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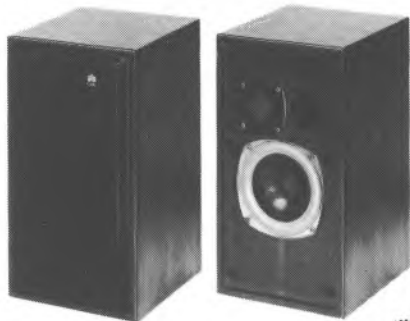
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HOW TO USE THIS BOOK

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

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

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

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

After the reviews proper, there is a short section of *Summary Reviews*, intended to cover briefly models tested in earlier issues which might still be available, or models for which we feel our data may not be entirely representative.

There is also a short feature on *Plattermats*, which can significantly affect the sound of the better turntable systems. This is updated from the previous issue to give some guidance to commercially available mats and the effects they can have in altering the tonal balance and colorations of a player.

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

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

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

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

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

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This is the fourth edition of *Choice* to deal with turntables and tonearms, and represents a significant shift in editorial policy, partly deliberate, partly involuntary. The schedule of this edition was such that many of the models due to be launched for the Autumn season by major Japanese manufacturers were not available in time. This is something of a pity, though past experience has shown that detailed examination of the vast majority of the players intended primarily for rack system sale is a fairly soul-destroying task. (In fact one sales manager told me he probably could have got us early samples, but wasn't planning to, as *he* knew how bad they were, and he didn't particularly want us to tell everyone else!)

If the 'bottom end' is a little sparse, high priced motor units are today's fast breeders. A few years ago these were an endangered species, but now we must devote considerable space to an area which receives an almost obsessive amount of attention from enthusiasts. We have gathered together an unprecedented collection of the most interesting exotica, whose comparison makes fascinating reading. Largely to accommodate the pretensions implicit in their pricing, and also to extend our consideration of the matching of separate components, we have expanded our coverage on many of these. *In toto* then we have been rather more selective in the product which has been included this time, but carried out our analyses in rather greater depth on components which appeared to warrant such treatment.

It is of course a shame to have missed out on the new cheap ranges from names like Sony, Technics and Marantz. Some models from the last edition which are still likely to be around on dealer's shelves for a while have been included as *Summary Reviews*. We have acceded to Rega's request for omission on the grounds that demand continues to outstrip supply; their inclusion in the last edition at least established that they are not perpetrating a 'mystical' confidence trick upon the public. Again on availability grounds the 'black' *Iltok*, Goldmund player and Micro-Seiki heavyweight turntables were omitted: the former is a 'test bed' whose improvements are gradually being incorporated in the standard model; the Goldmund is a French audiophile-orientated parallel tracking player of enviable reputation (all of which sounds like a bizarre contradiction in terms to me); M-S, like Goldmund, are sadly not available in the UK.

It is rather dispiriting to note, by and large, that cheaper turntables get progressively worse over the years, so that the better, more expensive models paradoxically seem to offer improving value for money. There are two main reasons for this. The cheap 'system' end of the market desperately tries to keep the prices of turntables and loudspeakers comparable with those for the electronic components, without coming to terms with the fact that 'rude mechanicals' have suffered much more inflation than electronics in recent years; the net result is turntables and speakers quite unworthy of the description hi-fi. In contrast top-end components are usually kept on the market for a number of years, with little attempt to peg prices and with the advantages of development and refinement.

Development certainly pays dividends, though it makes things tricky for the reviewer. It is perhaps ironical that the Thorens 160 and Linn *Sondek* designs both did well in our original turntable book, and maintain this position today; in the interim they have changed significantly, though not dramatically. The more exotic models tend to take a little time for the designs to 'settle down', and where the reviewer makes some pertinent criticism, he does so knowing that it is quite likely to receive attention before long. Our evaluations have to be based on the samples we receive, and although we try to be flexible over changes during the project, the purchaser is advised to try and confirm our findings rather than assume that a sample he may be considering is necessarily identical (it may be, but it may also be better – or worse!).

Looking back at my editorial for the last book, I am reminded again (yawn!) of the impending arrival of the digital Compact Disc, which seems no nearer now than it did then. The degree of procrastination, the priorities given to video over audio at present, and a variety of commercial problems still to be overcome makes me believe that there are quite a number of years left in analogue LP discs (even though CBS and others seem inclined to screw it all up prematurely by introducing a compression noise reduction system).

I propose to close this editorial by exhorting readers to use us as a guide rather than to follow us slavishly when buying hi-fi. And to draw attention to our companion *Cartridges & Headphones* volume (published Oct '80, still substantially current), to help in choosing a cartridge which is well matched to the record deck.

Paul Messenger

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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 sep-

arate 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 undesirable; 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-

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

Choosing the right turntable system.

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

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

changing the speakers for ones that have a less extended bass response can also clean up the sound coming from the turntable system!

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

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

The Job of the Turntable System

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

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

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

In order to further emphasise the inherent mechanical problems that the system has to try and overcome, it is both instructive and disturbing to examine the different magnitudes involved. This was poignantly portrayed by E. B. Meyer in the Boston Audio Society's magazine *The Speaker*, so I will draw heavily upon his data. To start with we must understand that the 'audio bandwidth' is the range of frequencies the human ear can hear, and extends from 'vibration rates' or frequencies from 20 to 20,000 cycles per second (abbreviated Hz).

(There are arguments that frequencies below 20Hz are also important, but this is still a matter for debate and it would only further complicate the issue to deal with them here.) Likewise the human ear can easily detect differences in loudness that encompass 60dB, or a ratio of 1,000,000 :1. Even the simplest music is likely to contain enormous numbers of these frequencies at all these different levels at any one time, and the problem for the record deck (and the hi-fi system as a whole) is to get as much of this back as possible, while avoiding adding too much extra of its own.

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

Assessing the System's Performance

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

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unwanted 'microphone' that will promote feedback. Turning to the pickup arm, it is necessary 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 undesirable 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?

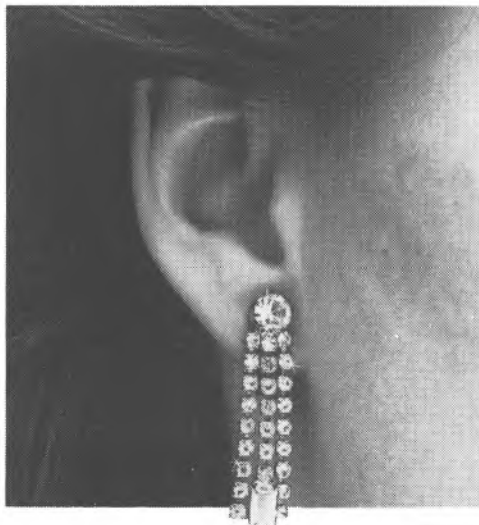
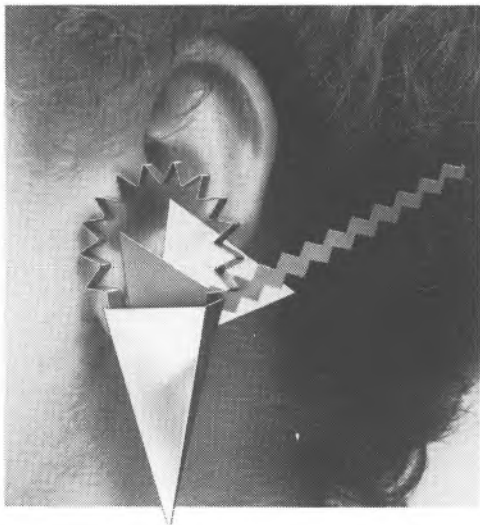
Absolute speed accuracy and drift stability, providing they are not severe, are unlikely to trouble the great majority of listeners at all. A minority of people (typically one per cent) are blessed — or cursed — with a sensitivity to and

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

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Mullard A sound basis. 

CONSUMER INTRODUCTION

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 technique 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 suitability 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 to 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

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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.

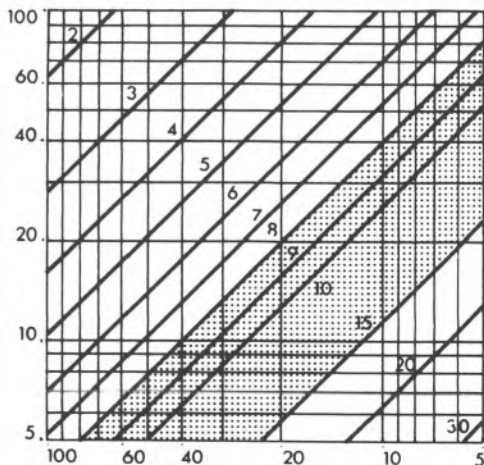
Getting back to the real position of the cartridge, stylus, and groove, we should get little relative movement and hence output below resonance, substantial output and possible tracking problems at resonance, and 'normal' output corresponding to the groove modulations above resonance. Now we are obviously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

MASS/COMPLIANCE/RESONANCE RELATIONSHIPS.

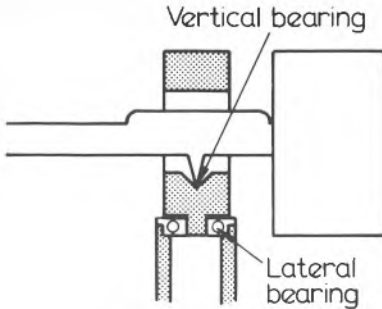
Calculating the main arm/cartridge resonance is relatively simple if one knows the following details; arm effective mass; cartridge mass; cartridge compliance.

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

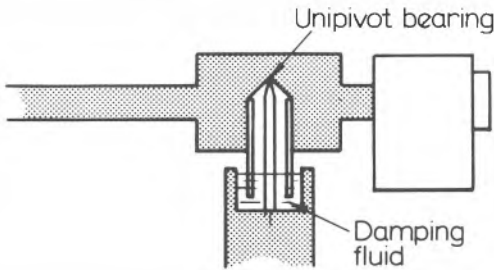
While not infallible, this technique usually gives useful and meaningful results.



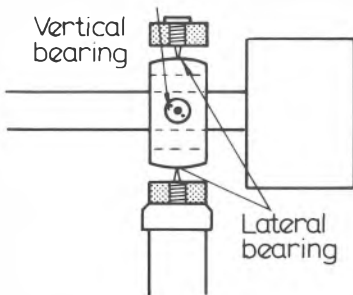
THREE TYPICAL ARM BEARING TYPES



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



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



3. The gimbal type bearing should be independent 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 undesirable 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

CONSUMER INTRODUCTION

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 intrinsic 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 undesirable 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'.

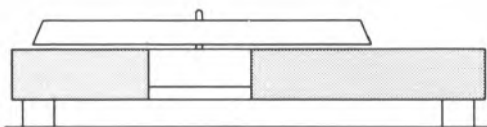
One cannot at this stage make definite assertions about the 'correct' approach to these situations, but evidence does suggest that systems resolving the most musical detail couple the cartridge closely to the arm tube, avoiding resonances as much as possible, and provide the finest bearings to transmit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

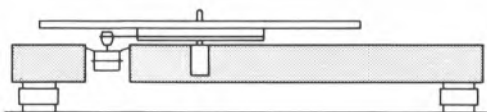
Pickup arms tend to use a limited number of engineering principles, and designers or their advertising agencies can be fiercely partisan about their chosen approach. It is true that some outstanding no-compromise systems can work extremely well for some people, but others may not find them to their taste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

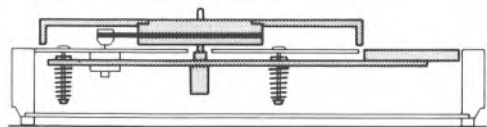
THREE TYPICAL TURNTABLE DESIGNS



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.

Don't read



d. Listen.

There's no need to spend sleepless nights over choosing a cartridge.

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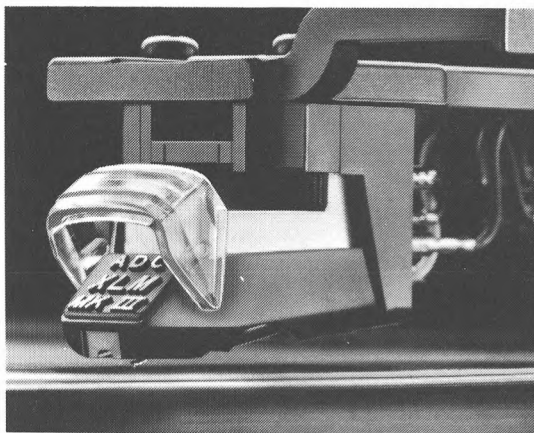
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John S. Wright of GRAMOPHONE listened...

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The best cartridge ever made! No compromise design with extended contact diamond stylus fused by laser onto a sapphire crystal cantilever and located in an Orbital Pivot

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XLM MK III IMPROVED

Widely acclaimed low mass design with nude mounted elliptical stylus on a tapered cantilever. Tracks at 1.2 grams - 0.3 grams.

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As XLM but with straight cantilever for applications requiring a more robust stylus assembly without loss of performance. Tracks at 1.2 grams - 0.3 grams.

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Unique Diasea elliptical stylus nude mounted onto straight cantilever. Reduced tendency to resonance, lower mass and better tracking ability than similarly priced conventional cartridge with bush mounted stylus. Tracks at 1.2 grams - 0.3 grams.

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Scunthorpe Leswright Tel: 67738

KENT

Beckenham Hi-Fi Connections Tel: 01-658 3540

Beckenham S.M. Music Tel: 01-650 4701

Bromley Sound Systems Tel: 01-460 4000

Bromley Halton Electronics Tel: 01-464 2600

Canterbury Canterbury Hi-Fi Tel: 65315

Canterbury Hy-Tek Electronics Tel: 39402

Margate The Longplayer Tel: 29357

Sevenoaks Sevenoaks Hi-Fi Tel: 35555

Tonbridge Standlers Tel: 35340

LANCASHIRE

Blackpool F. Bentley Tel: 49625

Blackpool H. Wiseman Tel: 29416

Chorley Monitor Sound Tel: 71935

Llytham Badgertracks Tel: 72947

Rochdale Cleatone H.I. Tel: 524652

Southport Audio Corner Tel: 37332

Southport Southport Hi-Fi Tel: 39001

LEICESTERSHIRE

Hickley Hinckley Sound Centre Tel: 61544

Leicester Leicester Hi-Fi Tel: 667801

Leicester Mays Hi-Fi Tel: 58662

LINCOLNSHIRE

Boston Oldrads Tel: 61251

Lincoln Critch Choice Tel: 38718

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R. Barden EB Tel: 01-254 8811

Cavendish Sales EB Tel: 01-257 3453

D & J Electronics, E10 Tel: 01 556 0017

Gem E11 Tel: 01-556 0223

Kimberleys Hi-Fi E12 Tel: 01 478 1176

Parkwest Electronics EB Tel: 01-2494814

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Amor Audio N14 Tel: 01-886 3094

Analog Audio N12 Tel: 01-445 3267

Andy's Electronics, N10 Tel: 01-883 8699

Atlantic Electronics, N10 Tel: 01-883 6931

Bartletts Hi-Fi Centre, N7 Tel: 01-607 2296

Cannonbury Audio, N1 Tel: 01-257 9332

Fotronix Int. N15 Tel: 01-882 0137

Goodwins, N22 Tel: 01-808 4077

Graham's, N1 Tel: 01-837 6412

Martins Hi-Fi Centre, N16 Tel: 01-254 5053

Mason Radio, N4 Tel: 01-837 1231

W. Redfern, N19 Tel: 01-7272813

LONDON NORTH WEST

Atlantic Electronics, NW10 Tel: 01-4510302

Avon Electronics, NW2 (GW 2 stores) Tel: 01-267 7223 and 01-485 8709

Sange Processing Systems, NW4 Tel: 01-202 5592

Studio 99, NW6 Tel: 01-326 6666

TV & Hi-Fi Studio, NW2 Tel: 01-450 3508

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Billy Vee, SE13 Tel: 01-318 5755

L.P. Stereo, SE5 Tel: 01-990115

LONDON SOUTH WEST

ACV, SW16 Tel: 01-769 3763

Chelsea Hi-Fi, SW3 Tel: 01-3510200

Hi-Fi & Hi-Fi, SW Tel: 01-402 2110

Juniper Audio Centre, SW12 Tel: 01-767 2810

Hi-Offen, SW19 Tel: 01-846 1520

Sounds & Video Centre, SW1 Tel: 01-673 3398

South London Hi-Fi Centre, SW2 Tel: 01-674 2033

South London Hi-Fi Centre, SW2 Tel: 01-747 0132

LONDON WEST

Azat (London), W1 Tel: 01-580 4532

Earls TV & Hi-Fi, W1 Tel: 01-749 3718

Hi-Fi Care, W5 (5 stores) Tel: 01-580 3459/783 and 01-629 0371

Hi-Fi Care, W1 Tel: 01-580 7383

Mason Radio, W12 Tel: 01-743 3698

Musical, W2 Tel: 01-402 9279

Nandos, W2 Tel: 01-723 6089

REW, W1 Tel: 01-634 2624

Radio Electronics, W1 Tel: 01-229 6411

Some Sound Audio, W1 Tel: 01-637 1909

Stinsons, W1 Tel: 01-637 8177

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Hazlewood: Chestergate Studios Tel: 01-483 9876

Manchester: Central Radio Tel: 061-834 6700

Stockport: Bespoke Tel: 061-658 513

Stockport: Fairbroths Tel: 061-480 4872

Urmston: Lydon-Paton Tel: 061-749 9722

Urmston: Shannon Radio Tel: 061-749 2313

Wigan: Wigan Hi-Fi Tel: 37977

MERSEYSIDE

Crosby PA Audio Tel: 051-924 7287

Liverpool: Beaver Radio Tel: 051-7099988

Liverpool: W. Brady Tel: 051-733 6859

Liverpool: CBS Tel: 051-690 088

MIDDLESEX

Eastcote: Eastcote Hi-Fi Tel: 01-868 2946

Greenberg: Planet Hi-Fi Tel: 01-892 3238

Enfield A.T. Labs Tel: 01-363 7994

Greenberg: Greenberg Electronics Tel: 01-578 9699

Ruislip: Manly F.A.S. Tel: 32217

Wemyss: Wemyss Hi-Fi Tel: 01-903 9506

NORFOLK

Great Yarmouth: Martins Electronic Centre Tel: 55044

King Lynn: Lyons Electronic Centre Tel: 61683

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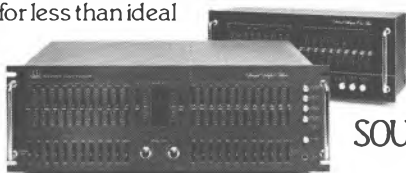
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The Quad ESL-63 at Harrogate

The Quad ESL-63 will be on demonstration at the Harrogate International Festival of Sound August 15th-18th in the Duchy Room-Cairn Hotel.

Complimentary tickets for demonstrations may be obtained in advance by writing to or telephoning The Acoustical Manufacturing Co. Ltd., stating day and time preferred.

Demonstrations will be held every twenty minutes from 11.00 a.m. to 7.40 p.m. on Saturday 15th and Sunday 16th August and at the same times on Friday the 14th.

Please note that the exhibition is not open on Friday the 14th, but by kind permission of the organisers we are opening a day early to give

members of the public an opportunity to listen to the Quad ESL-63 in comparative tranquility.

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For this fourth edition of *Turntables and Tonearms*, the product coverage has undergone necessary and significant revision. A sudden burgeoning of 'quality' items, notably motor units devoid of arm, together with certain perceived market trends, indicated that the best approach would involve a somewhat reduced selection of the mainstream and increasingly rack-oriented imported integrated models, to allow correspondingly more attention to be paid to acoustically advanced types, particularly those of UK design.

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.

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 quantify. For example, stereo imaging can be flawed in terms of both clarity and the ability to reproduce depth, due to instability in subchassis systems or unwanted energy input to the cartridge; the low bass range may be weakened due to incipient feedback cancellation, and its upper registers appear boomy and emphasised for the same reason. Midrange quality can be coloured due to the resonances in lids, plinths, and their supports,

as well as arm mounting boards, disc support (mats etc), platters and subchassis structure. Low mass platters are easily excited in acoustic terms, and they tend to suffer the greatest vibration amplitudes in a heavy plinth system; rotational inertia is also small, and under recorded modulation variations, dynamic wow can occur as a result of stylus drag changes.

