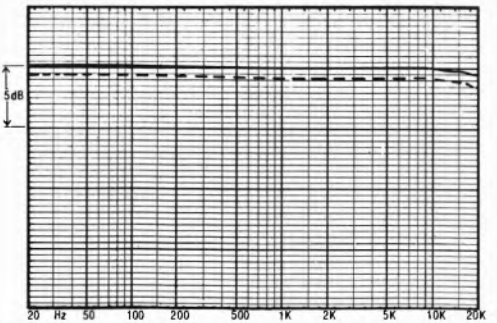
Output impedance ..... 440 ohms
De-emphasis ..... correct
Track access time ..... 4.8 secs
Error correction capability ..... 800μm gap, 800μm dot
Mechanical noise ..... slight clicking
Spurii up to 100kHz ..... > −109dB
Resolution at −90dB ..... +3.5dB
Headphone socket ..... yes
Estimated typical purchase price £450

Sound quality

In addition to the improved error correction, the current *101* players have gradually improved their sound quality to a level where it stands comparison with the Philips machines. The sound always showed good bass, and overall clarity as well as excellent stereo focus, and while early models could sound a touch hardened and compressed with a consequent loss of stereo depth, more depth is now apparent bringing the *101* to an above average position.

Conclusion

Fine finish and constructional quality, the facilities offered, including the remote control, and the improved sound and error correction ensure that the *CD101* is still a pretty competitive product, and the *HFC* recommendation is therefore continued.



Frequency response; dotted trace is right channel

RECOMMENDED

Sony CD-P701es

Sony (UK) Ltd, Sony House, South Street, Staines, Middlesex TW18 4PF
Tel Staines 61688

Well established on Sony's home market, the *CDP701es* is one of the most expensive CD players around. It was produced as something of a design exercise by the Sony engineers to show exactly what could be done with CD. It is largely based on the cheaper *101* machine, but with a number of engineering and electronic enhancements added.

A drawer-loader, with low mechanical noise and fast access, the *701* is a full-function deck which comes complete with infra red, wireless remote control. It is superbly finished in black with a sensible control layout, plus comprehensive digital display. Track numbers, elapsed time, remaining time and play time ar all shown, while index points may be accessed and the numeric keyboard also allows rapid programming of high order track numbers in any sequence. Sony's cueing system, with audible music output plus fast and slow cueing, is as yet unbeaten for ease of use. There is a high-quality headphone outlet with level control, while the signal 'line' output is fixed at the 2V nominal rms maximum.

On the technical side, the analogue electronics have been subjected to 'Espirit' analysis and considerable care has been taken over grounding, screening and the various power supplies, these exploited to maximise the electrical separation of the various circuits. The analogue output circuitry is of advanced design with high-power integrated circuits and generously-rated metal film resistors. The output brickwall filters are selected 11 pole types (instead of the usual 9 pole) and inter-channel phase delay has been banished by the simple expedient of using two selected D/A convertors instead of the usual one.

Lab performance

Channel balance was so good that the imbalance was not worth recording. Separation

at low and mid frequencies was extremely good, and only deteriorated to a still very good 80dB by 20kHz. Interchannel phase difference was very small, reaching a maximum of 3-5° at 20kHz. Total harmonic distortion was also very low at typically −106dB, midband and low frequencies, this equivalent to 0.0005%. Distortion/noise was also very good at high frequencies here measuring −89dB at full level and improving at lower levels. Harmonic distortion remained low throughout the dynamic range, while intermodulation distortion was also excellent — at better than 96dB down for the 19/20kHz double tone at a −10dB modulation level.

Perfectly balanced, the two channels gave an excellent +0.22, −0.15dB frequency response 20Hz to 20kHz. Tonally the player showed a bit of treble lift but this was very slight. The output level was also very close to 2V rms, with a moderate 350ohm output impedance. The de-emphasis worked correctly, while the track access time checked out at a speedy 4.5 seconds (for track 15 of test disc YEDS2). Mechanical noise was low and the error correction very good. The 800μm, 'gap' was passed, together with the troublesome 600μm 'dot', although the 800μm 'dot' was failed on my sample.

Signal to noise ratios were very good, at 98dB unweighted 20Hz to 20kHz and spurious signals showed excellent rejection to almost 110dB down. Tested on a −90dB tone the level error was just 1dB showing excellent linearity, close to full 16 bit performance.

Sound quality

Until very recently this was the best sounding player on sale. It provided a very precise, almost clinically clear soundstage, with excellent stereo focus and fine depth. The sound was highly detailed, with particularly good definition in the bass and treble. However, after detailed comparison against newer 'reference' players, the *701* now seems slightly lacking in the area of mid presentation, where the sound appeared slightly hardened and more 'forward', the overall effect being less relaxing.