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.

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 has minor revisions only, 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).

TECHNICAL INTRODUCTION

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. Other decks can sound equally as good, if not better in certain respects, but cannot be made to sound the same, and that difference can often be a source of confusion to the listener. For example, it can be shown technically that a felt mat is far from ideal and endows a turntable with a recognisable character. But remove it from a well set up *Sondek* equipped with the matching *Ittok* and *Asak*, replacing it with a 'better' mat, and the overall sound in subjective terms is generally the poorer for the substitution.

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 from 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 arm-board, the plinth, platter, disc and the subchassis.

The isolation accorded to this energy by the turntable is a key factor in determining sound quality and may be quantified on a comparative basis. The energy breakthrough to the cartridge is shown on the graph (Fig 1) and has been recorded for acoustic and vibration separately. Both should be assessed in unison, since in practice they occur simultaneously.

A vibration table was constructed using a high power linear exciter, and this was equalised to produce uniform acceleration of a random noise source over a 10Hz to 500Hz range. Turntables placed on this table could then have their vibration isolation measured on a comparative basis in this range. An equalised airborne sound field was provided by an AR3A woofer system, again in the dominant 20Hz to 500Hz frequency range, the scale being 10dB per vertical amplitude division and 50 Hz per linear horizontal division (see calibration for new curves, Fig. 1). The test cartridge rested on the first third of a flat non-rotating record, and its output was equalised to

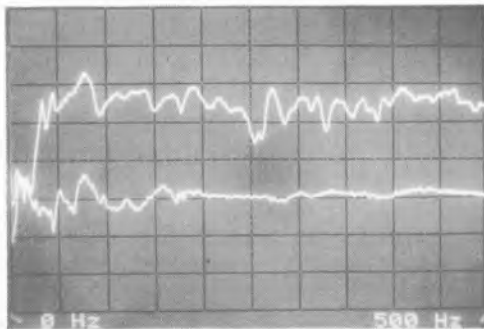
the normal RIAA standard before display on the spectrum analyser (*HP3582A*).

Subchassis behaviour

In addition to the measured isolation performance, other aspects of the mechanical filtering fitted to most turntables were also examined. If possessing poor stability when subject to shock, such mechanisms can worsen the performance, as in the case of subchassis resonance modes that are too close to or coincident with the arm/cartridge resonance. If this occurs, the cartridge performance is severely degraded, with resulting mistracking, scrub flutter, and other problems, due to constant interaction between the two coupled resonances. Ideally the subchassis modes should be moderately damped—a Q of 3–5 is appropriate—with a main resonant frequency in the 3–6Hz range, which will not adversely affect the rejection of higher frequency vibrations. This assumes a sensible arm/cartridge resonance at least an octave higher: around 9–12Hz is necessary to avoid interaction between the two.

Record damping

Energy appears in the record from stylus/groove interaction and acoustic excitation. The former has often been dismissed as unimportant, but is now recognised as a major factor in determining differences in the tonal qualities of mats (or disc supports in general). The termination and absorption of disc energy is also an important factor, with the choice of disc support a further element in fine-tuning the balance of a musically satisfying high performance ensemble. This time a test was used to explore a particular aspect of disc support damping as well as to reveal the presence



Breakthrough calibration signals: above soundfield (acoustic); below, acceleration (platform vibration) (lin freq; log amp).

of platter/subchassis support resonances (similar to that first described by Moncreiff). A light plastic rod of approximately 4g mass was allowed to fall some 4cm, to impact at 45° at the edge of a record, while an equalised cartridge sensed the resulting impulse transmitted to the opposite side of the record. Large undamped pulses were scaled on a 'X 1' presentation, while the smaller, better damped examples were magnified by 20dB (the 'X 10' presentation); these scale factors need to be borne in mind when comparing data.

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 close-coupled, less compliant moving-coil cartridges, the Dynavector 10X, used to illustrate resonant interactions with the tonearms we tested, being an example of the latter. Its compliance measured 18×10^{-6} cm/dyne (18cu), and the acceleration in the side of its die cast 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 torsional 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 the 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 imperfections 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 the 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 occurring 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 (see *Helius*, *Hadcock* graphs).

Arm effective mass and arm/cartridge subsonic resonance

Earlier issues of this series were rightly concerned over the poor compatibility of many tonearm/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

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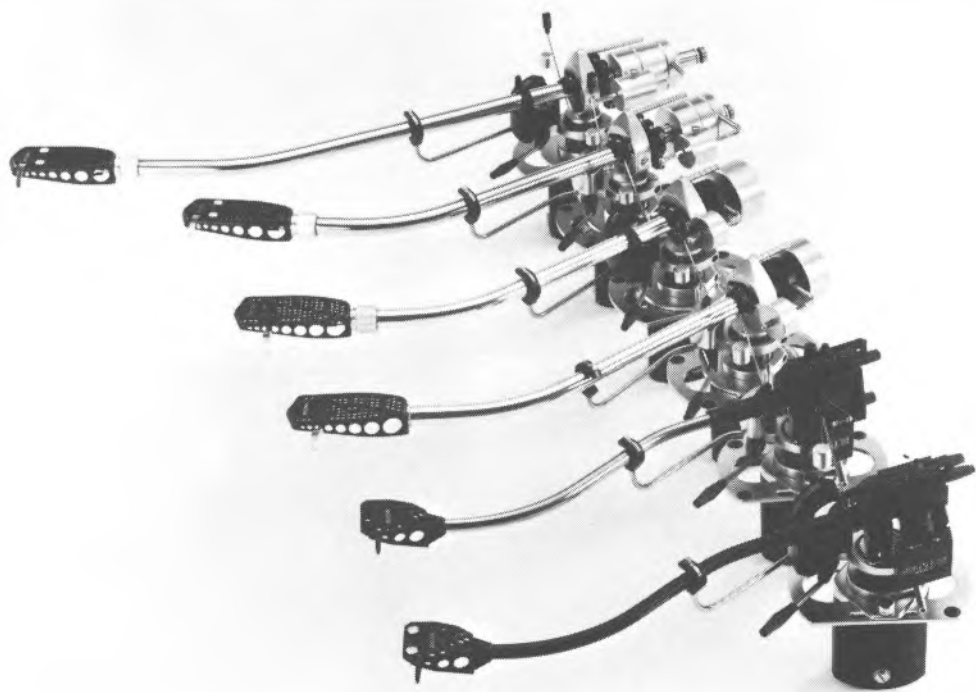
There are now six models in the range of SME precision pick-up arms covering all cartridge and deck requirements.

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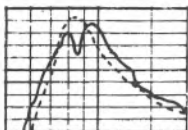


Fig. 2. Linn/Breuer resonance interaction: sub-chassis free (solid) and clamped (dotted).

poorly-damped 5–7 Hz 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 seems 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*.

Theoretically, a system resonance in the 9–12 Hz range with a rise of 5–10 dB currently provides the best compromise.

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 the last 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 30 kHz, 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 16 kHz), 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.

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 –80 dB, rather than the –65 dB attainable from the best records or the –73 dB 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 of rumble noise. With the help of the 'coupler' we have discovered that while a –72 dB DIN B figure was in some instances insufficient to guarantee inaudibility, with others measurements as poor as –66 dB 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 V15/IV with damper was mainly employed for the flutter tests, in place of the Ultimo). 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%.*

While still on this subject it is particularly interesting to note that some 0.1% unweighted peak wow can be produced by an off-centre displacement of the record of as little as 1mm which can be the result of poor record manu-

facture, 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 33 1/3 rpm, the wow frequency is 0.5Hz approximately, a rather slow rate.

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

Arm Geometry and Cartridge Alignment

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

A few degrees of cartridge misalignment will degrade the channel separation of a high class cartridge by a factor of some 15dB, but on the other hand it will produce relatively little impairment of the already moderate separation characteristic of a less expensive pickup. At present the importance of accurate arm alignment is highly underated. Virtually all Japanese arms and turntables are currently supplied with an alignment procedure called 'overhang adjustment', which is accomplished by altering the amount the stylus tip overhangs the record spindle when the cartridge body is aligned immediately above it. But this is next to useless when quality cartridges are involved. While a 1° error can be easily seen and corrected with a protractor, a small 1mm overhang error (less than 4/100 of an inch) can produce a similar degree of misalignment. One solution would be to use one of those protractor cards that are supplied with a number of universal

*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).

TECHNICAL INTRODUCTION

pickup arms, as these have an array of parallel lines against which the cartridge side face can be aligned when the stylus point is in a specified position. However the majority of protractor cards (SME and its counterparts) have a stylus point at a 6cm radius from the spindle, working on the basis that the optimum tracing distortion trade-off will thus be obtained, if using a traditional spherical stylus and a mix of 45 rpm singles and 33 $\frac{1}{3}$ LPs. In practice, this is not the best solution for the mean music radii of today's 33 $\frac{1}{3}$ LPs (45s discounted), particularly if used with the now almost universal elliptical and line/hyperbolic styli supplied with hi-fi cartridges.

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

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

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

set visually parallel have cantilever/generator axis 'rake angles' as great as 40°.

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

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

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

SUBJECTIVE TESTS

Each turntable was placed on a substantial wooden coffee table, located some 2m 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 tonarms was undertaken on a rigid wall-mounted platform, well-spaced from the speakers to minimise the turntable colorations.

Conceding that a firm and neutral extreme low

frequency range performance was difficult to achieve in my calibrated listening room, and also that its tonal balance was somewhat closer to a recording studio than many typical domestic listening rooms, we took the opportunity to use Studio 99's new 'Concert Room' listening facility at Swiss Cottage. Their (Naim) tri-amped Linn *Isobariks* were chosen as providing the cleanest low frequency delivery at good power levels, and were employed for the auditioning of a considerable proportion of the front rank models, in order to further aid their differentiation and classification.

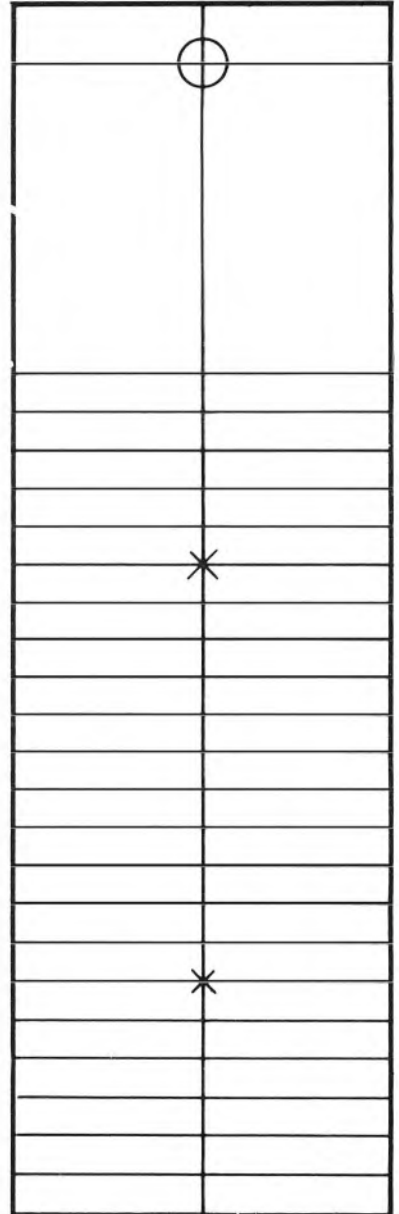
The *Concert Room* is rather unforgiving, showing an airy, light and bright character, tending to excess treble, but at the same time offering a spacious and relaxed perspective with exceptional low frequency solidity and attack. Since the Linn player was included, care was taken to assess and account for its special performance in an environment to which it was arguably more suited than any other player. Consequently the use of the *Sondek* as a reference was avoided as far as possible.

Speakers used in the tests in my room at home included the latest Mission 770s, the new Quad '63 electrostatics and the KEF *R105 II*, with the amplification mainly provided by Lentek. Test cartridges at the high quality end included very recent and matched *Asaks*, the *Koetsu* (wood), *Dynavector Karat*, *Technics EPC205 III* and *Shure M97HE*.

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.

Even using the same arms problems remained – for example, the arm/base interactions mentioned earlier. In general the *Ittok* was the highest ranked tonearm, but it did cause us some worry in that its sound quality differed quite significantly depending on which motor unit we used.

My own conclusion is that there is no such thing as a universal high performance motor unit, since the consequences of leaving other matters of disc support, arm and cartridge in someone else's hands usually prejudices the end result. I

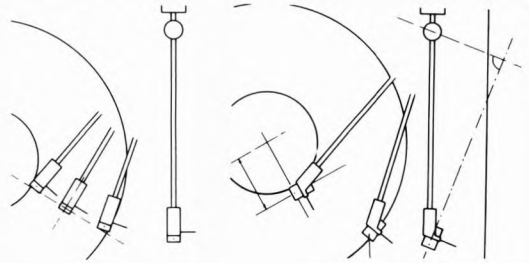


Alignment Protractor

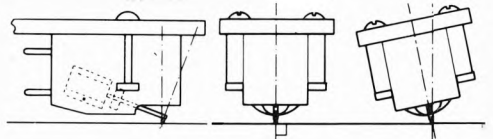
TECHNICAL INTRODUCTION

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.

Thanks are due to Gunther David, my assistant; to Marianne Colloms for her help in pre-editing and typing copy; to Paul Messenger, David Prake, John Atkinson and Alan McGechan for listening services; to KEF, QUAD, Mission, Lentek, Dynavector, Linn, Shure, Technics and Absolute Sounds for the loan of ancillary equipment, and to John Teller of Studio 99, Fairfax Road, London NW3 for the use of his new listening room.



The above diagrams show that the arm with offset head angle reduces lateral tracking errors.



Viewed from the side, the vertical tracking angle (v.t.a.) should be about 20°. Largely controlled by the cartridge design/manufacture, arm height adjustment allows 'fine tuning'.

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

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First system of musical notation. It features a grand staff with a treble clef on the upper staff and a bass clef on the lower staff. The key signature has three flats. The music consists of a series of eighth notes with a slur over them. Fingerings are indicated by numbers 1, 2, and 3. A dynamic marking of *ff* is present. A fermata is placed over the final note of the system.

Second system of musical notation. It features a grand staff with a treble clef on the upper staff and a bass clef on the lower staff. The music continues with eighth notes and a slur. Fingerings are indicated by numbers 1, 2, and 3. A dynamic marking of *ff* is present. A *Ped.* marking is located below the bass staff.

Third system of musical notation. It features a grand staff with a treble clef on the upper staff and a bass clef on the lower staff. The music continues with eighth notes and a slur. Fingerings are indicated by numbers 1 and 2. A dynamic marking of *ff* is present.

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Features and design

This new US-built model is intended to provide a universal mounting for a number of component tonearms, including those in ADC's own line. Of sombre appearance, it is finished in satin black, with the plinth of the solid block plus rubber feet variety. The pricing places it in the middle ground among such other motors as the Thorens TD160 and STD 305S, and for it to succeed it needed to produce a competitive performance; unfortunately, this does not appear to have been the case.

The major working parts are derived from the old *Accutrack*, including the Matshushita *MKL* motor and matching alloy strobe-patterned platter. This motor has long been known for its dynamic wow effects, while in addition the traditional ADC mat with its minimal disc contact does not possess good damping properties. The unit is entirely manually operated, and provides two speeds plus a variable fine control, which is necessary if the correct speed is to be maintained.

Lab results

Sample one suffered from excessive mains breakthrough rumble, which was improved but not perfected on the second sample to 67/74 dB DIN B L/R. The measurements were otherwise pretty good for speed and steady wow, but an estimated $\pm 0.3\%$ peak wow was produced under the program drag variations imparted by the stylus. Disappointingly below average or just average results were recorded for acoustic and vibration breakthrough, while disc damping was also poor, as illustrated by the 'X1' scaled impulse photo. However, the relatively heavy base and cover construction offset the worst effects of this limited isolation design, and while the rumble spectrum shows the serious 100 Hz and 300 Hz components, these were ameliorated with the second sample.

Sound quality

Auditioned with ADC's *LMF1* and *ALT1* tonearms, the sound quality proved just average. Stereo imaging was a touch 'muddled', with significantly restricted depth properties, while the frequency balance tended to hardness with a 'bumpy' and uneven bass register and a touch of 'splashiness' in the treble. Loud passages displayed a slight degree of pitch instability – caused by dynamic wow.

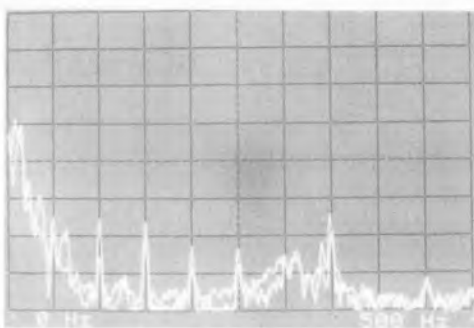
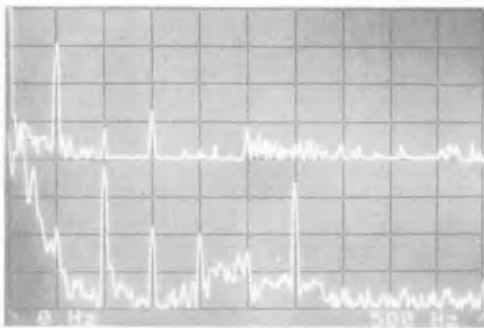
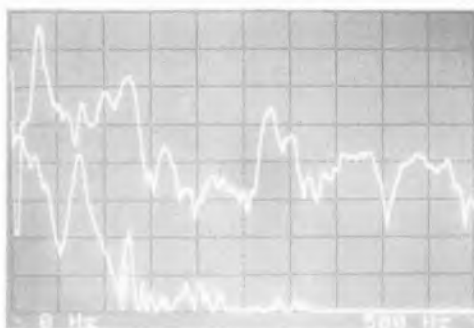
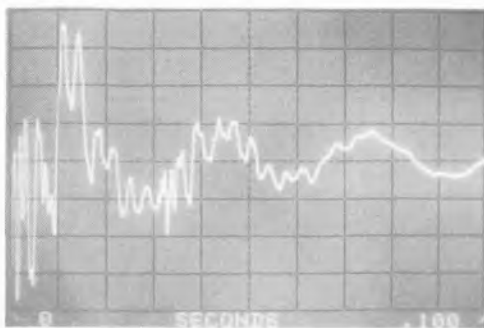
Conclusion

It is inexplicable to me how a company of ADC's size and involvement in audio could expect to profit from the introduction of a model which appears almost a decade out of date in terms of its overall design and the parts used. Its UK price is uncompetitive, and it is not a worthy partner for their tonearms.

GENERAL DATA

	Motor Unit
Type	direct drive
Platter mass/damping	1.6kg/fair
Finish and engineering	good/good
Type of mains lead/connecting leads	3 core/—
Speed options	variable 33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz)	0.16%/0.08%
Absolute speed error	variable
Speed drift 1 hour/load variation	<0.2%/–0.3%
Start up time to audible stabilisation	5secs
Rumble: DIN B wtd L/R av (see spectrum)	–69/–74dB
Size/clearance for lid rear	47.0(w) x 36.5(d) x 14.0(h)/6.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good*/average +
Vibration sensitivity/shock resistance	fair only/fairly good
Estimated typical purchase price	£170

Spectrogram Captions: *top left, Disc Impulse transmission, X1; top right, Breakthrough, acoustic above vibration; bottom left, Rumble(1st sample, electrical component superimposed); bottom right, Rumble(2nd sample, electrical component superimposed).*



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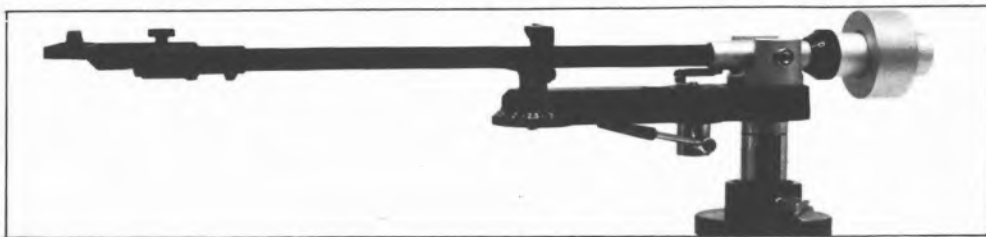
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ADC ALT1

(revised and reprinted)

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



Features, facilities, setting up and use

The recent success of ADC's foray into the component tonearm business with the LMF-1 seems to have prompted the release of a less costly version, whereby the tapered carbon-fibre tube of the LMF has been replaced by aluminium and the end product labelled the ALT-1. This detachable headshell arm is also used in a similar form in the 1600 and 1700 turntables. The counterweight assembly is shorter than that on the LMF-1, and is of a rotating scale rather than the more complex calibrated dial type. The arm is supplied with a simplified sliding base compatible with SME fixing centres which made for easy setting up and alignment (the SME type base is an extra with the LMF-1).

Lab performance

Proving not to be as well adjusted as we would have liked, the horizontal bearing was rather slack and showed a moderate if not particularly low friction of 40mg. However biasing was fine, and downforce calibration very good. The resonance graph revealed an untidy characteristic, although as the modes were well-controlled the result was in fact above average. However, if this is compared with the new graph for the LMF-1, the latter's superior performance in this department is only too apparent, albeit at twice the price. Lead capacitance was 180pF, which is fairly high and may be worth bearing in mind with some cartridges.

Sound quality

On a good turntable (TD160) the sound quality produced by this arm was judged as above average, despite some imprecision of stereo imaging.

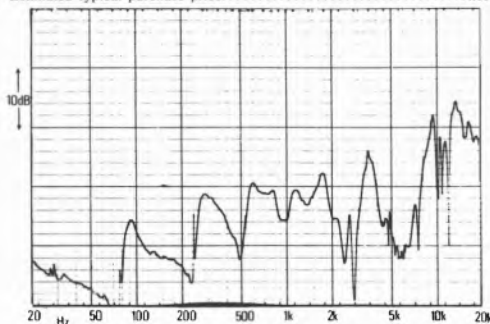
Conclusion

The value is quite good, and the fact that there are few low mass arms around at this price level works to the ALT-1's advantage, since the more complacent cartridges should work well in this model.

Re-examined for this latest edition, we found that the bearing slackness still remained, and overall we were a little less enthusiastic about this product in the context of more recent introductions on the tonearm scene. One of its least pleasant sound characteristics concerns a touch of 'brashness' and 'brittleness' in the upper range, which does little to help inexpensive cartridges, so models with a 'richer' balance are to be preferred.

This remains one of the least expensive models currently available, but will face stiffer competition than hitherto from other designs such as the new Linn *Basik*, both arms having components in common. Its specific advantage lies in its moderate effective mass, the figure for which has been amended to a more representative 8.5g in this issue.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	8.5g
Type/mass of headshell	special detachable/4.0g
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang, height
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/very good/good
Friction: typical lateral/vertical	40mg/25mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	225mg/225mg
Downforce calibration error: 1g/2g	< 0.02g/< 0.03g
Cue drift/8mm ascent/descent	negligible/0.4secs/1.5secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	180pF/some counter weight decoupling
Estimated typical purchase price	£35

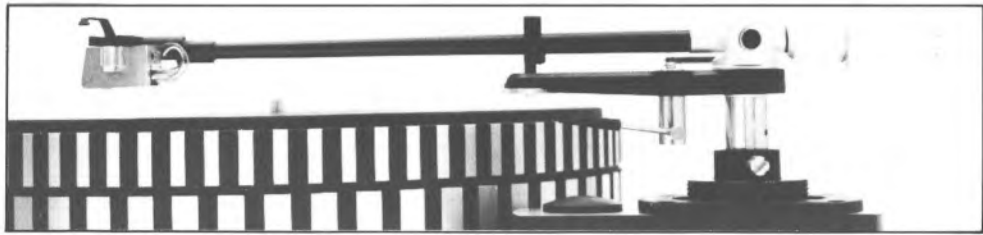


Arm resonances

RECOMMENDED

(revised & reprinted) **ADC LMF1 (LMF 2)**

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



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

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

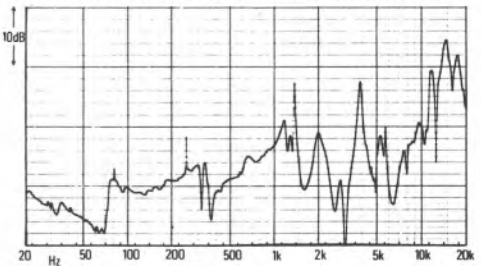
Friction was excellent in both planes with the bias in excess by approximately 30%, this allowing a correction of up to 2g downforce. Relative to the dialled settings, a commensurate 30% reduction is thus recommended when setting up.

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

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

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

GENERAL DATA	Tonearm
Approximate effective moving mass (excl cart. inc screws)	6g (7.5g)
Type of headshell	Fixed (special detach.)
Headshell mass (inc screws)	N/A/(4g)
Geometric accuracy	good
Facilities for adjustment	height, overhang
Finish and engineering	excellent
Ease of assembly/setting up	very good
Ease of use	very good
Friction lateral/vertical (typical)	< 10mg/ < 10mg
Bias comp. type/force nm/centre (1.5g ell set)	spring/280mg/250mg
Cueing: drift/8mm ascent/8mm descent	negligible/1.5secs/6secs
Downforce calibration error 1g/2g	-0.1g/-0.125g
Amount of damping	none
Arm resonances	good
Subjective sound quality	very good/above average
Motor recommended	TD160, note large rear clearance
Estimated typical purchase price	£70



Arm resonances (*LMF1*)

ADC 1500 (revised and reprinted)

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



Features, facilities, setting up and use

Launched just too late for inclusion in the last edition of *Turntables and Tonearms*, the UK made *1500FG* sports a tonearm closely derived from the earlier Accutrack series, fitted with the ADC detachable magnesium die cast headshell. First impressions were of a rather 'plastic' and lightweight design, but as the evaluation progressed so the picture slowly improved. A cartridge was supplied ready fitted, namely an ADC *QLM 34 III* – a type recommended last year by *Choice*, and one which was fully compatible with the *1500*.

A belt drive design, the motor was a frequency generator (FG) type affording fine speed adjustment in addition to the standard 33½ and 45 rpm. A stroboscope was incorporated which is viewed through a small aperture in the plinth, but the image was confusing, being rather distorted and only just readable. A useful auto-return facility was also built in. The platter was of moderate mass, fitted with a hard rubber mat carrying fine circular ribs which gave rather poor disc contact.

The counterweight was of the rotary calibrated scale type, with a heavy sleeve section which is supposed to slide, allowing the balancing of high mass cartridges. In practice, the sleeve was locked by a set screw, only accessible after the decorative rubber trim had been removed. Finally, the springs were barely sufficient to hold the lively polystyrene lid open, and the hinges were sloppy in action. On the plus side, some thought had gone into the vibration isolation and the cylindrical anodized feet contained quite effective springs, providing a 6.5Hz lateral suspension resonance,

although with little overall freedom. Movement was greater in the vertical mode, but with the main resonant frequency increased to 13Hz.

The instructions for cartridge alignment only applied to ADC models, and were in any case inaccurate; as supplied the cartridge was between 1° and 2° out, and required to be positioned fully back on the headshell fixing slots to give minimum tracing distortion. By implication, no further movement in this direction is possible for other cartridges which may need such adjustment (*ie* models with an increased stylus tip to fixing centre spacing).

Lab performance

Essentially the motor performance was good on all counts, taking into consideration the origin of the rumble result, which was mainly due to electric breakthrough rather than mechanical or main bearing noise. The speed characteristics and stability were fine with no dynamic wow, good torque and a rapid start up.

Arm effective mass was fairly high at 21g, though compatible with the supplied cartridge, the combination offering a near ideal 10.9Hz resonance of reasonable damping. The arm resonance characteristic was considered to be above average, and likewise the arm sound quality, which is an unusual finding at this price level, and one possibly due in part to the rigid headshell design. Lateral friction was satisfactory at 100mg in view of the 2g tracking cartridge fitted, although the bias levels were excessive at just about twice that required (a 1.5g setting is therefore suggested for 2–2.5g

tracking). Lead capacitance was high at 220pF, but once again was suitable for the *QLM*, provided that the amplifier adds no more than 100pF or so.

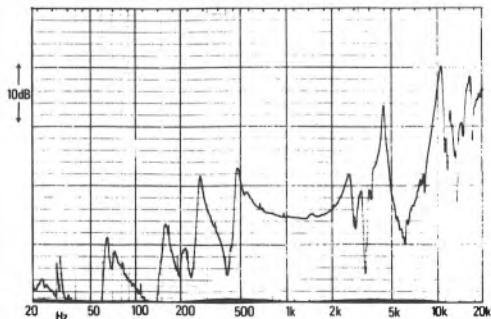
The sprung feet were moderately effective, and despite a below average rating for acoustic breakthrough the feedback margin in a listening set up was judged good. A trace of hum-related noise was audible at high sound levels but was not felt to be too obtrusive, and the player did exhibit a good resistance to shock excitation.

Sound quality

An average rating overall was achieved which is good for the price, especially as the included cartridge is a positive attribute rather than an afterthought or simply a sales convenience, as is so often the case.

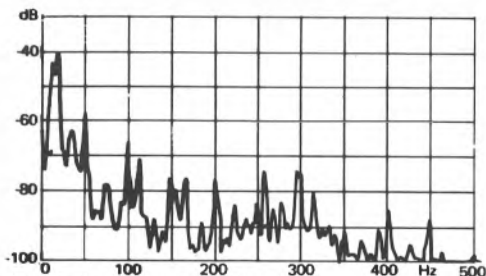
Conclusion

While a bit flimsy in construction and possessing some weaknesses, namely a poor strobe, a suspect mat, and just satisfactory noise levels, the *1500FG* did offer an above average arm plus a good cartridge, auto-return, variable speeds and fairly effective feet. With an 'average' sound quality rating at a well below average price, it is clearly worth considering.

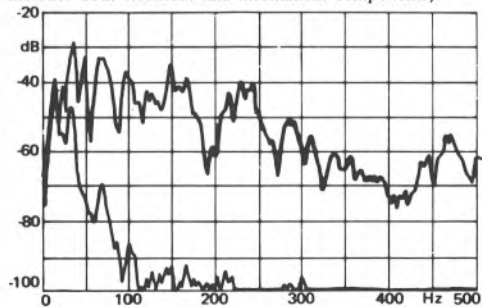


Arm resonances

GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto-return, belt drive
Platter mass/damping	1.2kg/very good
Finish and engineering	good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33%, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.14%/<0.05%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	-0.15%/ -0.2%
Start up time to audible stabilisation	1.0secs
Rumble: DIN B wtd L/R av (see spectrum)	67/68dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	21g
Type/mass of headshell	universal detachable/9.5g
Geometric accuracy	good
Adjustments provided	overhang/lateral angle
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	100mg/20mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	350mg/450mg
Downforce calibration error: 1g/2g	+0.05g/+0.05g
Cue drift/8mm ascend/descent	negligible/0.8secs/2.0secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	220pF/decoupled counterweight
System as a whole	
Size/clearance for lid rear	47(w) x 38(d) x 15.7(h)/3.7cm
Ease of use	good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	satisfactory/good
Vibration sensitivity/shock resistance	good/good
Estimated typical purchase price	£70 (inc <i>QLM</i> 34)



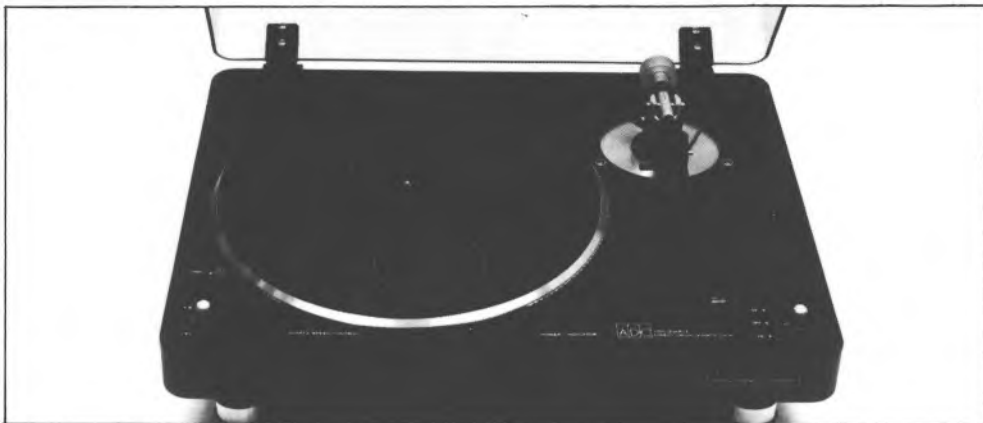
Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

ADC 1700 (revised and reprinted)

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



Features, facilities, setting up and use

As with the 1500, the 1700 and 1600 are both supplied fitted with ADC cartridges. The 1600 (a non quartz lock version of the 1700) is provided with a *QLM 36 III*, while the subject of this review, namely the 1700 DD, comes with an *XLM III*. In all other respects including specified performance, the 1600 and 1700 are identical. An auto-return direct drive design, the 1700 was fitted with an aluminium tube version of the established *LMF2* low mass pickup arm, the latter made in Japan for ADC and fully compatible with the cartridge supplied as part of the package.

In common with the 1500, the plastic double-skinned ABS moulded plinth was mounted on large sprung feet. The rather resonant polystyrene lid was hinged onto the plinth, and was thus acoustically coupled to the arm; perhaps in an effort to reduce feedback, the arm mount was mildly decoupled from the plinth on small rubber bushes. A good flat rubber mat was fitted, which offered good disc and platter damping. For the correct cartridge alignment (as supplied it was accurate), the *XLM* was mounted in the front of the headshell slots. This of course means that no further forward movement is available for other cartridges which might need further correction (for example, the Dynavector 20 series).

The motor was under quartz lock control, but this could be switched out to provide variable speed facilities, the latter a permanent feature of the 1600. The stroboscope was much clearer than on the 1500, although the same lid spring problem was again encountered, namely barely sufficient

tension to keep the lid up. In context, neither the finish or 'feel' of the controls were up to the usual Japanese standard, although they did show a definite improvement over the old BSRs. The instruction manual was sparse and gave no information as regards cartridge alignment excepting for their own ADC models. The rumble results were a little poorer than specified, and a retest produced much the same results. Interestingly, the arm bearings on sample one were sloppy whereas on sample two they were much better adjusted; tight but not binding, thus indicating certain sample variations to be present here. We have since been told that the better arm bearing tolerances will be maintained.

Lab performance

Of fair platter mass, start up was fine at 1.8secs, with good weighted wow and flutter, although the linear wow figure was higher than average. Drift and torque were good, while speed stability was excellent as might be expected with the quartz lock reference switched on. Tests showed the presence of some dynamic wow (excessive speed overshoot on load variations), although this was not considered serious. The rumble figures were satisfactory and were mainly due to mechanical noise from the mains transformer; however, the rumble spectrum also showed some pole switching harmonics from the motor, these components being those which do not appear on the 50Hz vertical calibration marker lines.

The arm resonance graph showed a marginally better than average trend, mainly due to the lack of

severe breaks and a generally even character, particularly in the final octaves. The effective mass was low despite the special detachable headshell, and should be fully compatible with medium-high compliance cartridges, but lateral friction was on the high side at 150mg. (This improved with the second sample to c.30mg, but was still poorer than the extravagant 5mg claimed in the specification.) Biasing was quite appropriate and lent no additional friction, and although lead capacitance was fairly high at 200pF, this is about right for the cartridge. For the best results, the additional amplifier contribution should be less than say 75pF.

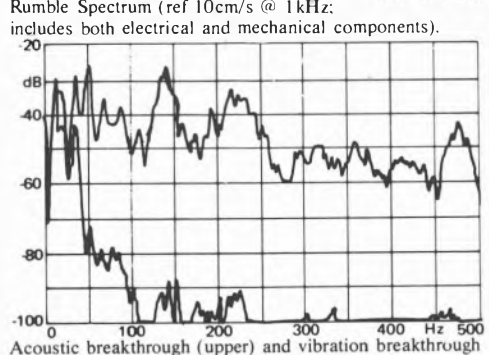
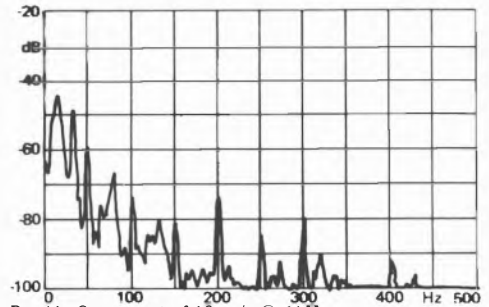
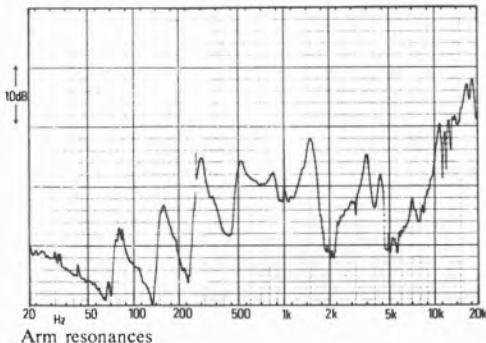
With reasonable vibration isolation, the acoustic breakthrough (mainly lid induced) was poorer than average, and was also quite peaky. The feet helped to produce a fair feedback margin, and the above average arm was instrumental in achieving an overall 'average' rating for sound quality. Shock immunity was also good.

Conclusions

It is difficult to summarise the performance of the 1700 DD. The motor was not quite good enough, and some quality control problems are apparent, but the arm looks promising and the fitted cartridge was firmly recommended in last year's issue of *Cartridges and Headphones*.