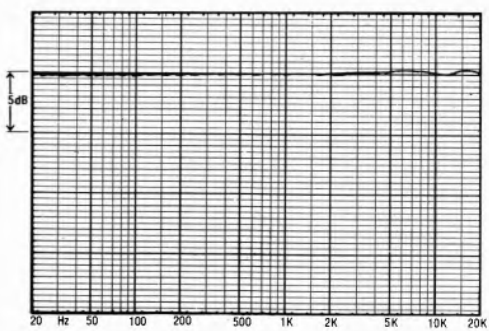
Conclusion

The *701* remains a very good player of superb build quality and a very comprehensive specification. Lab performance was excellent and the high sound quality place it up with the top few models. However it does not rate as particularly good value for money. In the right system, especially with speakers and amplifier of a musically 'laid back' character, it will be found to perform very well.

GENERAL DATA — Compact Disc Player

Channel balance	
At 20Hz	excellent
At 1kHz	excellent
At 20kHz	excellent
Stereo separation	
At 20Hz	115dB
At 1kHz	110dB
At 20kHz	80dB
Channel phase difference	
At 20Hz	0.1°
At 1kHZ	0.5°
At 20kHz	3.5°
Total harmonic distortion at 0dB	
At 20Hz	−104dB
At 1kHz	−106dB
At 20kHz	−89*
Total harmonic distortion at −10dB	
20Hz-20kHz	−96dB
Total harmonic distortion at −60dB	
20Hz-20kHz	−50dB
Total harmonic distortion at −80dB	
20Hz-20kHz	−26dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	−90dB
At −10dB, 19kHz/20kHz	−96dB
Frequency response	
Left channel	+0.22, −0.15dB
Right channel	+0.22, −0.15dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	−98dB
No emphasis, CCIR ARM, 1kHz ref	−93dB
Output level, 0dB	
Left channel	1.99V
Right channel	1.99V
Output impedance	350 ohms
De-emphasis	correct
Track access time	4.5 secs
Error correction capability	900μm gap, 600μm dot
Mechanical noise	low
Spurii up to 100kHz	> −109dB
Resolution at −90dB	−1dB
Headphone socket	yes
Estimated typical purchase price	£890

including noise



Frequency response; dotted trace is right channel

RECOMMENDED

Technics SL-P7

Panasonic UK Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB
Tel (0753) 34522

Technics' first CD player was the battleship-sized *SLP10*, an early generation model which proved that Technics could put a machine together without outside assistance, this expertise extending to the production of the CD discs themselves. The *SLP7* is a second generation model, fully production engineered to make the most efficient use of materials. Price is well down on that of the *10* as is the size, the *SLP7* being a compact drawer loader with a simplified operating control panel. This proved highly efficient, and showed that there is no need to over-complicate the operation of a CD player.

No numeric keyboard is fitted, but the player can access both track numbers and index points sequentially, which needs less time to do than it takes to describe the facility, despite the need for repeated key depressions. Both search and index keys have two speeds, namely slow on first depression, then faster traverse if the key is held down. As with the Sonys, bursts of cued audio are reproduced at a muted level to aid track location.

Interior examination reveals a simplified design, with extensive use of the most recent LSIs (large scale integrated circuits) which considerably reduce the component count. A single D/A convertor is used, a conventional 16 bit type, time shared, while the output filters are the usual thick-film active modules. Despite the shared convertor the *SLP7* includes phase compensation to equalise the phase angle for the two channels over the frequency range.

The output level is fixed, and the terminals are standard phono sockets. Like most 'basic' models, the *SLP7* is without a headphone socket.

Lab performance

This player exhibited a very good channel balance, typically within 0.2dB. Channel separation was well maintained and over the frequency range at 92dB or better, while inter-channel phase difference was also very low, measuring less than 2° even at 20kHz.

Very slight non linearity was present at full modulation where distortion, both harmonic and intermodulation was fractionally poorer than usual. Still, −90dB distortion at 0dB/20kHz is not to be sneezed at! Indeed the high frequency two-tone intermodulation performance was superior to that of many highly rated preamplifiers. 1kHz harmonic distortion remained respectably low at reducing signal levels. At −80dB modulation the distortion reading was −20dB, and with the 4.3dB amplitude error on the −90dB tone, this indicates 15-15½ bit linearity.

However, the frequency response was very flat, measuring +0.2, −0.0dB 20Hz to 20kHz, with no significant emphasis anywhere.