GENERAL DATA

Motor Section	Integrated Turntable
Type	semi-automatic quartz direct drive
Platter mass/damping	1.4kg/very good
Finish and engineering	good/fairly good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable 33%, 45rpm
Wow and flutter (DIN peak wld sigma 2)	0.1%
Wow and flutter (LIN peak wld 0.2 6Hz/6-300Hz)	0.18%/0.08%
Absolute speed error	<0.05%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	1.8secs
Rumble: DIN B wld L/R av (see spectrum)	66/71dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	6g
Type/mass of headshell	special detachable/4.0g
Geometric accuracy	fairly good
Adjustments provided	overhang/lateral angle
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	150mg/25mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	app 250mg/app 250mg
Downforce calibration error: 1g/2g	<0.05g/<0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.1secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	200pF/slight counterweight decoupling
System as a whole	
Size/clearance for lid rear	47(w) x 38(d) x 15.7(h) 3.6cm
Ease of use	very good
Typical acoustic breakthrough and resonances	below average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/above average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£105 (incl. XLMH1 cart)



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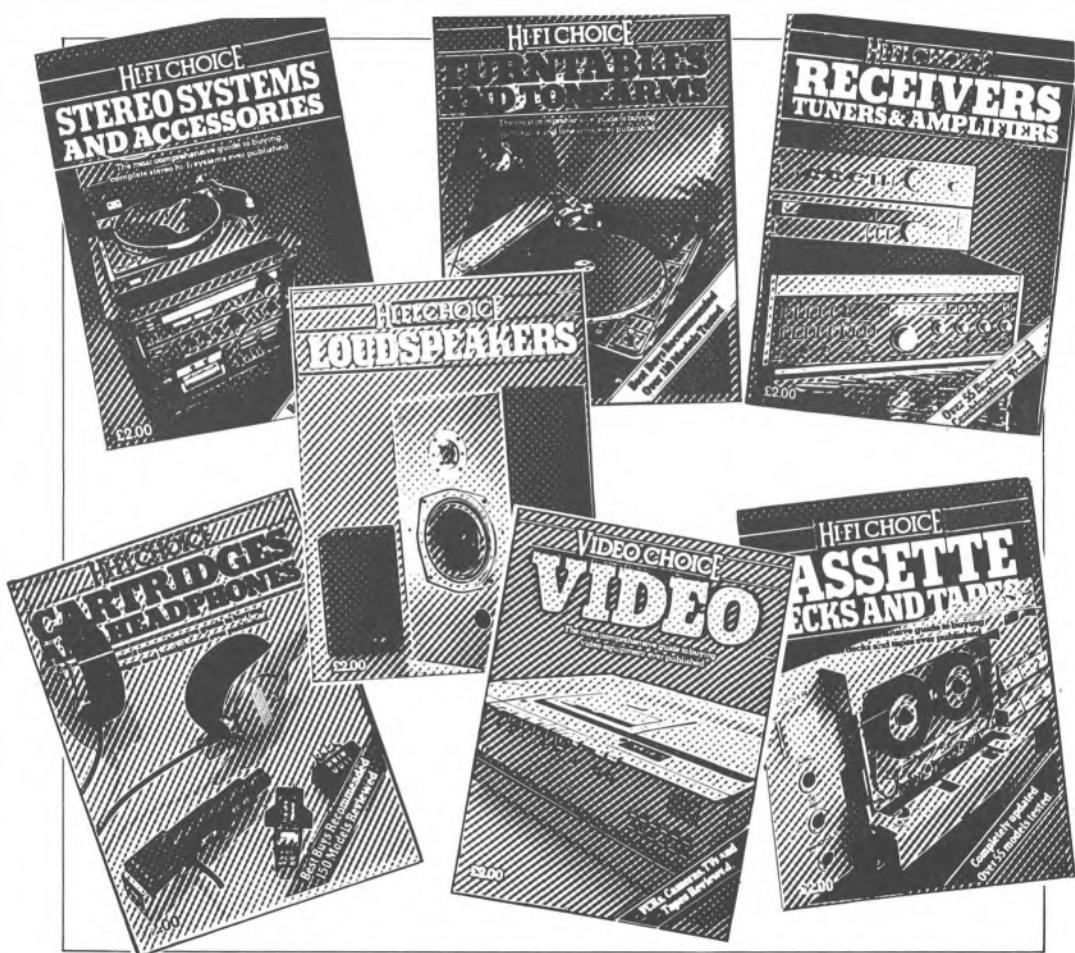
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Aiwa LP3000 (revised and reprinted)

Consumer Information Dept., Aiwa Centre, 56-58 Brunswick Centre, Marchmont Street, London, WC1. Tel. 01-278 2081



Features, facilities, setting up and use

Representing Aiwa's most elaborate turntable to date, this costly design is based on microprocessors and offers a wide range of operating facilities. While essentially highly automated, in fact it took some time to learn how to use it owing to the sheer complexity of the controls which number some 30 in all. Basic features comprised the parallel tracking tonearm (with zero lateral tracking error and no need for bias correction), driven by a separate motor via a lead screw arrangement. In all other respects the tonearm was conventional, though with a special detachable headshell. The connections here were however multiway, and coupled the record sensing assembly at the front of the headshell to the internal electronics. *Via* a microprocessor, a total of fifteen track sections may be played up to 24 times each in any desired order. In all, three motors were employed: one for arm tracking, one for cueing and a quartz-referenced direct drive one for the platter, which comprises a heavy chromed zinc die-casting, well damped by a good flat mat. The speeds were under synthesiser control allowing variation of up to $\pm 6\%$ in 0.1% steps, with both 33 $\frac{1}{3}$ and 45 rpm independantly monitored by digital LED displays.

The heavy acrylic lid required only minimal extra rear clearance — an important fact in view of the otherwise large overall depth requirements. Substantially built, the whole assembly was supported on 'insulator' feet adjustable for height,

but these were excessively stiff, and despite the suspended weight the plinth foot resonance was poorly defined at rather high frequencies of 15Hz in the lateral and 25Hz in the vertical modes. Ideally these resonances should be below that for the arm/cartridge — an unlikely event here in view of the highish effective arm mass. The space occupied by the sensor block in the headshell and the necessity for the sensor and record to be within closely prescribed limits meant that it was impossible to fit many cartridges to this model, and this is one aspect which the purchaser should investigate. For example, we had no trouble with the reference Mission 773 but found the Dynavector 10 and 20 series unsuitable.

Lab performance

The motor section was considered quite well engineered, and delivered good results for rumble, wow and flutter, speed accuracy, stability and torque. The motor start up time was unimportant owing to the far greater delay involved in the automatic arm cueing and tracking operation, and although some motor pole harmonics were present in the rumble spectrum, the latter was in fact dominated by static electrical components at 50, 100, 150 and 200Hz. Dynamic wow effects were negligible.

Arm effective mass was high at 25g, ideally requiring a lowish compliance cartridge of 15cu or preferably less. The parallel tracking and sensitive error-correction assured excellent

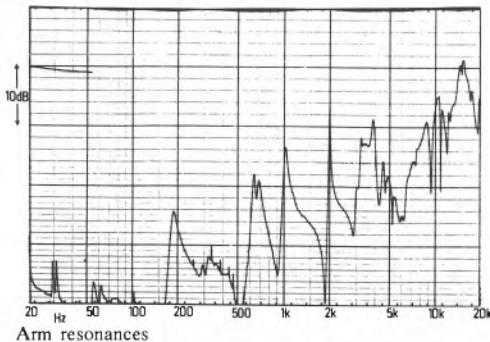
geometric alignment, while arm friction values were negligible and downforce accuracy satisfactory. The cue rates were fast, but not so much as to risk damage. The lead capacitance was quite high at 250pf, so the system needs to be carefully matched with the chosen cartridge. Although the picture improved somewhat above 5kHz, overall the arm resonances were pretty disappointing for a model in this price range, with numerous resonances possessing high peak-to-trough ratios. The massive lid and plinth contributed to a fine resistance to acoustic breakthrough, while shock resistance was also good, but these were to some extent compromised by the below average resistance to shelf-borne vibration, particularly from 10Hz to 100Hz.

Sound quality

An 'average' sound quality rating — a rather disappointing result at the price level — was confirmed for this model. The frequency balance was quite 'open' with fair upper treble, but the stereo depth was restrained, the midrange lacked clarity, and the bass registers were neither very firm nor deep.

Conclusion

The key to the judgment of this design lies in the importance a purchaser attaches to the myriad facilities it offers. We can add to an average sound quality rating such features as synthesised variable speeds, automatic operation, programmed track order, repeat and sensing, as well as a parallel tracking arm. If these are worth around £375 to you, then this may be the deck for your system.



GENERAL DATA

Integrated Turntable

Motor Section

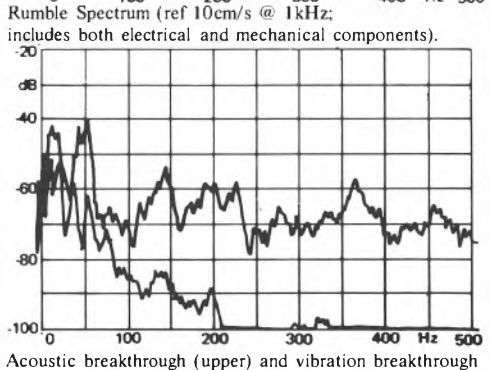
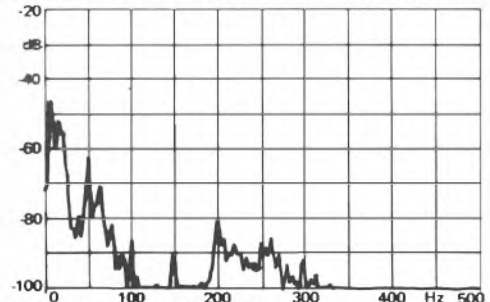
Type	quartz direct drive automatic, parallel tracking
Platter mass/damping	2.8kg/very good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	3 core/phonos + earth
Speed options	synthesised variable, 33%, 45 rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/<0.04%
Absolute speed error	+0.1%
Speed drift 1 hour/load variation	quartz/<0.05%
Start up time to audible stabilisation	N/A
Rumble: DIN B wtd L/R av (see spectrum)	74/73dB

Arm Section

Approximate effective mass inc screws, excl cartridge	25g
Type/mass of headshell	special detachable/17.3g
Geometric accuracy	excellent
Adjustments provided	only height required
Finish and engineering	very good
Ease of assembly/setting up/use	both v good/v good when understood!
Friction: typical lateral/vertical	<15mg/<15mg
Bias compensation method	not required
Bias force: nm/centre (set to 1.5g elliptical)	N/A/N/A
Downforce calibration error: 1g/2g	-0.10g/-0.08g
Cue drift/8mm ascent/descent	negligible/1.5secs/0.3secs
Arm resonances	poor
Subjective sound quality	below average
Lead capacitance/damping method	250pF/-

System as a whole

Size/clearance for lid rear	48(w) x 44(d) x 15(h)/3cm
Ease of use	very good once understood
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	below average/good
Estimated typical purchase price	£375



Akai AP-Q70C

Akai UK Ltd., Unit 12, Silver Jubilee Way, Haslemere Heathrow Estate, Parkway, Hounslow, Middx. Tel 01-897 7171



Features and design

The most elaborate and costly Akai turntable ever to appear in *Choice* possesses many facilities, not the least of which is the inclusion of a properly compatible low mass cartridge (Ortofon *LM12B*) in a good state of alignment. Founded on a substantial metal die-cast plinth, the *Q70C* incorporates a form of sprung sub-chassis isolation, although this is somewhat stiff and overdamped compared to the 'classic' designs.

An auto return model with a quartz oscillator-locked direct drive motor, the digital display reads the speed in rpm, plus the percent pitch deviation set *via* conductive touch controls. A sensibly flat rubber mat is fitted to the substantial and well-damped 2.4kg cast platter.

The tonearm uses the universal detachable shell fitment, and cannot conveniently balance cartridges with a mass of greater than 8g (ruling out the Dynavector *10X*, for example); but in practice most models are 8g or less these days. At an estimated 13.5g effective mass, it is suited to low compliance models such as the fitted Ortofon, which gave an ideal 11Hz subsonic resonance (tracking at 1.5g). The arm uses a spring type bias compensator, and an unusually elaborate counterweight assembly.

Lab performance

The first sample gave a marginally high result of 0.13% for wow and flutter, but a second sample was tried which provided a fine 0.08%, with balanced levels of separately weighted wow and

flutter. Rumble levels were also fine from motor and main bearing, though some 100Hz of signal was present at a near inaudible level, apparently corresponding with the servo control signal frequency. The motor was powerful with a speedy start up time and a negligible overshoot or transient wow.

Helped by the suspension, a fairly good vibration isolation characteristic was recorded, and the acoustic isolation was also above average, if a trifle 'lumpy'. Shock immunity could have been better and was limited by close association of the cartridge subsonic and suspension resonance frequencies. Not quite good enough to merit expanded presentation, the 'X1' scaled disc impulse graph was nonetheless very promising, showing good disc termination.

The tonearm was well built and aligned, with low friction levels and generally good overall behaviour. Biasing was slightly low at end of side, although not seriously so, and cue rates were too slow. The arm resonance curve showed well above average control, with resonances suppressed to 2kHz and an even character thereafter: in fact this arm is not quite as rigid as the curve might indicate, due to its detachable headshell, but this mode is suppressed on our presentation.

Sound quality

Largely in agreement with the lab findings, this model showed an above average resistance to feedback, and provided a promising sound quality. A pleasant balance resulted from using the *LM12B*, demonstrating good definition, quite

extended and clear bass, plus a promising stereo image and depth. With a top class cartridge the sound remained well integrated, though with a trace of mid 'hardness' and 'nasality' plus some mild bass 'lumpiness'.

Conclusion

Almost certainly Akai's best turntable to date, the APQ70C is a relatively clean and well-balanced performer, providing a standard well above most of its similarly priced competitors. Furthermore it was supplied with a competent and compatible cartridge from a respected source, but is nonetheless worthy of a cartridge upgrade at a later date, should the purchaser so desire. Although not in the top class of subchassis models, it clearly offers promising value for money.

GENERAL DATA

Integrated Turntable

Motor Section

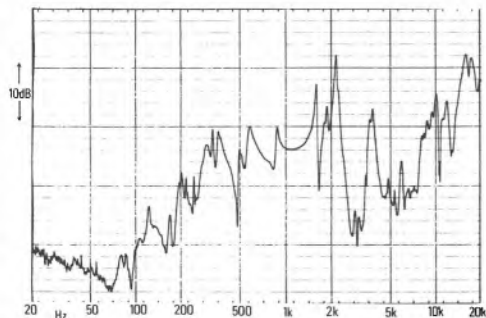
Type..... direct drive, quartz lock, auto return
 Platter mass/damping..... 2.4kg/good
 Finish and engineering..... very good/good
 Type of mains lead/connecting leads... 2 core/phono + earth
 Speed options..... variable pitch + 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2)..... *0.12%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... *0.12%/*0.13%
 Absolute speed error..... <0.01%
 Speed drift 1 hour/load variation..... <0.01%/<0.01%
 Start up time to audible stabilisation..... approx 2secs
 Rumble: DIN B wtd L/R av (see spectrum)..... -74dB
 *Second sample..... 0.08% DIN pk, 0.1% w, 0.09% F

Arm Section

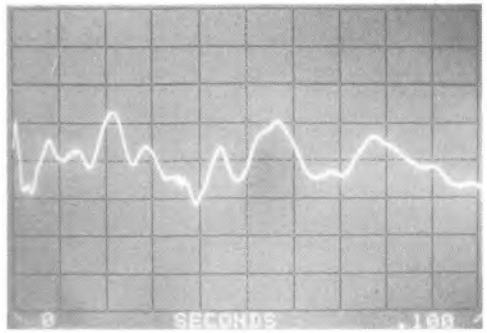
Approximate effective mass inc screws, excl cartridge... 13.5g
 Type/mass of headshell..... universal detachable/6g
 Geometric accuracy..... very good
 Adjustments provided..... overhang, lateral, height
 Finish and engineering..... very good/good
 Ease of assembly/setting up/use... very good/very good/very good
 Friction: typical/lateral/vertical..... less than 20mg/less than 30mg
 Bias compensation method..... internal spring
 Bias force: rim/centre (set to 1.5g elliptical).... 250mg/160mg
 Downforce calibration error: 1g/2g..... -0.15g/-0.1g
 Cue drill/8mm ascent/descent..... negligible/2.5secs/3.5secs
 Arm resonances..... fairly good
 Subjective sound quality..... above average
 Lead capacitance/damping method..... pF/nona

System as a whole

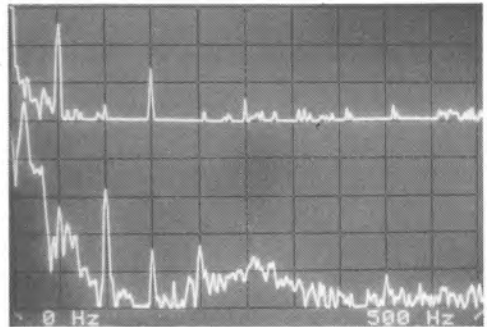
Size/clearance for lid rear..... 43.5(w) x 4.00(d) x 14.0(h)/6cm
 Ease of use..... very good
 Typical acoustic breakthrough and resonances..... good
 Subjective sound quality of complete system... above average
 Hum level/acoustic feedback..... very good/good
 Vibration sensitivity/shock resistance..... fairly good/fairly good
 Estimated typical purchase price..... £160



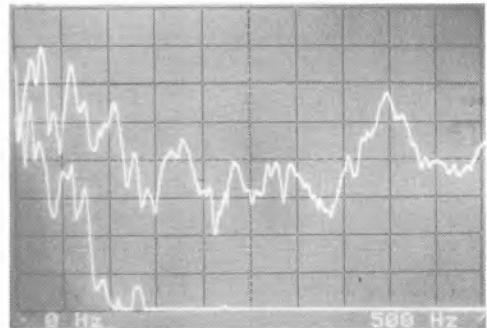
Structural arm resonances, audio range.



Disc impulse transmission, standard X1.



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



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

RECOMMENDED

Ariston RD80

Ariston Acoustics Ltd., 1 Society Street, Maybole, Ayrshire KA19 7BH. Tel (0655) 82424



Features and design

At something like two-thirds the cost of its luxury finish brother the *110*, the *RD80* sacrifices little considering the price difference. The finish is plainer, but nonetheless the plinth is wood veneered and the machined alloy platter weighs 2.45kg. A single large pulley and foolproof drive runs at a $33\frac{1}{3}$ rpm via a conventional rubber belt, the three point sprung steel subchassis successfully isolating the platter/arm system from environmental disturbance.

Although improved since last reviewed, setting up is still time consuming, though helped by using underside bolts accessible without removing the bottom cover. Possibly as a result of the reduced platter mass, this deck was more stable in its set up and remained so for longer than the *RD110*. The plinth will accept some of the longer arms, and the lid is a generously thick dark-tinted PVC moulding.

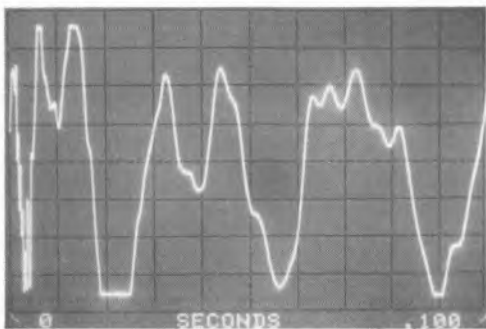
Lab results

Performing well on the lab tests, wow and flutter, torque, rumble, start up time and speed error were all very good for the class and type of deck. A trace of 100Hz motor breakthrough was however present, measuring -65dB unweighted. The sensible flat mat gave an above average disc impulse result, allowing a X10 scaling for the photo.

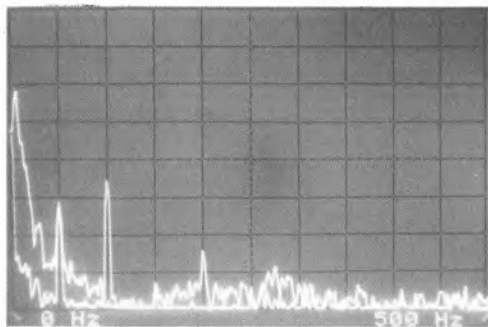
If anything its isolation and acoustic rejection were superior to those of the *110*, probably because of the more stable subchassis behaviour, and good to very good results were obtained here.

Sound quality

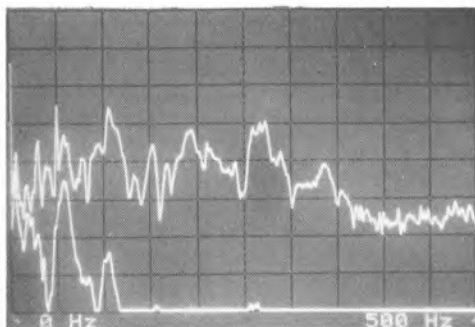
In tonal balance the *RD80* was judged quite good with a well integrated character, if slightly dull. The sound field was quite secure and stable, demonstrating fairly good bass as well as a precise image, with good focus and fair depth - all strong plus points at the price.



Disc impulse transmission, magnified X10.



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



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

Conclusion

The RD80 has come out well in virtually every respect, paralleling and in some areas proving marginally superior to the performance of the recommended Thorens TD160S. As such, it clearly merits recommendation itself, and will happily partner many good quality tonearms costing up to £150 or so.

GENERAL DATA

Type	Motor Unit
Platter mass/damping	belt drive
	2.45kg/good

Finish and engineering	good/very good
Type of mains lead/connecting leads	3 core/phone
Speed options	33rpm
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.07%
Absolute speed error	+0.35%
Speed drift 1 hour/load variation	synchronous
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	-76.5dB
Size/clearance for lid rear	44.5(w) x 36.0(d) x 17.0(h)/4cm
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 sensitivity/shock resistance	good/fairly good
Estimated typical purchase price	£170

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Ariston RD110

Ariston Acoustics Ltd., 1 Society Street, Maybole, Ayrshire KA19 7BH. Tel (0655) 82424



Features and design

Developed from the *RD11* which was reviewed in the previous issue, the *RD110* was conceived as a model offering variable speed control. This was finalised as an auxiliary outboard electronic power unit, which supplies a frequency-controlled output at mains voltage suitable for operating any normal mains-powered synchronous motor (including those fitted to other subchassis turntables as well as the Ariston). Unfortunately this optional extra was not in production by the time this issue was produced, so had to be omitted.

As with the '11*S* and its less costly brother the '80, the design of the 110 is based on a pressed steel reinforced subchassis poised on three internally adjustable coil springs. The subchassis plate is arranged to run beneath the centre of the arm pillar, so deliberately increasing the coupling between it and the platter main bearing.

Early 110s employed a stepped and crowned drive pulley using a flat drive belt, but problems

resulted, including a tendency for the belt to shed itself. In our sample the drive had reverted to the *RD11* system, namely a square section rubber cord driven by an integral clutch and grooved drive pulley. At present, the two speeds are selected by hand, after removal of the outer platter; we are not entirely happy with this, since contamination of the belt is likely, and the operation in itself is clumsy. Furthermore, the *RD110* and *RD11* both have rather softly sprung suspensions, and the chassis alignment can be disturbed only too easily.

Overall the 110 was in fact a tricky model to set up (more so than a Linn *Nirvana* for example); this is a job best done on site, with the turntable handled carefully thereafter.

Fitted with its own custom flat rubber mat, in mid brown to match the 'picture frame' construction of the moulded plinth, the metal parts are lacquered a pale gold, including the massive 5.75kg platter. On grounds of style and colour the *SME 111* is a notable match, though the

limited clearance below the deck and SME lead stiffness makes effective alignment quite difficult, but not impossible.

Lab results

In some respects the performance of the *RD110* did not match that of the *RD11* predecessor. Wow and flutter was marginal at 0.13%, although I doubt many listeners would detect this with most records. Torque and speed accuracy were both fine, as was the -75dB weighted rumble figure.

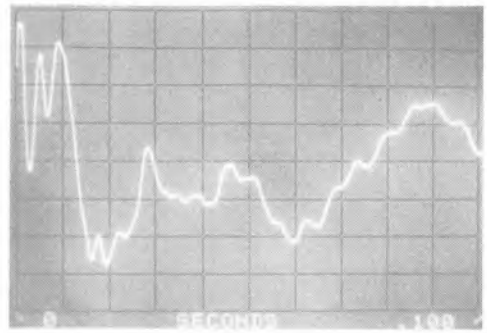
The subchassis stability was not optimised in favour of minimum stylus excitation, and while the fundamental resonance (vertical) was very low at 3.5Hz, rocking and torsional effects reached up to 10Hz, and some cartridge stylus movement was visible under adverse vibration conditions. Some breakthrough was evident on the vibration isolation graph, though the acoustic result was pretty good and the above average mat permitted the expanded X10 transient response presentation.

Sound quality

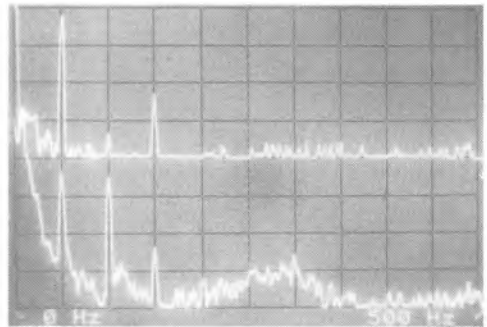
Auditioned using an SME *111*, the standard was undoubtedly good but of an unremarkable character. No specific strengths were noted apart from a pleasant and neutral overall balance, while the ultimate levels of stereo focus, musical detail, low frequency differentiation and musical 'drive' were just out of its reach. Careful checking by using other tonearm models indicated that in this case the arm was not the prime limitation.

Conclusion

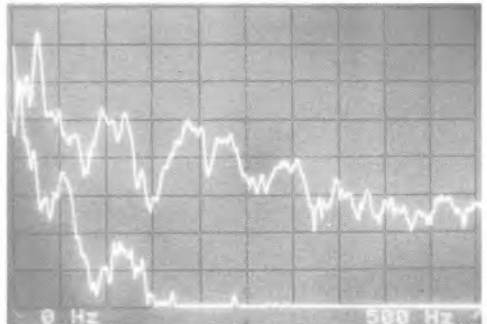
This exotically finished subchassis design may be a little less expensive than the best currently available, but then it does not quite provide the performance of the best, either. Setting up procedure was undoubtedly a bit temperamental, so at present recommendation is withheld from this model.



Disc impulse transmission, magnified X10.



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

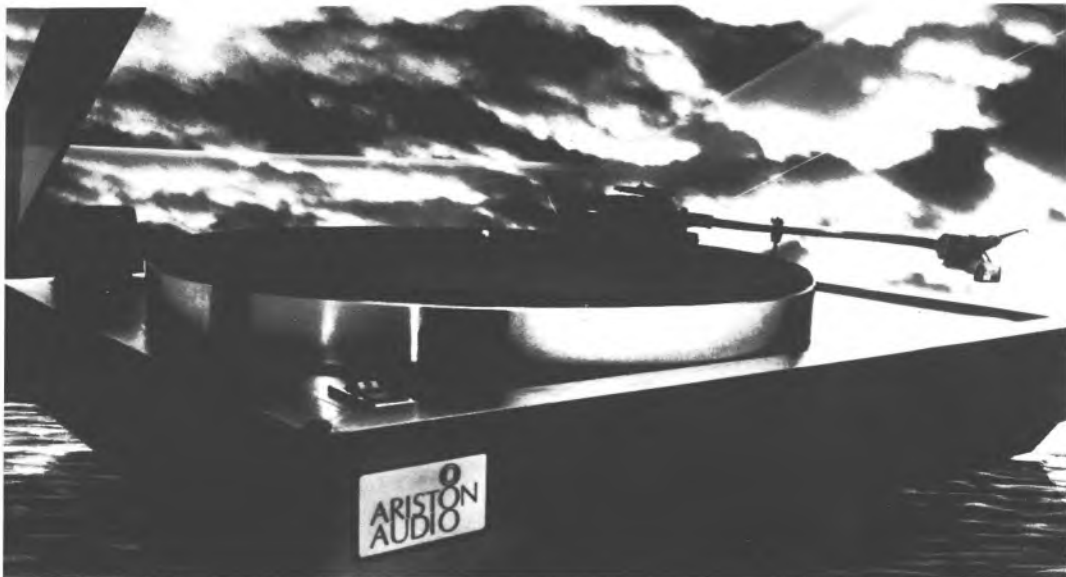


Breakthrough (0-500Hz line): above, acoustic; below, vibration.

GENERAL DATA

	Motor Unit
Type	belt drive
Platter mass/damping	5.75kg/good
Finish and engineering	very good/good
Type of mains lead/connecting leads	3 core/phono + earth
Speed options	33/45rpm, manual change
Wow and flutter (DIN peak wtd sigma 2)	0.13%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.18%/0.14%
Absolute speed error	+0.3%
Speed drift 1 hour/load variation	synchronous/-0.25%
Start up time to audible stabilisation	7.0secs
Rumble: DIN B wtd L/R av (see spectrum)	-75dB
Size/clearance for lid rear	45.5(w) x 37.0(d) x 16.3(h)/5.5cm
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 sensitivity/shock resistance	good/fairly good
Estimated typical purchase price	£250 (Electronic £320)

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Further information available from
Ariston Acoustics, Unit 176, Brieryside,
Prestwick Airport, Ayrshire. KA9 2RD.


ARISTON RD80

*Correct at time of going to press

(revised and reprinted)

Ariston RD11S

Ariston Acoustics Ltd., 1 Society Street, Maybole, Ayrshire KA19 7BH.

Tel. 0655 82424



Ariston's troubled history at last appears to be stabilising with this, the latest version of the *RD11*. The resemblance to the *Sondek* is close -- not surprising in view of their intertwined ancestry. However separate development has occurred for some years now, with the notable external difference between the two decks being the small circular arm mount of the Ariston as opposed to the full depth arm board of the Linn.

Equipped with a steel sub-chassis suspended on coil springs, the *RD11* platter was a massive two section die casting, weighing 5.5kg, this inclusive of the hard flat rubber mat. This combination was well damped and a square section ground neoprene cord was used to drive the centre platter hub from a 24 pole low power synchronous motor. Two pulley diameters were provided, but the speed change is manual and inconvenient, requiring the removal of the outer platter. A non-resonant acrylic lid was fitted which gave above average arm clearance: it would for example accommodate the *ADC LMF1*. The sub-chassis resonance was dominant at a low 4.8Hz, although a secondary rocking mode at 9.5Hz was also present, suggesting that the sub-chassis was not fully dynamically balanced.

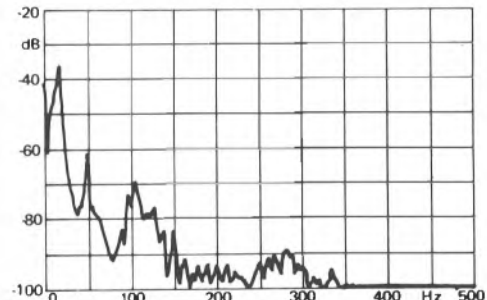
Torque was good and the speed accurate, but the heavy platter extended the start up time to a long 6.5 seconds. Wow and flutter was good, with both load stability and rumble fine, the latter averaging 73dB and showing signs of improvement with running in. The deck did however prove awkward to set up, and required care in appropriately dressing the arm leads to ensure proper operation of the sub-chassis suspension. This done, very good acoustic breakthrough curves resulted, with quite excellent vibration isolation (using *SME III*).

Excellent feedback immunity was also shown, with a fairly good impact shock resistance.

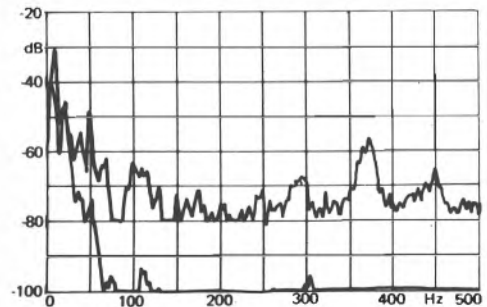
Partly dependent of course on the chosen arm, this turntable gave a good performance. In our system the supplied mat was favoured, and the general standard appeared comparable with other good subchassis turntables in this price region. Some problems have been encountered in alignment and its stability but this model is still worth considering.

GENERAL DATA

GENERAL DATA	Motor Unit
Type	isolated subchassis, belt drive
Platter mass/damping	5.5kg/very good
Finish and engineering	both very good
Type of mains lead/connecting leads	2 core/N/A
Speed options	manual change, 33 $\frac{1}{3}$, 45 rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.16%/0.06%
Absolute speed error	+0.05%
Speed drift 1 hour/load variation	synchronous/-0.1%
Start up time to audible stabilisation	6.5secs
Rumble: DIN B wtd L/R av (see spectrum)	75/72dB
Size/clearance for lid rear	45(w) x 36(d) x 14(h)/5.5cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	very good/excellent
Vibration sensitivity/shock resistance	excellent/good
Estimated typical purchase price	£250



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Audio Linear TD4001 (re-assessed)

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



Features and design

A Belgian created and Spanish made component, the original *TD4001* was reviewed in the last issue. It suffered from certain design and production problems, but has since been extensively revised to produce the new *Super* version tested here.

The rather slim 6mm bearing has been retained, but the platter is now a very heavy 6kg laminated alloy structure fitted with a flat Avon Rubber composition mat. Driven by a round section rubber cord from a synchronous motor, the speeds are selected by a soft action push control engaging one of the two pulley diameters. The thick smoked-acrylic base plate is mounted on industrial type vibration isolators concealed in the adjustable cylinder feet. The lid is not isolated, but it is made of a substantial fabricated acrylic which is relatively non resonant; however, its clearance is none too generous, so the choice of tonearm needs some care – for example, the ADC *LMF1* and Audio Technica *AT1100* are unsuitable on grounds of back extension.

Lab results

In contrast to the original design, and in confirmation of the new intended design objectives, very fine results were obtained for wow and flutter, rumble, and speed accuracy. Torque is also substantially higher; whereas the older, lighter platter took 4 seconds to attain a stable speed, they new, much heavier one only needed 2½ seconds start up time to reach a stable speed.

In general the impulse resonance characteristics were good, although one mode was visible on the otherwise good transient disc response (X10 scaling). This is related to the platter mass

rocking on the slim bearing shaft. Vibration and acoustic isolation were fairly good but not outstanding, and the unit was quite stable with respect to shock.

Sound quality

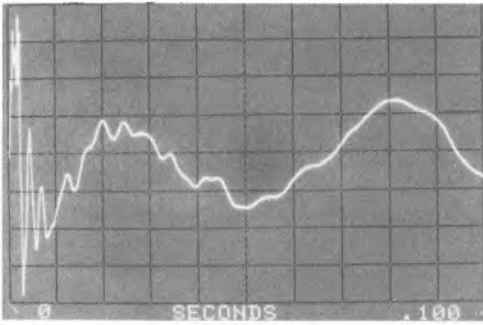
Subjectively judged, the *4001* was much superior to its predecessor and set a good standard. The sound was notably well balanced and secure, with good stereo focus and fair depth, and while some loss of lower mid and bass definition was apparent, this was not too serious.

Conclusion

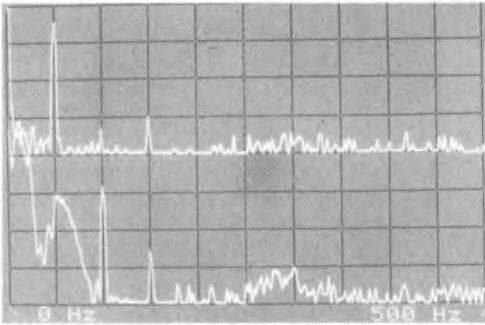
This well made and finished model delivers a good overall performance and is a worthwhile contender, particularly suited for use in lower sound level environments and where a strong shelf is available to back up the isolation factor. Had this performance been achieved at the original price, this model would have been recommended.

GENERAL DATA

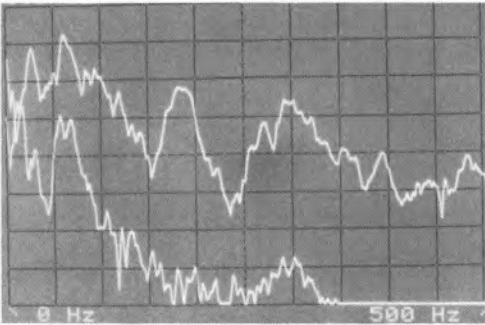
Type	Motor Unit belt drive
Platter mass/damping	6.0kg/very good
Finish and engineering	excellent/good
Type of mains lead/connecting leads	3 core/N/A
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/<0.05%
Absolute speed error	+0.1%
Speed drift 1 hour/load variation	synchronous/-0.1%
Start up time to audible stabilisation	2.8secs
Rumble: DIN B wtd L/R av (see spectrum)	-77dB
Size/clearance for lid rear	45.0(w) x 36.5(d) x 15.5(h)/6cm
Ease of use	good
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	fairly good/good
Estimated typical purchase price	£200



Disc impulse transmission, magnified X10.



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



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

The refined heavyweight

AT 1010

A superbly engineered medium to high mass tonearm with many unique features such as variable negative feedback damping and our Dynamic Tracing System. High rigid construction brings an overall tightness to the sound spectrum with significant improvements in bass reproduction. And an SME type baseplate accessory now gives even wider fitting options.

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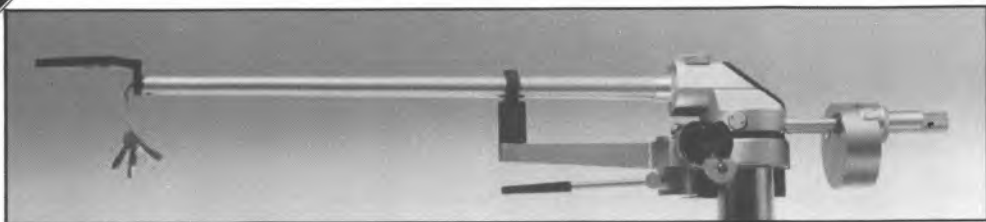
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RECOMMENDED

Audio Technica AT 1100/ 1010 (re-assessed)

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



Features and design

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

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

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

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

In contrast to the 16g effective mass of the 1010, the 1100 offers a genuinely low 6g. An accessory S-tube carrier is also available which

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

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

Lab results

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

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

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

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

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

The second 'S' tube resonance graph used the detachable headshell and heavier counterweight, the latter's resonance mode now appears at 75Hz, with a headshell socket resonance at 190Hz; the remainder was quite tidy and well-controlled.

Sound quality

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

Conclusion

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

continued overleaf

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AT 1100
 An ultra low mass tonearm concept which has won worldwide acclaim. Innovative design includes a choice of integrated plug-in arm tubes, resonance frequency fluid damping and our Dynamic Tracing System. They add up to sophisticated performance. And now an SME type baseplate accessory gives the AT 1100 even greater versatility.

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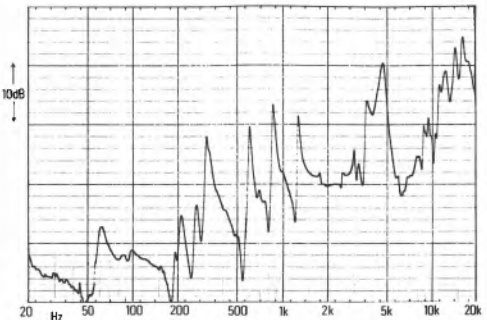
considerable merit, allowing the use of headshell cartridges as well as models of lower compliance.

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

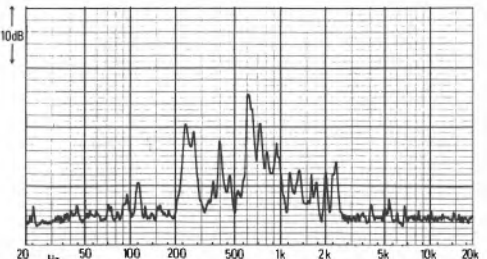
GENERAL DATA		AT1100 (straight tube)
Approximate effective mass inc screws, excl cartridge	.....	6.0g
Type/mass of headshell	.....	plug in straight arm/N/A
Geometric accuracy	.....	excellent
Adjustments provided	.....	overhang, lateral angle, height
Finish and engineering	.....	excellent/very good
Ease of assembly/setting up/use	.....	excellent/very good/very good
Friction: typical lateral/vertical	.....	25 mg/less than 10mg
Bias compensation method	.....	weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	.....	260 mg/220mg
Downforce calibration error: 1g/2g	.....	+0.05g/+0.05g
Cue drift/8mm ascent/descent	.....	negligible/0.5sec/2.2secs
Arm resonances	.....	good
Subjective sound quality	.....	good++
Lead capacitance/damping method	.....	95 pF/fluid damping optional
Estimated typical purchase price	.....	£100

GENERAL DATA		Tonearm
Approximate effective mass inc screws, excl cartridge	.....	12.5g
Type/mass of headshell	.....	universal detachable on accessory 'S' tube/9g
Geometric accuracy	.....	excellent
Adjustments provided	.....	tilt, overhang, height
Finish and engineering	.....	excellent/very good
Ease of assembly/setting up/use	.....	excellent/very good/very good
Friction: typical lateral/vertical	.....	50 mg/less than 10mg
Bias compensation method	.....	weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	.....	300 mg/280mg
Downforce calibration error: 1g/2g	.....	+0.02g/-0.05g
Cue drift/8mm ascent/descent	.....	negligible/0.5sec/2.0secs
Arm resonances	.....	fairly good
Subjective sound quality	.....	good
Lead capacitance/damping method	.....	95 pF/fluid damping optional
Estimated typical purchase price	.....	£120

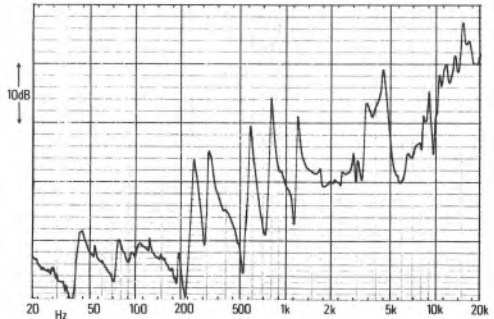
GENERAL DATA		AT 1010
Approximate effective mass inc screws, excl cartridge	.....	16g
Type/mass of headshell	.....	universal detachable/11g
Geometric accuracy	.....	excellent
Adjustments provided	.....	overhang, tilt, height
Finish and engineering	.....	excellent/very good
Ease of assembly/setting up/use	.....	excellent/very good/very good
Friction: typical lateral/vertical	.....	30 mg/less than 10mg
Bias compensation	.....	weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	.....	380 mg/320mg
Downforce calibration error: 1g/2g	.....	-0.1g/-0.05g
Cue drift/8mm ascent/descent	.....	slight/0.5sec/2.3secs
Arm resonances	.....	fairly good
Subjective sound quality	.....	good+
Lead capacitance/damping method	.....	95 pF/some variable counterweight decoupling
Estimated typical purchase price	.....	£150



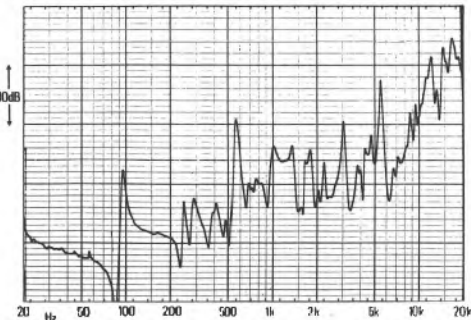
Arm resonances, tight damping, AT1010.