Output was fixed at close to the nominal 2V, measured at 1.96V from a 320 ohms source impedance. The de-emphasis (generally employed on Japanese CD pressings) was fine, while track access was very fast 2.0 seconds, this a record in fact. Mechanically, a slight whistle was present from the laser head, and a location away from the listener is therefore preferable.

Error correction proved very good, with both the 900μm 'gap' and the 800μm 'dot' errors handled with confidence. Signal to noise ratios were to the full standard, 98dB unweighted and 93dB CCIR ARM (1kHz/weighted), without pre-emphasis.

Spurious responses were well filtered, at better than 110dB down, referenced to peak level.

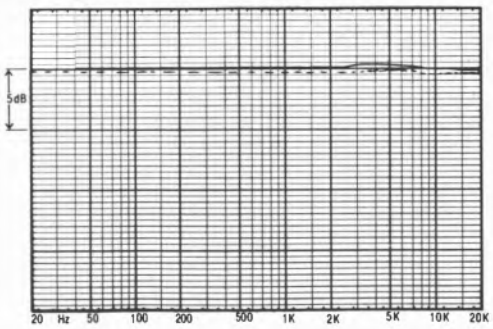
GENERAL DATA	Compact Disc Player
Channel balance	
At 20Hz	0.15dB
At 1kHz	0.2dB
At 20kHz	0.15dB
Stereo separation	
At 20Hz	95dB
At 1kHz	94dB
At 20kHz	92dB
Channel phase difference	
At 20Hz	0.2°
At 1kHZ	0.5°
At 20kHz	1.5°
Total harmonic distortion at 0dB	
At 20Hz	−96dB
At 1kHz	−98dB
At 20kHz	−90dB
Total harmonic distortion at −10dB	
20Hz-20kHz	−88dB
Total harmonic distortion at −60dB	
20Hz-20kHz	−37dB
Total harmonic distortion at −80dB	
20Hz-20kHz	−20dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	> −96dB
At −10dB, 19kHz/20kHz	−60dB
Frequency response	
Left channel	+0.2, −0dB
Right channel	+0.2, −0dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	−98dB
No emphasis, CCIR ARM, 1kHz ref	−93dB
Output level, 0dB	
Left channel	1.96V
Right channel	1.96V
Output impedance	320 ohms
De-emphasis	correct
Track access time	2 secs
Error correction capability	900μm gap, 800μm dot
Mechanical noise	slight whistle
Spurii up to 100kHz	−110dB
Resolution at −90dB	+4.3dB
Headphone socket	no
Estimated typical purchase price	£399

Sound quality

Compared with the first-generation models, including Technics' own *SLP10*, the *SLP7* offered a distinct improvement. The sound was judged to be clearer with a better reproduction of depth, plus a sweeter midband. Bass was good though the treble could show a touch of brittleness; overall it was judged as approaching the Philips standard.

Conclusion

A good basic machine, the *SLP7*s status has been undermined by recent price reductions on the part of Philips/Marantz and Sony, as well as the introduction of more recent second generation designs. It is worthy of recommendation but no longer offers particularly good value for money.



Frequency response; dotted trace is right channel

Technics SL-P8

Panasonic UK Ltd, 300-318 Bath Road, Slough, Berks SL1 6JB
Tel (0753) 34522

A new 'second generation' player, the *SLP8* is an advanced machine incorporating a unique blend of features. The most important of these is the wire-less infra-red remote control — a slim design like those supplied with Panasonic VHS video recorders. The keyboard includes a number array for quick entry of the required tracks.

The machine is a low profile type, with a drawer loader mechanism. There is a versatile digital display which can show total playing time, elapsed time and remaining time. In addition track numbers and index points are shown. Amongst the list of the machine's facilities we must include two speed cueing, with audible music scan, the full track programmability, repeat functions and programme indexing. A headphone socket is included with a level control, but the phono sockets carry the usual fixed output at fairly low impedance.

Interestingly the player includes a variable pitch control, which at first sight seems impossible due to use of the quartz locked frequency reference for the CD speed standard. However, Technics have exploited their synthesiser technology to include a ±6% variation in pitch. User-adjusted speeds are still locked to the quartz reference. Questions then arise concerning the fixed filter, and indeed the normal position of the 21kHz brick-wall filter is then not ideal. However, the compromises involved are small indeed, and for a musician this might prove to be a valuable feature for accompaniment practice.

In other respects, the interior design and mechanics are similar to the *SLP-7*, with extensive use being made of Matsushita integrated circuit technology.

Lab performance

Frequency response was extremely flat with only the slightest ripple observed at the highest frequencies. +0.05 −0.25dB limits sufficed for the entire 20Hz to 20kHz frequency response when running at normal speed.

Channel balance was excellent, the left and right channels overlapping perfectly on the measuring trace. Channel separation was very good, if not up to the standard of the best examples. Inter-channel phase difference was excellently low — in fact under 0.3° over the whole range. Excellent harmonic distortion results were also obtained, at low and mid frequencies and though poorer at 20kHz, giving −85dB of down band, noise signal. This was nonetheless a fine result. 1kHz distortion was low at the −10 and −60dB intermediate levels but was a trifle poorer than average at −80dB, with 10% distortion. Intermodulation 19/20kHz was very good at full level, and further improved at −10dB level to an excellent −97dB of difference tone.

The output level was precisely 2V rms for a usefully low 200 ohms output impedance, well suited to passive control unit use. De-emphasis was well within the frequency response tolerance while the track access was very fast, the 15th test track reached in just two seconds. Mechanical noise was also pleasingly low.

Error correction was first rate, the player passing the largest errors provided on the '4A' test disc — both the 900μm 'gap' and the 800μm 'dot'. The signal to noise ratio was excellent, the 99dB unweighted and 93.5dB CCIR ARM (1kHz) weighted. Spurious output signals were well filtered measuring 106dB or more below the reference output level.

Sound quality

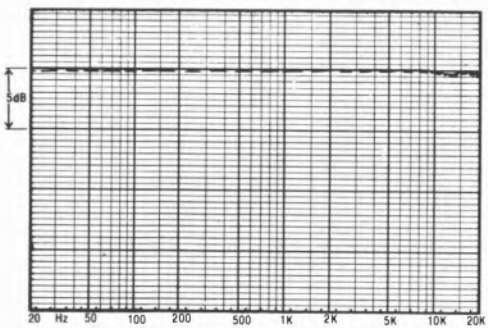
Basically similar to the *SLP7*, the *SLP8* was judged to be marginally superior. Overall, the standard was pretty good when compared with ordinary analogue turntables; however, when put against the best CD players the Technics showed some modest shortfall in stereo precision and depth. A touch of mid hardness was also audible when contrasted with the reference player.

Conclusion

Reaching a good sound standard coupled with a fine lab performance, this versatile player was well equipped with full programmability, headphone socket and remote control. However for some purchasers the variable pitch ability might prove to be the deciding point, and on this basis it is worth considering.

GENERAL DATA	Compact Disc Player
Channel balance	
At 20Hz	excellent
At 1kHz	excellent
At 20kHz	excellent
Stereo separation	
At 20Hz	87dB
At 1kHz	88dB
At 20kHz	75dB
Channel phase difference	
At 20Hz	0.1°
At 1kHZ	0.12°
At 20kHz	0.2°
Total harmonic distortion at 0dB	
At 20Hz	−102dB
At 1kHz	−105dB
At 20kHz	−85dB*
Total harmonic distortion at −10dB	
20Hz-20kHz	−96dB
Total harmonic distortion at −60dB	
20Hz-20kHz	−42dB
Total harmonic distortion at −80dB	
20Hz-20kHz	−20dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	−91dB
At −10dB, 19kHz/20kHz	−97dB
Frequency response	
Left channel	+0.05, −0.25dB
Right channel	+0.05, −0.25dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	−99dB
No emphasis, CCIR ARM, 1kHz ref	−93.5dB
Output level, 0dB	
Left channel	2.0V
Right channel	2.0V
Output impedance	200 ohms
De-emphasis	correct
Track access time	2 secs
Error correction capability	900μm gap, 800μm dot
Mechanical noise	low
Spurii up to 100kHz	> −106dB
Resolution at −90dB	−3.4dB
Headphone socket	yes
Estimated typical purchase price	£499

**including noise*



Frequency response; dotted trace is right channel

RECOMMENDED

Toshiba XR-Z70

Toshiba UK Ltd, Toshiba House, Frimley Road, Camberley, Surrey GU16 5JJ
Tel (0276) 62222

Toshiba were one of the first to take the plunge last year with their first generation *XRZ90* player. A big black box, it produced a pretty fine sound, as well as an unusually fast track access. Its successor, the *XRZ70*, sells for about £200 less than the *Z90* player at £390 and yet it now includes an extremely handy infra-red remote control.

This is a low profile machine which would look at home in a number of rack systems. A headphone socket is provided, with a level control; this also controls a pair of rear panel phono sockets which carry a ridiculously high maximum output level, 7 times (or 11dB above) normal line level! Fortunately, the player has a second pair of outputs at the usual fixed output of 2V maximum.