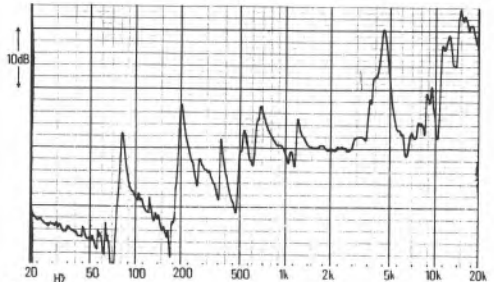
Vibration transmitted via AT1100 measured on Logic arm board.



Arm resonances, loose damping, AT1010.



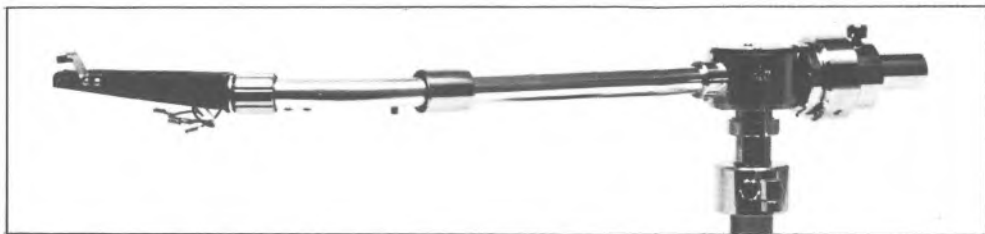
Arm resonances, fixed light counterweight, AT 1100.



Arm resonances, 'S' version with heavy counterweight.

Audio Technica AT1005 (revised and reprinted)

Audio Technica UK, Hunslett Trading Estate, Low Road, Leeds. Tel. 0532 771441



Features, facilities, setting up and use

This particular arm was almost discontinued after having been on sale for nearly a decade but due to a resurgence of demand, it is still in production. The overall standard of engineering and finish was excellent, despite the modest price. It sports a 'universal' detachable headshell to an Audio Technica perforated design, and a rest pillar was provided but no lift/lower cue device; this must be effected manually via the headshell finger lift.

The offset counterweight ensured that the arm was dynamically balanced, aiding shock resistance, while standard gimbal ball race bearings were used, the latter excellently adjusted and free of both friction and looseness. Downforce was set via a sliding rider weight on the main arm tube. Moving mass proved high at 19g and is thus best suited to low compliance cartridges, with the low 75pF lead capacitance permitting 'padding' to suit any compatible cartridge. It should be noted however that the arm is fairly deep and will not suit some of the smaller turntables.

Lab performance

The geometrical accuracy was very good when set up as instructed. Frictions were very low and the biasing was effective, although a little on the high side and tending to an inverse ratio from rim to centre (in general, the rim value should be less than that pertaining at the centre). Downforce calibration was quite accurate.

Unfortunately in view of the other aspects of its performance the arm resonances were judged to be quite serious. Several breaks of notable severity were present, namely at 150, 700 and 600Hz, with further modes at 2.1kHz, 3.5kHz and 4.2kHz.

Sound quality

For a component arm fitted to a good turntable, the average sound quality rating was disappointing. The sound was a trifle brash and 'loud' with some edginess in the treble and a hardness on

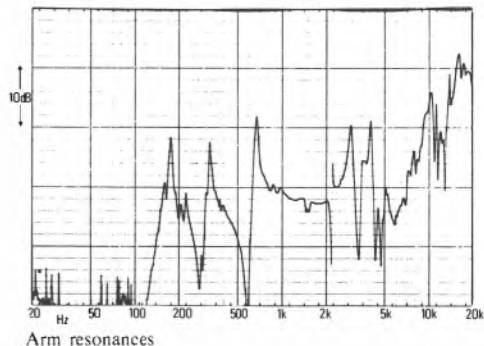
piano, while stereo information was also reduced.

Conclusion

The excellent constructional quality of this arm was not sufficient to make up for its ageing design, particularly with regard to arm resonances.

GENERAL DATA

Approximate effective mass inc screws, excl cartridge	19g	Concern
Type/mass of headshell	universal detachable/8.5g	
Geometric accuracy	very good	
Adjustments provided	height, lateral angle, overhang	
Finish and engineering	very good	
Ease of assembly/setting up/use	good/very good/fairly good	
Friction: typical lateral/vertical	<20mg/15mg	
Bias compensation method	thread and weight	
Bias force: rim/centre (set to 1.5g elliptical)	275mg/235mg	
Downforce calibration error: 1g/2g	-0.07g/-0.15g	
Cue drift/8mm ascent/descent	N/A/N/A/N/A	
Arm resonances	below average	
Subjective sound quality	average	
Lead capacitance/damping method	75pF/-	
Estimated typical purchase price	£35	



Aurex SR-M70

Toshiba House, Frimley Road, Frimley, Camberley, Surrey. Tel (0276) 62222



Features and design

A lightly built but inexpensive belt drive integrated turntable, the SR-M70 is one of those products where, in our opinion, fidelity has been sacrificed in favour of a clever operational feature. In this case a sensor system is fitted which allows the starting point on a record to be pre-selected by a process of band counting. For example, it can start on band three having missed the first two, and while playing three it can then be programmed to skip further tracks before playing the next selected one. It does not however have the ability to store a sequence of tracks in any special order; furthermore, while an ability to count to 10 is provided, the start buttons only go to five, and higher numbers must be obtained by addition! Auto return and stop are also featured, together with a fine speed control and a mains referenced stroboscope. The usual light and resonant plastic lid is fitted, and the plinth feet offer minimal isolation.

The tonearm uses many plastic components including the non-detachable headshell. Total moving mass was some 20g, suitable for the specified cartridge compliance of 8cu, and in fact the cartridge fitted is a special one, although Aurex do not mention this in any of the literature. The record sensor is inbuilt, and hence the cartridge cannot be changed. It comprises a basic moving magnet model, equipped with a shank mounted spherical stylus and a quoted compliance of 8cu, with a 2g tracking force. It was factory fitted and supplied slightly out of alignment, but this was probably an insufficient error to produce any major change in sound quality.

A rather light 0.8kg platter was fitted with a mat which offered some disc support, but platter resonance itself prevented the use of expanded scaling for the disc impulse response. Neither could the arm resonance curve be taken; instead the frequency response and separation of the fitted cartridge was measured, with results not unlike those for the Linn *Basik* model. (Note that the small regular blips on the trace are from the test record and not the responsibility of the cartridge.)

Lab results

The cartridge was a satisfactory tracker at a 2g downforce, giving a 20Hz to 20kHz response ± 2.5 dB, a channel separation of around 27dB midband, and a good 16dB plus from 10kHz to 20kHz. The loss in separation at 200Hz was probably due to an arm/headshell flexure.

While wow and flutter results were good, the rumble performance was not of true hi-fi calibre, measuring an average -65 dB DIN B. Spectral analysis revealed a whole chain of motor vibration harmonics, which were audible on audition. Vibration isolation was also poorer than average, while below 250Hz the acoustic isolation was distinctly poor. The disc impulse test was dominated by a severe low frequency platter rock at 20Hz. Although considerable play was evident in the bearings, the arm exhibited satisfactory friction and biasing, and the automatics (cue rate, etc) were all fine.

Sound quality

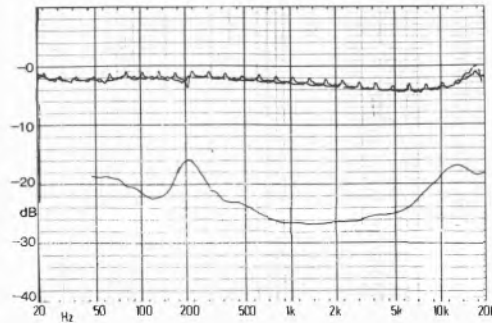
Putting considerations of price aside for the moment, the sound did not find favour with the

panelists. The treble appeared 'splashily' emphasised, and was not very clean, while little front to back depth was apparent. The unit showed a tendency to feedback at high levels. Coloration was evident in the midrange, and the bass was 'softened' with weak transient attack plus a notable loss of extreme low frequency power. On very quiet program some motor noise was also audible.

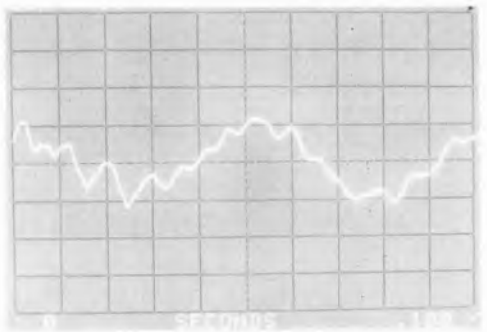
Conclusion

The partial automation of programme detection and space skipping have clearly taken a heavy toll in this model, and it would not be unfair to describe it as a 'music centre' product. It was not unpleasant to listen to, but the sound had little to do with quality reproduction in the *Choice* context, so this deck cannot be recommended.

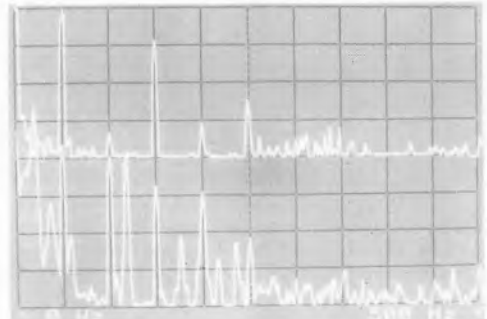
GENERAL DATA	Integrated Turntable
Motor Section	
Type	auto belt drive, track selection
Platter mass/damping	0.8kg/fairly good
Finish and engineering	very good/fair
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33/45rpm (variable)
Wow and flutter (DIN peak wtd sigma 2)	0.07%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.15%/0.08%
Absolute speed error	variable
Speed drift 1 hour/load variation	-0.4%/+0.4%
Start up time to audible stabilisation	approx 1.5secs
Rumble: DIN 'B' wtd L/R av (see spectrum)	-62/-67dB
Arm Section	
Approximate effective mass inc screws, incl sensor cartridge	20g
Type/mass of headshell	non detachable/N/A
Geometric accuracy	fairly good
Adjustments provided	overhang, lateral angle
Finish and engineering	good/good
Ease of assembly/setting up/use	
Friction: typical lateral/vertical	very good/very good/very good +
Bias compensation method	60mg/60mg
Bias force: rim/centre (set to 1.5g elliptical)	internal spring
Downforce calibration error: 1g/2g	220mg/200mg
Cue drift/8mm ascent/descent	-0.2g/-0.15g
Arm resonances	negligible/1.3secs/1.5secs
Subjective sound quality	not applicable
Damping method	see cartridge response
System as a whole	Decoupled counterweight
Size/clearance for lid rear	42.0(w) x 38.0(d) x 13.0(h)/5.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	fair only
Hum level/acoustic feedback	fairly good/below average
Vibration sensitivity/shock resistance	below average/good
Estimated typical purchase price	£121



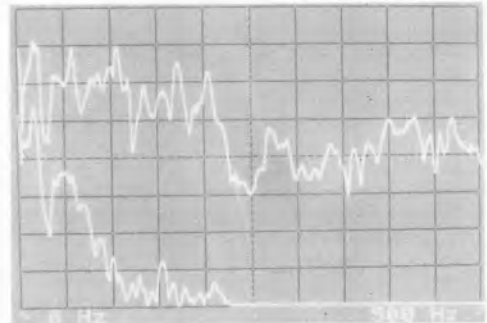
Cartridge response/crosstalk.



Disc impulse transmission, standard X1.



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



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

Aurex SR-Q770

Toshiba House, Frimley Road, Frimley, Camberley, Surrey. Tel (0276) 62222



Features and design

As the Q in this model's title implies, this Aurex uses a quartz-locked direct drive motor. But lest this convey an image of overall quality engineering, note should be taken of the very light 0.7 kg platter, a considerable proportion of which is supplied by the weight of the rubber mat!

Possessing fewer automatic features than the SRM-70, the 770 nevertheless incorporates record size detection cueing, accomplished once the correct speed has been set; auto-return at end of side is also fitted. For some unknown reason a digital readout of the record speed is given, despite it being already indicated on the speed selector; fine pitch control is not included.

At 5.5 kg the whole player weighs less than some audiophile platters alone. The light plastic lid was highly resonant in acoustic terms, and the situation is aggravated because the resulting vibrations are coupled straight into the plastic plinth. Little attention has been paid to vibration isolation, with rubber feet providing a plinth support resonance in the 10-15Hz range; this is above the likely arm/cartridge resonance, but is in the cartridge operating area nevertheless.

The arm was not particularly rigid, with some play evident in the bearings, and it uses a fairly popular detachable Japanese low mass headshell, made of lightweight plastic and fixed by a clampscrews. The overall effective mass of 8.5g suggests cartridges in the 15-30cu range.

Lab results

In practice the motor was fairly respectable, providing sufficient torque as well as a servo system free of dynamic wow effects. Wow and flutter was well controlled, and as with all quartz lock models speed accuracy and stability were beyond reproach.

Rumble was satisfactory at -71/72dB DIN B weighted, but spectrum analysis showed that the motor produced quite a strong electrical pole switching field, reflected by the pole harmonics in the electrical graph. Comparison with the total rumble (below) reveals further pole harmonics of a mechanical nature, and this is evidently not a very 'clean' motor. X1 scaling was essential for the disc and impulse transmission graph, which showed moderate mid damping dominated by a severe platter mode at 30Hz. Vibration isolation was acceptable, but the acoustic breakthrough result only merited a 'poor' rating.

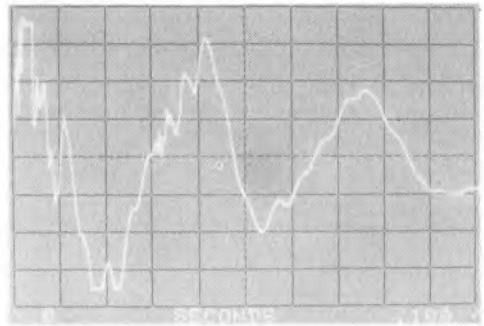
The arm was satisfactory with respect to biasing, friction and geometry, but unpromising in terms of audio band resonance analysis. The counterweight resonated at 55Hz, followed by the headshell at 150Hz (with a rattle). This then led to a complex multiple breakup sequence, with the energy levels falling rather than rising (as should have been the case). We found the arm cue lever was a little stiff, and rather limited space was provided in the headshell to accommodate longer cartridges.

Sound quality

Immediately this turntable was used at high sound levels, feedback problems became apparent, requiring careful listening for their amelioration. The bass register was 'boomy' and lacked depth while the stereo was 'flat' with noticeable midrange coloration. Tonally the sound was unbalanced, with a mid/treble 'sharpness' and 'hardness', while detail was significantly blurred.

Conclusion

On sound quality grounds alone no recommendation is possible for this model. Furthermore, the rumble performance was below par, and the player was also feedback prone. However modestly priced, it cannot be said to offer 'sound' value for money.



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

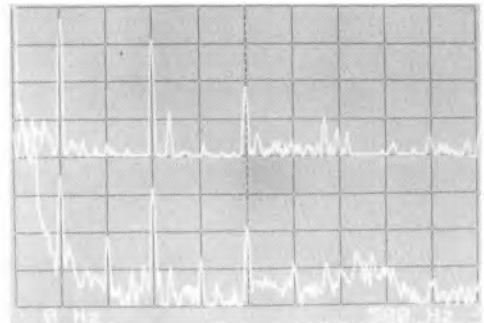
Type direct drive, quartz lock, fully automatic
 Platter mass/damping 0.7 kg/fairly good
 Finish and engineering very good/good
 Type of mains lead/connecting leads ... 2 core/phonos + earth
 Speed options 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) 0.06%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ... <0.1%/<0.06%
 Absolute speed error <0.01%
 Speed drift 1 hour/load variation <0.01%/<0.01%
 Start up time to audible stabilisation approx 1.2secs
 Rumble: DIN B wtd L/R av (see spectrum) -71/72dB

Arm Section

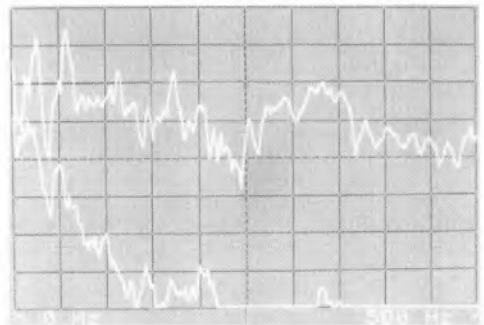
Approximate effective mass inc screws, excl cartridge 8.5g
 Type/mass of headshell ... special detachable (ADC type)/4.5g
 Geometric accuracy very good
 Adjustments provided overhang, lateral angle
 Finish and engineering very good/good
 Ease of assembly/setting up/use ... very good/very good/very good
 Friction: typical lateral/vertical less than 30mg/less than 30mg
 Bias compensation method spring
 Bias force: rim/centre (set to 1.5g elliptical) 220mg/180mg
 Downforce calibration error 1g/2g 0.00g/0.05g
 Cue drift/8mm ascent/descent negligible/0.5sec/1.0sec
 Arm resonances fair
 Lead capacitance/damping method 175pF/decoupled counterweight

System as a whole

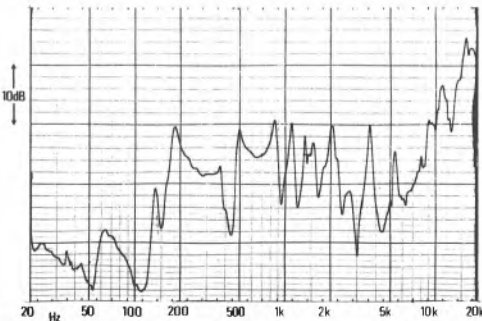
Size/clearance for lid rear 42.0(w) x 38.2(d) x 12.5(h)/6cm
 Ease of use very good
 Typical acoustic breakthrough and resonances below average
 Subjective sound quality of complete system below average
 Hum level/acoustic feedback fairly good/below average
 Vibration sensitivity/shock resistance below average/fairly good
 Estimated typical purchase price £140



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



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



Structural arm resonances, audio band

RECOMMENDED

Beogram 1700

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



Features and design

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

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

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

Lab results

While the light platter offered little potential for either support or damping, requiring the 'X1' scale to illustrate its 'transient response', it was rather better behaved than that of the much more costly 8000, presumably because the *nextel* patches did contact at least some of the disc surface area.

The turntable started up rapidly, and the automatic cycle was very quick to engage the leading grooves. Wow and flutter was low in DIN peak-weighted form, but was not so clean unweighted, suggesting that it might have been optimised for the specification. Speed slowing under load was a trifle high at 0.5%, but the torque was more than sufficient for the cartridge supplied. Rumble was fine, and better than for previous designs.