The front panel in fact seems over-complicated at first glance, with a large number of control buttons. One row provides the 0-9 number sequence for the rapid entry of the chosen track, and full programmability is also provided, together with rapid scanning and cue facilities (not with audible music). The fluorescent display shows track numbers, times and indexing, and when in use it was pretty quiet.

The machine uses a number of Toshiba integrated circuits though the straightforward 16 bit D/A convertor is a bought-in item. A single convertor is used, time shared, with the usual brickwall modular filter removing the spurious digital 'rubbish' above 21kHz.

Constructional quality is good, with fairly easy access to the circuit boards; in this respect it is notably simpler than the first generation model.

Lab performance

Very good channel balance was shown, while the frequency response was very uniform up to a few kilohertz, above which a very slight treble lift was present, just enough to give a slight difference with other machines on direct, critical A/B comparison.

The usual interchannel phase difference was measured, just a few degrees in the mid band increasing to 77° by 20kHz; a difference which so far is considered to be subjectively harmless.

For a CD player the full level harmonic distortion was poorer than average. Some high level non-linearity was shown by the −85dB distortion results at 1kHz, this probably due to the analogue electronics and not considered to be very significant. The result at 20kHz was about average.

Interestingly the distortion improved at −10dB level, where it reached a fine −92dB. This good linearity was then maintained down the dynamic range and, taken in conjunction with the minor 1.3dB amplitude error at −90dB, indicated a good 15½ bit decoder resolution.

Intermodulation distortion (19/20kHz difference tone) was fine. The output from the fixed terminals was to the 2V nominal standard, while the variable output produced up to 5V from a relatively low output impedance, 100-200 ohms. Direct connection to any power amplifier is possible with this machine.

The de-emphasis response was to close amplitude limits and track access was rapid, timed at 3.5 seconds, the mechanism running fairly quiet.

Much improved over the earlier first-generation machine, the error correction was able to deal with the worst the test disc could offer, namely the 900μm 'gap' and the 800μm 'dot'. The *Z90* was below average in terms of signal to noise ratio — OK at 95dB unweighted, probably due again to the analogue circuitry. Spurious rejection was satisfactory at −100dB.

Sound quality

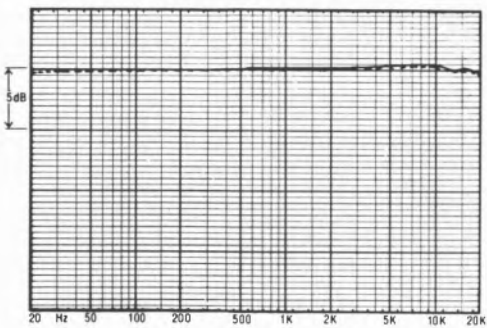
Even tricky discs were handled well, confirming the good error correction ability. The sound quality was up to the fine standard set by the earlier model, but was not considered to be much above the average set by other manufacturer's second generation machines. The usual CD attributes were well in evidence, namely firm bass, zero wow, fine stereo staging plus good focus and image stability. When compared with the best, some mild loss of depth was noted, while the bass was a touch 'softer', the treble slightly 'grainy', and the mid showed a touch of hardness and compression. We could however be accused of a degree of nit picking here!

Conclusion

Toshiba have put together a good value and versatile package with useful, attractive features. Having a good all round performance aside from a fraction more background noise than usual the *XRZ70* does qualify for a recommendation.

GENERAL DATA	Compact Disc Player
Channel balance	
At 20Hz	0.1dB
At 1kHz	0.18dB
At 20kHz	0.13dB
Stereo separation	
At 20Hz	100dB
At 1kHz	98dB
At 20kHz	77dB
Channel phase difference	
At 20Hz	0.1°
At 1kHZ	4°
At 20kHz	77°
Total harmonic distortion at 0dB	
At 20Hz	−80dB
At 1kHz	−85dB
At 20kHz	−80dB*
Total harmonic distortion at −10dB	
20Hz-20kHz	−92dB
Total harmonic distortion at −60dB	
20Hz-20kHz	−53dB
Total harmonic distortion at −80dB	
20Hz-20kHz	−23dB
Intermodulation distortion	
at 0dB, 19kHz/20kHz	−85dB
At −10dB, 19kHz/20kHz	−85dB
Frequency response	
Left channel	±0.2dB
Right channel	±0.2dB
Signal to noise ration	
No emphasis, 20Hz-20kHz unweighted	−95dB
No emphasis, CCIR ARM, 1kHz ref	−88.5dB
Output level, 0dB	
Left channel	2.02V
Right channel	2.02V
Output impedance	variable, 100-200 ohms
De-emphasis	correct
Track access time	3.5 secs
Error correction capability	900μm gap, 800μm dot
Mechanical noise	fairly low
Spurii up to 100kHz	> −100dB
Resolution at −90dB	+1.3dB
Headphone socket	yes
Estimated typical purchase price	£389

**including noise*

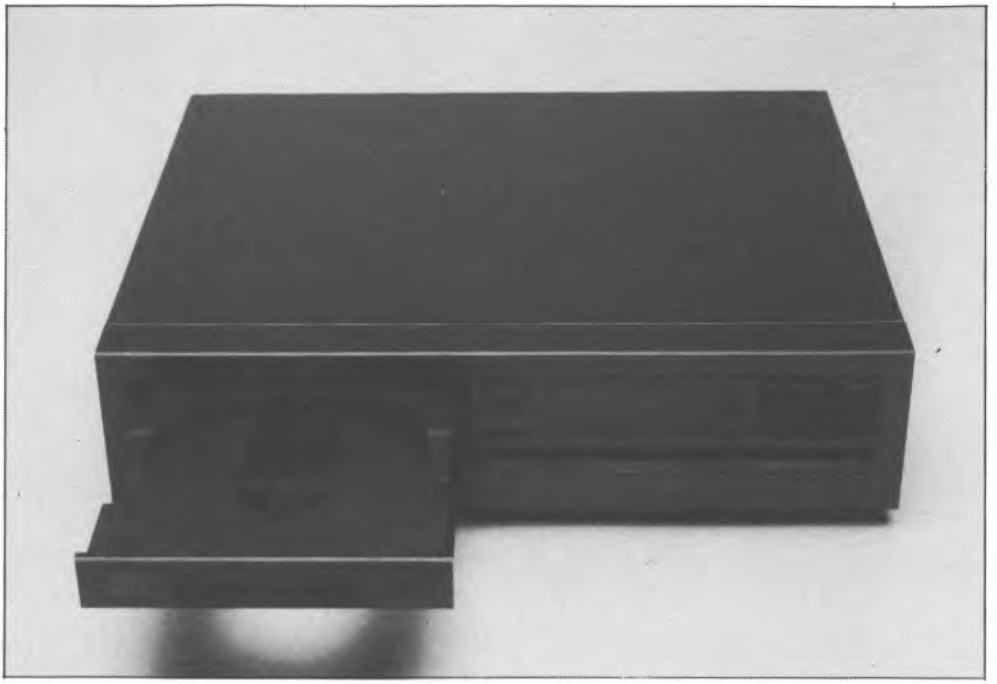


Frequency response; dotted trace is right channel

BEST BUY

Yamaha CD-X1

Natural Sound Systems Ltd, 7 Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 36740



Yamaha's first-generation CD player was very expensive and sold only in limited numbers, but even so acquired a good reputation. Their new model also appears to have done well in Japan, and yet is relatively cheap for a CD machine at around £360. A true second generation machine, like the Technics *SLP7*, it is fully engineered for mass production with use of the most recent large scale integrated circuits, much simpler printed circuit boards and an economic laser head and drive. The case is largely made from plastic, and this machine's light weight clearly points to the future application of CD to portables and the like.

Nonetheless, Yamaha have not skimped on the essential features. The *CDX1* has a play mode selector — auto, start, normal and single track — plus a memory repeat with programmable cue points, a fully programmable track selection memory and two speed music cuing/track selection.

The digital display is in red, which unfortunately is not too distinct in bright ambient light conditions. It shows track number, total play time, track total elapsed time and remaining time.

Yamaha have also provided some innovations on the technical side. Loosely paralleling the Philips technique where four times oversampling is used, Yamaha have chosen just to double the sampling frequency to 88.2kHz, allowing the use of some up-band filtering, which can improve treble resolution, as well as reduce the steep filter demands at lower frequencies. Yamaha use a 7 pole discrete LC type filter in conjunction with a good quality 16 bit D/A convertor (Burr-Brown). The output circuitry is unexceptional which is about what one would expect for the price.

Lab performance

Over most of the range the channel balance was very good, with just a tiny deviation to 0.45dB in the last couple of kilohertz up to 20kHz. The frequency response for the worst channel met close +0, −0.8dB limits, +0, −0.3dB sufficing for the range up to 17kHz.

Channel separation was pretty good, though not up with the best. Phase shift was zero at

1kHz, and increased to a modest 44° at 20kHz. This was due to the doubled sampling rate, which halves the interchannel delay resulting from the use of a time shared D/A convertor.