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

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

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

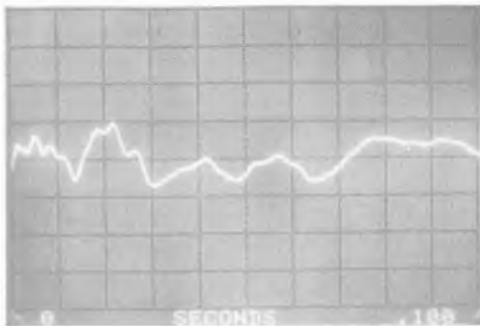
Sound quality

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

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

Conclusion

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



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

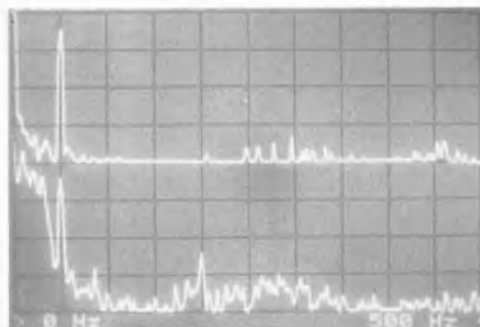
Type.....	belt drive, fully automatic
Platter mass/damping (outer platter).....	0.45kg/fair
Finish and engineering.....	very good/good
Type of mains lead/connecting leads.....	2 core/DIN
Speed options.....	33/45rpm
Wow and flutter (DIN peak wtd sigma 2).....	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz).....	0.14%/0.16%
Absolute speed error.....	-0.1%
Speed drift 1 hour/load variation.....	<0.15%/-0.5%
Start up time to audible stabilisation.....	<1.5secs
Rumble: DIN B wtd L/R av (see spectrum).....	-75dB

Arm Section

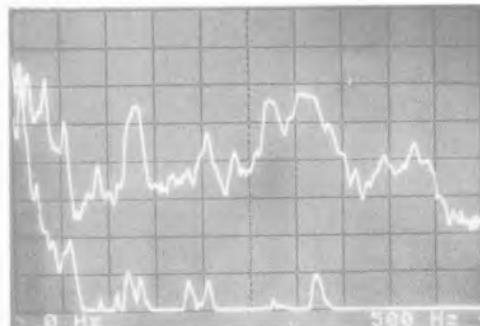
Approximate effective mass inc screws.....	6g incl cartridge
Type/mass of headshell.....	N/A / N/A
Geometric accuracy.....	very good
Adjustments provided.....	downforce
Finish and engineering.....	good/fairly good
Ease of assembly/setting up/use.....	excellent/excellent
Friction: typical lateral/vertical.....	est <50mg/est <30mg
Bias compensation method.....	internal spring
Bias force: rim/centre (set to 1.5g elliptical).....	150mg/250mg
Downforce calibration error: 1g/2g.....	+0.1g/-0.1g
Cue drift/8mm ascent/descent.....	negligible/1 sec/1 sec
Arm resonances.....	graphed with B&O cartridge
Damping method.....	N/A

System as a whole

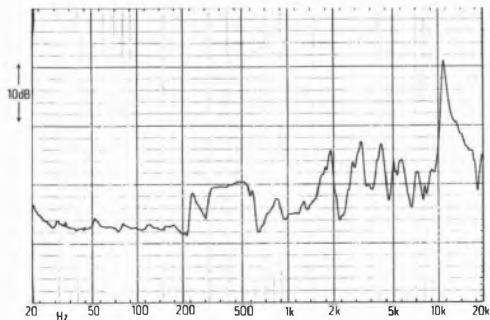
Size/clearance for lid rear.....	44.0(w) x 33.0(d) x 9.5(h)/not required
Ease of use.....	excellent
Typical acoustic breakthrough and resonances.....	very good
Subjective sound quality of complete system.....	above average
Hum level/acoustic feedback.....	very good/excellent
Vibration sensitivity/shock resistance.....	very good/very good
Estimated typical purchase price.....	£95



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



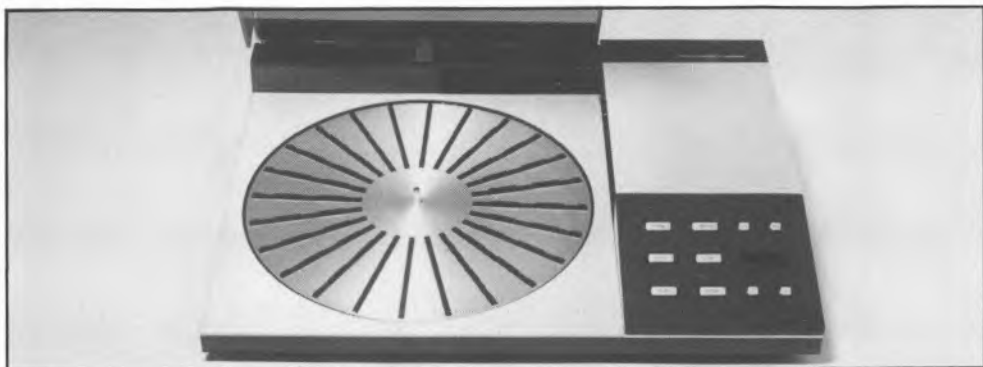
Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Arm resonances, B&O 20S cartridge.

Beogram 8000

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



Features and design

Developed from the famous 4000 parallel tracking deck, the 8000 enters the micro-processor age with internally programmed controls and an ability to transmit and receive information down a unique B&O computer 'bus' system. This allows remote control via a central interface which accepts and transfers signals to the other system components such as receiver, cassette deck, etc.

The tonearm section appears little changed from the 4000 series, comprising a transport carriage below the deck plate driven by a micro servo motor driving a lead screw. This assembly floats with the platter on a gravity sprung suspended die-cast subchassis of fine dynamic balance behaviour. The belt drive of the earlier design has been replaced by a servo-controlled eddy-current direct drive motor, acting on a torque rotor drum beneath the alloy platter. The latter still sports its characteristic and sparse radially ribbed disc support pattern, which is 'read' like a stroboscope by the sensor system to detect record size and thereby engage the automatic speed selection. Digital speed read-out is provided, together with deviations if such are programmed on the control panel.

Push button cueing and variable speed arm traverse are included, proving a little fiddly and needing some practice for reliable track selection. In the B&O tradition, the ultra low mass arm came fitted with a fully compatible cartridge, their top MMC20CL model, which has ranked highly in past editions of *Choice*. We did take a look inside the player, and as with so much B&O equipment we had considerable difficulty not only getting it apart but also in putting it back together again. In my view, while B&O's mechanical systems are ingenious, effective and innovative they also

tend to be awkward, and must be a trial for the service engineer.

Lab results

The platter motor has very low power consumption, with theoretically comparably low levels of unwanted vibration and by implication rumble. However it would not sustain even 50% of our test speed loading (c. 3.5g downforce dustbug) without servo control instability. In the absence of any firmer evidence it must be hoped that speed fluctuations do not occur with program material, particularly in view of the low 0.6kg platter mass.

The other results were fine for the motor, with the rumble spectra and results only limited by the lacquer disc necessary for measurement with this type of arm. As mentioned earlier, disc damping was relatively poor, and the X1 scaling was necessary to illustrate the poor absorption offered by this design. On the plus side, both acoustic and vibration isolation were very good – a feature inherited from its predecessor – and shock immunity was exceptional for the type. The arm construction prevented the taking of many measurements, though the parallel tracking design ensures excellent geometry, while the cartridge was also shown to track stably at a low 1g downforce.

For comparison with the 1700 the same B&O 20S cartridge was used to take the resonance graph, which is therefore not strictly comparable with the others in the issue. Good behaviour was demonstrated up to 480Hz, above which a number of breakup resonances occurred, indicative of minimal structural damping.

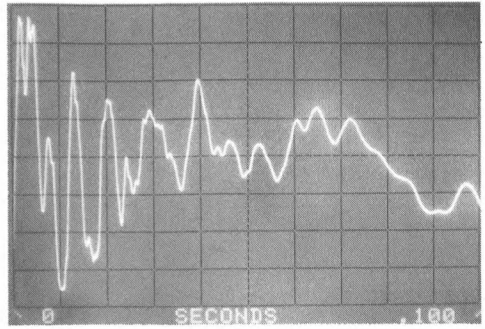
Sound quality

Bearing in mind that this assessment of course

includes the 20CL cartridge (used above 22°C, as it needs to be), in the context of today's quality systems and considering the price, the 8000 sound was pleasant enough, if uninspiring. There was an overall 'softness' and veiling of midrange detail and low frequency transients, with a 'dulled', slightly 'broken' effect in the treble. Vocals were tonally well reproduced, but lacked the incisiveness and 'conviction' expected of today's top players.

Conclusion

This elegant piece of automated and foolproof equipment offers fairly decent sound quality plus remote control potential. While it will not satisfy the true audiophile, it may nonetheless prove a logical purchase in the context of a top line B&O system.



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

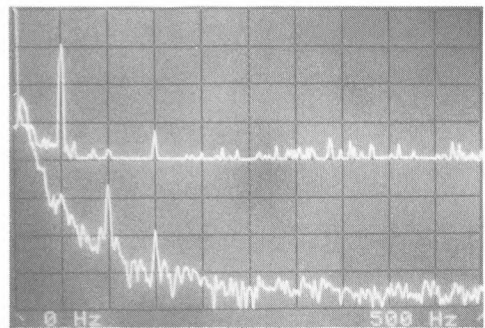
Type..... direct drive, fully automatic
 Platter mass/damping 0.6kg/poor
 Finish and engineering both very good
 Type of mains lead/connecting leads 2 core/DIN and special pin
 Speed options..... 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2)..... 0.06%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... 0.18%/0.065%
 Absolute speed error +0.1%
 Speed drift 1 hour/load variation... <0.15%/out of servo range
 Start up time to audible stabilisation not applicable
 Rumble: DIN B wtd L/R av (see spectrum)..... <74dB

Arm Section

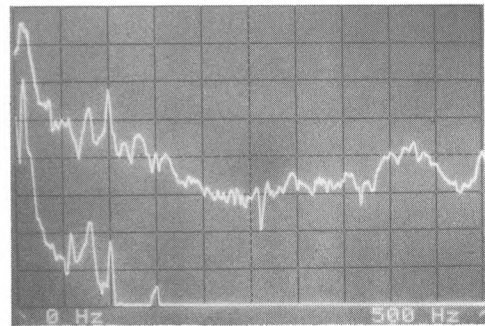
Approximate effective mass inc screws 7g incl cartridge
 Type/mass of headshell fitted cartridge/N/A
 Geometric accuracy..... excellent
 Adjustments provided..... downforce
 Finish and engineering..... very good/very good
 Ease of assembly/setting up/use... excellent/excellent/excellent
 Friction: typical lateral/vertical..... N/A / N/A
 Bias compensation method..... not required
 Bias force: rim/centre (set to 1.5g elliptical)..... N/A / N/A
 Downforce calibration error: 1g/2g N/A / N/A
 Cue drift/8mm ascent/descent..... negligible/0.5sec/0.8sec
 Arm resonances taken with B&O 20 S cartridge
 Damping method..... none

System as a whole

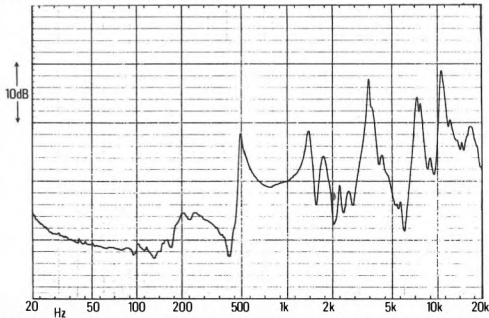
Size/clearance for lid rear..... 49.0(w) x 37.5 (d) x 9.0(h)/0cm
 Ease of use very good
 Typical acoustic breakthrough and resonances..... very good
 Subjective sound quality of complete system... above average
 Hum level/acoustic feedback very good/very good
 Vibration sensitivity/shock resistance..... very good/very good
 Estimated typical purchase price..... £360



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



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



Arm resonances, B&O 20S cartridge.

Denon DP30L

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



Features and design

The medium priced *DP30L* integrated turntable is fairly traditional in terms of its appearance and engineering. It is a direct drive model from one of the earliest exponents of the art, and the familiar coded strip used by Denon for servo speed control of the platter is located here on its inner rim, and read by a magnetic head. While not an automatic, the *30L* has power cueing, lift and descent under push button control, and can be actuated to lift off at end of record side via a sensor.

Separate cue controls are not provided, this function being accommodated by the speed selector stop/start buttons. The platter has a moderate 1.5kg mass, with a sensible rubber mat affording good record contact. Denon's usual solid plinth construction is in evidence, with the over damped sprung rubber feet endowing the system with only marginal isolation and plinth suspension resonances of the order of 10–20Hz, overlapping the arm/cartridge resonance range. The lid is direct coupled and in resonance terms very noisy.

The traditional arm has a matt black finish and employs a universal detachable headshell, offering an effective 18g mass in the 'heavy' category, only suited to low compliance cartridges. The arm bearings exhibited some play, with 'notchiness' in the horizontal plane giving rise to some friction.

Lab results

Denon claim a 0.019% rms wow and flutter spec, determined without a test record but employing the internal signal output from their error detecting servo system. We could not verify this figure, but noted a value at the threshold of our

test lacquer disc. To this excellent wow and flutter result must be added rapid start up, fine torque, an overshoot-free servo characteristic and very good rumble figures, the output proving free of pole related harmonics.

However, all this technical merit was counteracted by the results for acoustic and vibration breakthrough, which were below average and inadequate to secure a good subjective result. Fortunately the fairly smooth trends are in its favour, and as with many such turntables the shock resistance was better than average. The disc termination was just sufficiently good to permit X10 scaling for the impulse response; the picture shows good damping of the higher frequency range, but the main platter mode is less satisfactory at about 30Hz – possibly the platter rocking on the main bearing and its mounting.

Estimated at 17.5g, the arm effective mass suits cartridges in the 8–14cu range, but high quality models are not viable in view of the resonance characteristics. Friction values were satisfactory, and the biasing effective if 30–40% high. In the audio bandpass, the arm resonance graph showed a poor performance, with the counterweight break at 35Hz followed by an early and severe headshell socket flexure at 150Hz. Further breaks at 450Hz and 1kHz occurred before the arm 'settled down', the upper range effectively decoupled from the sensing cartridge.

Sound quality

'Average' sums up the sonic performance of this deck, with the overall effect slightly 'dull' and lacking 'bite'. With an *EPC 205 III*, while not as coloured as the arm graph might suggest, the

midrange was nonetheless obscured, with little depth effect, while a lack of sharp focus was evident on the frontal stereo imaging. The bass register was uneven with a loss of low bass, and at high volumes it showed a tendency to feed back, and the player needed care in siting.

Conclusion

This well made and finished turntable does not attain a sufficiently good subjective standard to merit recommendation. Too many areas of its design lack the specific features that are important to good sound, and the results thus confound the narrow established viewpoint that only the technical motor performance is important. Here is an example of a fine motor which has not given rise to a fine player, though the price is sufficiently reasonable for the model to merit consideration.

GENERAL DATA

Integrated Turntable

Motor Section

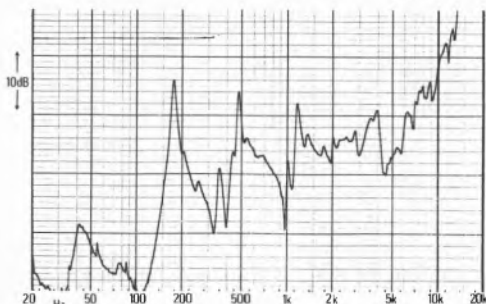
Type direct drive, auto lift
 Platter mass/damping 1.5kg/very good
 Finish and engineering very good/very good
 Type of mains lead/connecting leads .. 3 core/phonos + earth
 Speed options 33/45rpm (+ variable)
 Wow and flutter (DIN peak wtd sigma 2) <0.06%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) .. 0.1%/<0.08%
 Absolute speed error mains stroboscope <0.1%
 Speed drift 1 hour/load variation +0.3%/-0.1%
 Start up time to audible stabilisation approx 15secs
 Rumble: DIN B wtd L/R av (see spectrum) -74/-75dB

Arm Section

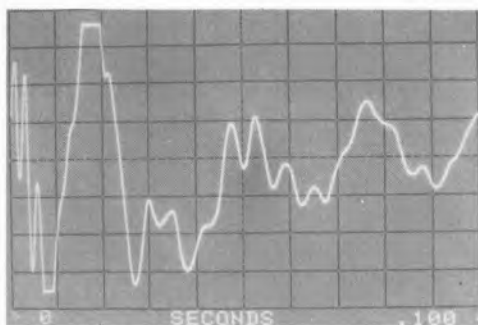
Approximate effective mass inc screws, excl cartridge ... 17.5g
 Type/mass of headshell universal detachable/9g
 Geometric accuracy very good
 Adjustments provided overhang, lateral angle
 Finish and engineering very good/good
 Ease of assembly/setting up/use very good/very good/very good
 Friction: typical lateral/vertical 50mg/30mg
 Bias compensation method spring
 Bias force: rim/centre (set to 1.5g elliptical) 200mg/250mg
 Downforce calibration error: 1g/2g -0.08g/-0.1g
 Cue drift/8mm ascent/descent negligible/0.9sec/2.5secs
 Arm resonances fair only
 Subjective sound quality average
 Lead capacitance/damping method 80pF/some via decoupled counterweight

System as a whole

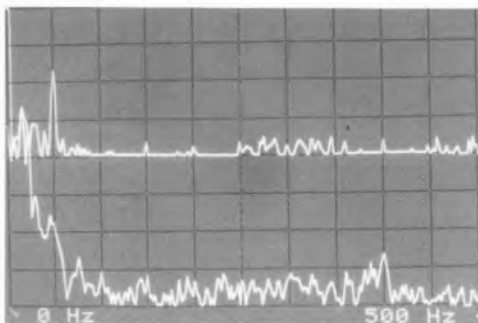
Size/clearance for lid rear 45.0(w) x 40.3(d) x 14.0(h)/0cm
 Ease of use good
 Typical acoustic breakthrough and resonances fair
 Subjective sound quality of complete system average
 Hum level/acoustic feedback very good/fairly good
 Vibration sensitivity/shock resistance fair only/fairly good
 Estimated typical purchase price £130



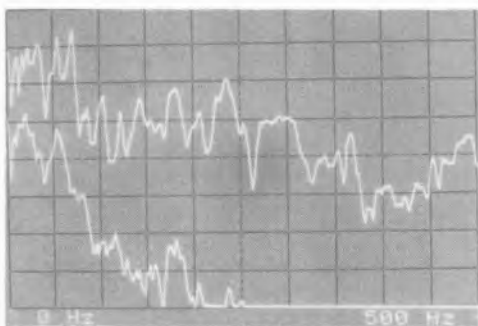
Structural arm resonances, audio range.



Disc impulse transmission, magnified X10.



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



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

Denon DP33F

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



Features and design

Related in some ways to the less expensive *30L*, the *33F* is a more robustly built affair, with a dense low resonance composition plinth. The arm has been upgraded and is fully automatic, with controlled cueing traverse powered by an electromagnetic force motor of completely silent operation. Disc size must be pre-set on a small dial, and all the controls are accessible on the angled plinth front, located clear of the lid. The latter is a light polystyrene type of unhelpful acoustic properties and the lid resonances were effectively transmitted to the arm despite the composition plinth. Similarly the rubber type feet were relatively unsuccessful in blocking the vibration from a shelf or support cabinet.

Directly driven by a two-speed motor, the error control uses a magnetic stripe printed on the inner rim of the platter. In contrast to the *DP30*, the speed is referenced to a quartz oscillator for immaculate stability, but the same 1.5kg platter and finely ribbed rubber mat are common to both models.

The arm automatics are frustratingly slow, and although a 'record sensing system' is described, in fact this seems to be merely a mechanical arm control arrangement, relating position to manually pre-selected record size and speed. The arm geometry was not ideal and optimum two point alignment was impossible; furthermore, the supplied (modest) moving magnet cartridge was out of alignment by 0.75° . This carries a *DL-8* a type number, tracks at 2g, and is fitted with a spherical stylus. A rather low optimum load is stated as 100pF; the arm alone is 80pF, to which must be added the amplifier contribution.

Lab results

All the drive motor characteristics were excellent bar rumble, which may still be described as good, but measured poorer than the cheaper *30L*; components -80dB at 400Hz and -85dB at 300Hz contributed to the result which just fails spec, but this is probably a sample fault as Denon are usually a reliable brand.