Total harmonic distortion was very good at full level, and remained so at lower levels, but the amplitude error at −90dB was rather high, the player actually reading −84dB.

Intermodulation distortion was also very good at peak levels; a record −98dB for the difference tone was measured, and this quality was reflected in the other high-frequency tests as well. Output was to the nominal 2V standard, but the output impedance was much higher than usual, at 2.4K ohms. Some attenuation will occur with moderate impedance passive control units.

The de-emphasis was fine and track access a speedy 4.3 seconds. The player could emit a mild mechanical whirr and ideally it should not be placed too close to the listening position.

Error correction was excellent on the tested sample, though an earlier machine gave trouble on one or two music records after it had been left switched on continuously for a number of hours.

The signal to noise ratios were a bit disappointing, measuring only 90dB unweighted, the 86dB CCIR ARM weighted, 1kHz. Analysis should the presence of some digital noise breakthrough in the form of a 'chirping' which was inaudible at normal listening levels. Better circuit isolation inside could easily cure this. Aside from this random in-band noise, the spurious responses were excellently rejected, −117dB at 88kHz for example.

Sound quality

The Yamaha had the ability to make other players sound inferior by varying amounts. By comparison, the *CDX1* was softer, sweeter, less hard and compressed, and more spacious, with a better depth impression. The margin was enough, in fact, to make the other review machines sound subjectively rather more like each other than they had done before.

This is not to say that the Yamaha was perfect — the bass and treble extremes were a little softened, with some mild shortfall in attack and definition. On balance, the superior midrange more than made up for this.

Conclusion

In our view the *CDX1* was the best-sounding player in the review group. It had a couple of weaknesses shown up on test but these did no prejudice the overall result. Possessing fine error correction, good basic facilities and selling at a competitive price, the Yamaha is *HFC*'s Best Buy CD player.

GENERAL DATA — Compact Disc Player

Channel balance
At 20Hz 0.1dB
At 1kHz 0.15dB
At 20kHz 0.45dB

Stereo separation
At 20Hz 88dB
At 1kHz 85dB
At 20kHz 78dB

Channel phase difference
At 20Hz ..... −1°
At 1kHZ ..... 0°
At 20kHz ..... 44°

Total harmonic distortion at 0dB
At 20Hz ..... −102dB
At 1kHz ..... −104dB
At 20kHz ..... −85dB

Total harmonic distortion at −10dB
20Hz-20kHz ..... −88dB

Total harmonic distortion at −60dB
20Hz-20kHz ..... −40dB

Total harmonic distortion at −80dB
20Hz-20kHz 23.5dB

Intermodulation distortion
at 0dB, 19kHz/20kHz ..... −98dB
At −10dB, 19kHz/20kHz ..... −85dB

Frequency response
Left channel ..... +0, −0.8dB
Right channel ..... +0, −0.4dB

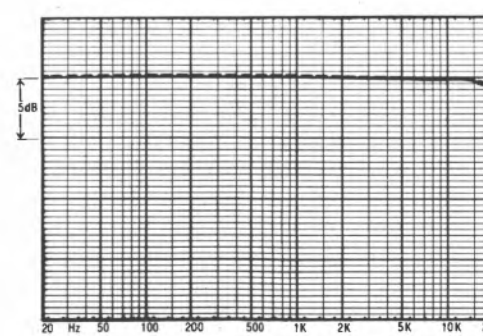
Signal to noise ration
No emphasis, 20Hz-20kHz unweighted ..... −90dB
No emphasis, CCIR ARM, 1kHz ref ..... −86dB

Output level, 0dB
Left channel 2.15V
Right channel 2.17V

Output impedance ..... 2.4k ohms
De-emphasis ..... correct
Track access time ..... 3.5 secs
Error correction capability ..... 900μm gap,800μm dot
Mechanical noise ..... slight whirr
Spurii up to 100kHz ..... −117dB*
Resolution at −90dB ..... +6dB
Headphone socket ..... no
Estimated typical purchase price £359
**in-band 'chirping' at −100dB*

Stop Press

A recent sample showed reduced background noise.



Frequency response; dotted trace is right channel

Price Breakthrough

PICKERING XV-15/625 E

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* Excludes abuse & Stylus wear

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& Stan Curtis again
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It is now 30% lower at £30!

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David Prakel rated;
value for money... 75%
& "naturally smooth and clear"
It is now 26% less at £20 and now must rate...
Value for Money... 101%

Popular hi-fi Aug '83
XV-15/757S at £42.50
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with "a lot of potential"
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Value for Money... 105%

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with "an enthusiastic review"
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COMPACT DISC PLAYERS: CONCLUSIONS AND BEST BUYS

This edition is the first in which we have been able to make a comprehensive comparison of Compact Disc players, including some of the true second-generation models which are now gradually becoming available from several makers.

We have come some way since our early tests of CD players in the last *Turntables* edition. At that time we were able to make some assessment of the players available at the system launch in March 1983; for this edition, we have most of the genuinely current machines, some manufacturers' ranges still being in a state of flux. For example, the Kyocera-based machines, notably the first Akai model, are currently available at special low prices which relfect their first-generation design, and newer versions must be expected sooner or later. Many companies nominally have CD players in their catalogues, but these are often deliberately in limited supply — the intention being simply to show a presence in the field, rather than to properly supply the market.

Compact Discs themselves were originally in severely limited supply, but this situation has changed greatly since the last edition, and a good choice is becoming available for the lighter rock and classical enthusiast building a new collection. It is still however limited in scope and before purchasing a player, it would be worthwhile scanning the CD racks to make sure that you could obtain a worthwhile selection of discs of your type of music. For example there are not many good jazz CDs, and other special interest groups are also poorly served — a situation unlikely to be remedied in the foreseeable future.

What is apparent, though, is that CD has settled down well during this first year of production both as regards the players and the discs, these providing an available and highly reliable music source. Essentially, error problems have been solved, and the quality standard is high — in fact must be considered competitive with analogue disc player alternatives for most users. Further gains in stereo depth and 'sweetness' are apparent with the most recent players, and this continuing process, in conjunction with improving standards of programme production and digital mastering, will provide further rewards. Acceptance by most audiophiles is now a distinct possibility, as the system evolves.

The general characteristics of the CD medium have been covered fully in the *Technical Introduction*, which also deals with the comparison of CD with conventional analogue reproduction. While the differences between CD players may be regarded as small (relative to those that exist between analogue systems), they were clearly revealed in our tests and are certainly significant.

BEST BUYS

Yamaha CDX1 (£360)
Compact, versatile and with a winning sound quality, this true second-generation player is the first *HFC* 'Best Buy' CD player.

Marantz CD63/Philips CD100, CD101 (£300) (£300-£400) CD73
The *CD100*, the Marantz equivalent model *CD63*, and the recently-introduced Philips *CD101* represent the basic European-built CD player and give good sound. Further price reductions make these players inevitable best buys as long as they are available.

RECOMMENDED

Philips CD104 (£330)
In addition to the fully-reviewed Philips models, we looked at the *CD104*, an attractive front loader, which at this stage can be provisionally recommended. Marantz equivalents are likely to be similar.

Pioneer CD-70 (£400)
This second-generation Pioneer player has some versatile functions and gave a good lab performance along with better-than-average sound.

Sony CD-P101 (£425)
Currently improved in sound and in error correction, this well-built player has good facilities including infra-red remote control.

Toshiba XRZ70 (£385)
Possessing essentially average sound quality, this player is very well equipped, including infra-red remote control, and offers good value.

WORTH CONSIDERING

Players judged to miss the 'Recommended' category but still worth considering were; **Hitachi DA800; Sony CD-P701es; Technics SLP7** and **SLP8.**

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 the 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 to the DIN B curve, to bring te 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: Equivalents 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 = 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 platt 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. 33⅓rpm 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.

ADVERTISERS' INDEX

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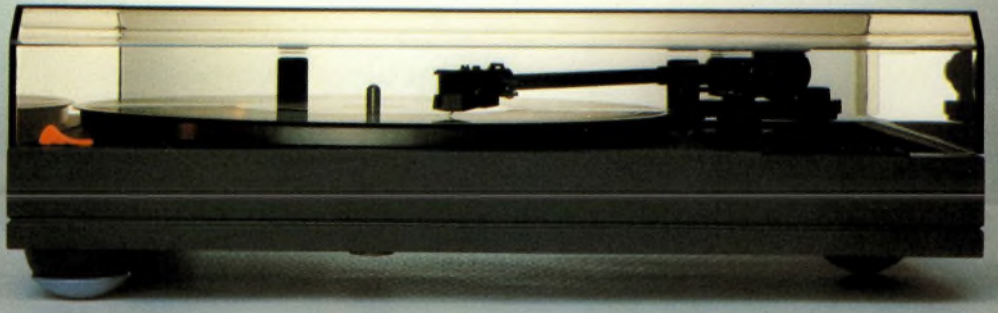

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