Scaling of X10 proved just possible for the disc impulse response tests, which showed good control of high frequency components above 500Hz but weaker damping of frequencies below this. Both acoustic and vibration isolation graphs illustrated a below average result, with a noticeably uneven trend which might be expected to induce coloration.

The arm possessed a fairly high effective mass requiring the use of a low compliance cartridge for the best results; even when fitted with an integrated type model of say 6-8g, the total mass of 15g is suitable only for models in the 12-22cu range. The biasing was excessive and the dial settings some 1g or so too high, though in the right ratio. The audio resonance graph was unpromising, with modes from 40Hz upwards, though it was better controlled than the *30L*; perhaps the headshell damping was helpful here.

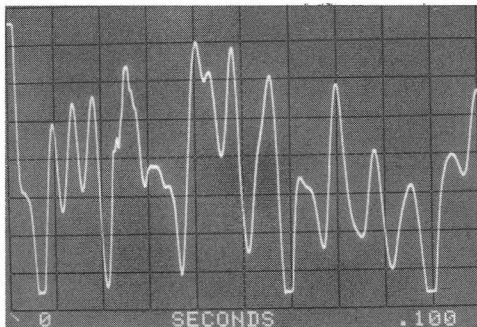
Sound quality

Of a pleasant and inoffensive nature, the *33F* did not portray much detail in the sound image, and provided only limited depth and ambient impression. The bass reproduction was average, falling somewhat short of the best available at this price level. The treble register was muzzy

lacking clear transients, although it did avoid the harshness of some of its competitors.

Conclusion

The value of this turntable partly depends on the importance the purchaser places on such features as quartz referenced drive, semi automatic arm positioning etc. In real terms the arm is of limited versatility, the player lacks effective acoustic or mechanical isolation, and has an average technical performance. In terms of the *Choice* framework, this model cannot qualify for recommendation; while the modest supplied cartridge is a small bonus, overall this package cannot be taken very seriously in true hi-fi terms.



Disc impulse transmission, magnified X10.

GENERAL DATA

Integrated Turntable

Motor Section

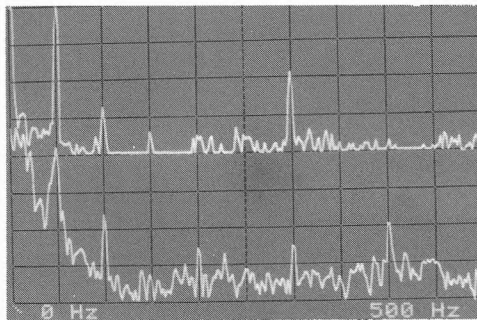
Type..... quartz direct drive, fully automatic
 Platter mass/damping..... 1.5kg/good
 Finish and engineering..... very good/good
 Type of mains lead/connecting leads... 2 core/phonos + earth
 Speed options..... 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2)..... <0.05%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... <0.1%/<0.06%
 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)..... -72dB

Arm Section

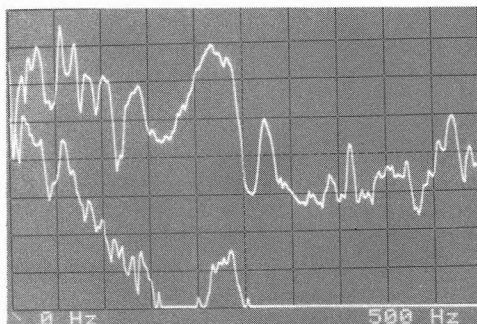
Approximate effective mass inc screws, excl cartridge.... 18.0g
 Type/mass of headshell..... universal detachable/10g
 Geometric accuracy..... fairly good
 Adjustments provided..... overhang, lateral angle
 Finish and engineering..... very good/good
 Ease of assembly/setting up/use... very good/fairly good/very good
 Friction: typical lateral/vertical..... 50mg/30mg
 Bias compensation method..... electronic
 Bias force: rim/centre (set to 1.5g elliptical) 250mg/300mg
 Downforce calibration error: 1g/2g -0.05g/-0.3g
 Cue drift/8mm ascent/descent..... negligible/0.5sec/1.5secs
 Arm resonances..... fairly good
 Subjective sound quality..... average
 Lead capacitance/damping method..... 80pF/none

System as a whole

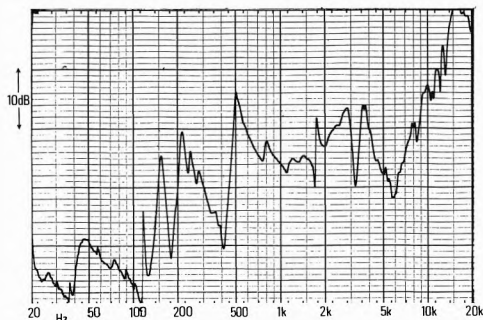
Size/clearance for lid rear ... 45.0(w) x 40.3(d) x 14.0(h)/5.5cm
 Ease of use..... very good
 Typical acoustic breakthrough and resonances..... fair only
 Subjective sound quality of complete system..... average -
 Hum level/acoustic feedback..... good/fair
 Vibration sensitivity/shock resistance..... fair only/fairly good
 Estimated typical purchase price..... £200



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



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



Structural arm resonances, audio range.

Denon DP60L

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



Features and design

The 'flagship' model amongst the Denon turntables available in the UK, the *DP60L* comprises an integrated turntable supplied with interchangeable arm tubes in the style of the Technics *EPA500* and the *AT1100*. The motor unit is also available without arm as the *DP55K*, and this report covers both options.

Weighing in at 13kg, a deep, strongly constructed laminated wood plinth is employed, finished in a rosewood type veneer, and fitted with sprung/rubber adjustable isolators. A recent version of Denon's classic high power direct drive motor is incorporated, here fitted with quartz-oscillator referenced speed stability, and electronic braking for speed change and stop. An unusual large AC mains powered brushless torque motor is used, servo-controlled to the correct speed via Denon's magnetic stripe control system whereby a magnetic head reads 1000 pulses per revolution from a signal recorded on the platter's inside rim. A special mat 'designed using laser interferometry' is fitted to the 1.7kg platter to minimise disc resonances.

The lid is a fairly substantial moulding, but could have been less resonant as it is coupled direct to the record via the plinth hinges. The plastic socket arrangement for the interchangeable arm tubes resembles the SME fitment, but with the addition of a locking thumbwheel; since the main arm bearing assembly is integral with the turntable, Denon have been able to incorporate some automatic features, notably power cueing (actuated by an angular force motor), and lift off via an end of side position sensor. To account for the differences in arm effective

mass, two counterweights are supplied, both with rotating sliding scales and easy to set up. Denon recommend using the two arms as appropriate for different cartridge compliances, aiming at a 11Hz system resonance for maximum stability. The heavier 'S' tube accepts universal detachable headshells and similar integrated cartridges; when measured with a typical headshell (ADC magnesium alloy), it gave a medium/high value of 15.5g.

In contrast the low mass, fixed head straight tube was established at 8g, suited to medium compliance models in the 15-25cu range. However the plastic cartridge fixing bracket did not seem very rigid, and likewise there was some play in the visually elegant arm bearing array. Arm height adjustment is incorporated in the pillar design, with an integral spring mechanism for bias compensation.

Lab results

Dealing with the disc support first, the performance was sufficiently good to justify X10 magnified presentation of the impulse response. In general damping was good, but the response was dominated by a low frequency mode at approximately 50Hz; this is believed to be due to platter rocking, and is beyond the control of any mat. With a rapid start up time plus excellent torque and overshoot characteristics, the drive motor confirmed Denon's considerable expertise in this department. Wow and rumble etc were all virtually at our measurement limits, the only significant rumble component being -85dB at 50Hz - possibly magnified by the aforementioned platter mode.

Such a performance is to little advantage however if the acoustic and vibration breakthrough graphs are found wanting. These were undoubtedly better than those recorded for its less expensive stablemates, but fell well short of the standard required at this price level, even though the trends were relatively even over the charted range.

The tonearms showed good geometry with quite satisfactory calibration of bias and downforces. Friction levels were satisfactory, but could to advantage have been lower, considering the implied cost of the arms. The resonance characteristics were however distinctly different for the two types. The universal 'S' model showed a very low frequency counterweight mode at 20Hz, followed by a gap until the first flexure due to the headshell socket at 100Hz – not a very high figure. The energy level jumped 10dB at this point, with a series of further resonances up to 5kHz.

The straight arm was rather different, with its counterweight mode an octave higher at 60Hz. Clearly of low rigidity, a complex torsional mode appeared at 200Hz, followed by a bending at 300Hz, beyond which point the resonant behaviour was better controlled, particularly above 3kHz.

Sound quality

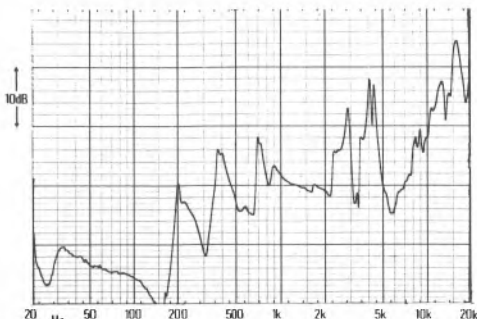
Auditioned first with the 'S' tube (and using an ADC magnesium headshell), the sound fell somewhat short of the standard possible at this price. High sound levels showed feedback tendencies, with low frequency instability as the first sign, and overall the bass lacked definition and 'weight' in the lower ranges, being emphasised higher up. While the frequency balance appeared neutral, significant coloration was noticed on female vocals (attributed to the tonearm), and the treble register was 'grainy'. Stereo showed some 'phasiness' which detracted from the central focus, while ambience and detail were both subdued.

Substituting the lower mass straight arm resulted in improved clarity, with better image stability and central precision; vocal coloration was also improved.

Conclusion

Flagship or not, this basically outdated model does not deliver the standard expected for the price, particularly with the 'S' arm option. The straight arm low mass option offers a reasonable sound quality, which can be assisted by mounting the deck on a substantial shelf to protect it from feedback.

At the price this model cannot be seriously recommended unless its style and features matter more than its sound quality.



Arm resonances, S-arm with ADC shell.

GENERAL DATA

Motor Section

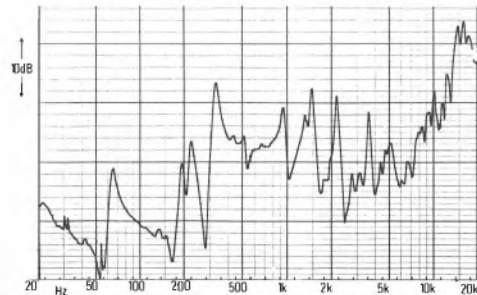
Type	quartz direct drive, manual	Integrated Turntable
Platter mass/damping	1.7kg/very good	
Finish and engineering	excellent/very good	
Type of mains lead/connecting leads	2 core/phonos + earth	
Speed options	33/45rpm	
Wow and flutter (DIN peak wtd sigma 2)	<0.05%	
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	<0.01%/<0.05%	
Absolute speed error	<0.01%	
Speed drift 1 hour/load variation	<0.01%/<0.01%	
Start up time to audible stabilisation	approx 1.2secs	
Rumble: DIN B wtd L/R av (see spectrum)	better than -76dB	

Arm Section

Approximate effective mass inc screws, excl cartridge	(S' 15 5) 8g
Type/mass of headshell	
interchangeable arm with detachable or fixed tubes/not supplied	
Geometric accuracy	very good
Adjustments provided	overhang, lateral angle, arm height
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/very good/good
Friction: typical lateral/vertical	40mg/25mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	180mg/200mg
Downforce calibration error: 1g/2g	0.02g/-0.1g
Cue drift/8mm ascent/descent	negligible/0.5sec/1.0sec
Arm resonances	(S' average -) average
Subjective sound quality	(S' average -) average
Lead capacitance/damping method	75pF/none

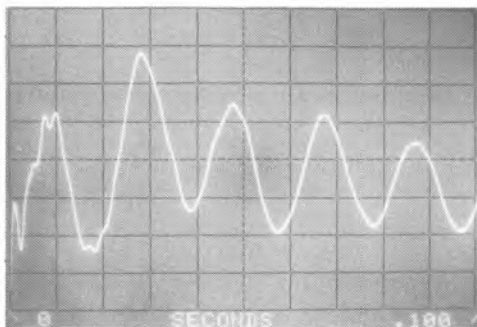
System as a whole

Size/clearance for lid rear	48.0(w) x 41.0(d) x 15.0(h)/5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average +
Hum level/acoustic feedback	very good/fair
Vibration sensitivity/shock resistance	fair/good
Estimated typical purchase price	£250

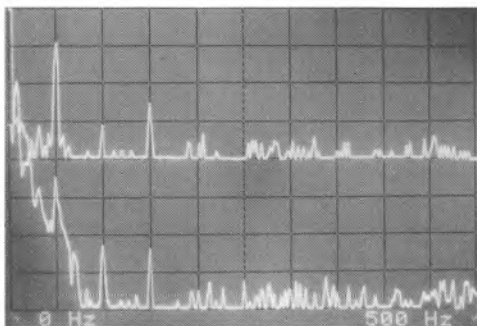


Resonances, straight lightweight fixed-d-head arm.

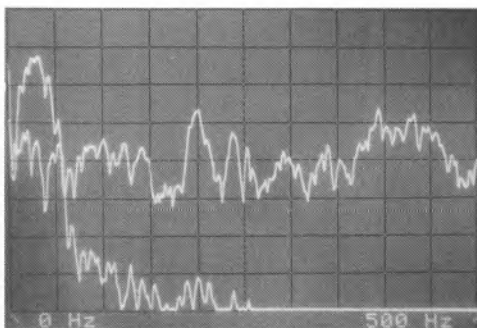
continued overleaf



Disc impulse transmission, magnified X10.



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



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



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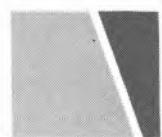
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Dual CS 505

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



Features and design

Dual's somewhat confusing model range begins with the black-finished 505 which is the cheapest deck they produce, and its 'twin' silver-finished 505-1. Developed from the CS506 reviewed last year, it is related to another new model in the range, the 506-1 (£96), black only, which unlike the 505 comes supplied with a cartridge (*ULM 45E*). An improved motor and spring suspension has been fitted to all models.

The 505 retains Dual's traditional flanged steel deck plate chassis, mounted on four plastic foam-damped steel coil springs. The belt drive uses a new 16-pole synchronous motor, fitted with Dual's ingenious vari-pitch control mechanism, which employs an expandable motor pulley. The light 1.1kg platter carries strobe markings and in the case of the 505 relies on external illumination; a lamp is fitted on the more expensive 506-1. Both decks have the Dual 'two ring support' rubber mat, which leaves considerable scope for improvement, as can be seen from the 'X1' disc impulse display.

Dual's forte is the production of high quality tonearm mechanisms, which are fitted even to their cheaper models, and the 505 proved to be no exception. The arm is designed for dynamic balance, and the well engineered gimbal bearings showed little play and were free of 'notchiness'. The overall effective mass of 6.5g suggests cartridges in the 12-30cu range (to some extent

dependent on the weight of the cartridge concerned). The cartridge mounting bracket clips in beneath the fixed headshell, and is locked in position by a lever. It may be further secured by a tiny grub screw which is visible on the top surface of the headshell itself - a type of fixing common to all models in the new Dual range. An anti-resonator system is fitted in the counterweight, but it had remarkably little effect on the subsonic resonance of our test cartridge in common with its predecessors.

Lab results

Employing our new automated sigma 2 measurement for wow and flutter, the first sample produced a marginal 0.15%, which is poorer than spec; although not fully on target, a second model was quite satisfactory at 0.11%. Torque was also satisfactory, giving a reasonable start up time, and the rumble reading was much better than for last year's model at a fine -73dB, although some motor rotational harmonics can be seen between 25 and 200Hz on the rumble spectrogram.

The disc impulse response (X1 scaling) illustrates poor damping of the narrow higher frequency components, which show large peak amplitudes; the longer duration ringing at 27Hz was probably the platter itself. The acoustic isolation was promising if rather 'lumpy', and would have been improved with a better and heavier mat. Vibration isolation was above average for the price, but was again irregular, with prominences at 50 and 275Hz.

The tonearm gave good basic results, and was generally quite accurate on all its settings, with the bias values nominally correct if slightly in the wrong ratio. However, it proved unexceptional in terms of audio resonances, with minor modes at 55Hz and 140Hz, and a major flexural resonance (probably torsion) at 200Hz, displacing the energy trend by 15dB. Above this point and for a whole decade (200Hz to 2kHz) the behaviour was very good, leading to a final major mode at 2.5kHz.

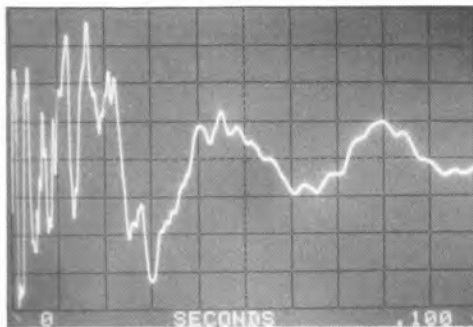
Sound quality

Rated as 'average', a fine result at the price, the 505 demonstrated a stable, relaxed quality, with quite decent presentation of stereo, bass extension and ambience; the arm sounded more integrated in character than the resonance graph might have suggested. The substitution of a good mat helped quite considerably (*Audio Ref* used, though others are also suitable), serving to clean up the sound and improving detail, depth

and clarity in the bass. The arm even coped with an Asak cartridge, although this is not a recommended combination!

Conclusion

Dual have at last arrived at a well-balanced turntable, offering a fine performance at a budget price, the end result determined by the choice of cartridge and mat. Inevitably it gains a full recommendation in terms of value for money. Theoretically the 506-1 should qualify similarly, but here the final value judgement must be reserved, depending on the quality of the supplied cartridge, the alternative of a 505 with quality cartridge and mat appearing the best option.



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

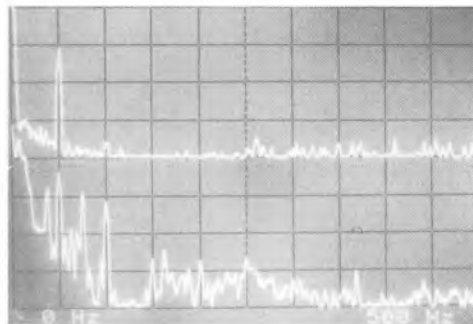
Type..... belt drive, manual and auto stop/lift
 Platter mass/damping..... 1.1kg/fair
 Finish and engineering..... very good/good
 Type of mains lead/connecting leads... 2 core/phonos + earth
 Speed options..... variable 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2)..... *0.15%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... 0.4%/0.16%
 Absolute speed error..... fine variable control
 Speed drift 1 hour/load variation..... synchronous/-0.4%
 Start up time to audible stabilisation..... 2.5secs
 Rumble: DIN B wtd L/R av (see spectrum)..... -73dB
 *Second sample result..... 0.11% DIN, 0.22% W, 0.15% F

Arm Section

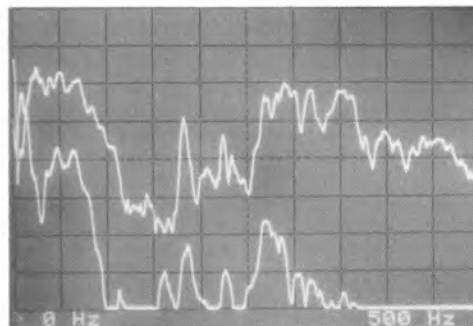
Approximate effective mass inc screws, excl cartridge..... 8g
 Type/mass of headshell..... detachable, special bracket/N/A
 Geometric accuracy..... very good
 Adjustments provided..... overhang, lateral angle
 Finish and engineering..... very good/very good
 Ease of assembly/setting up/use..... very good/very good/good
 Friction: typical lateral/vertical..... less than 20mg/less than 20mg
 Bias compensation method..... internal spring
 Bias force: rim/centre (set to 1.5g elliptical)..... 200mg/150mg
 Downforce calibration error: 1g/2g..... +0.1g/0g
 Cue drift/8mm ascent/descent..... negligible/2secs/1sec
 Arm resonances..... average
 Subjective sound quality..... average
 Lead capacitance/damping method... 150pF/seismic counterweight

System as a whole

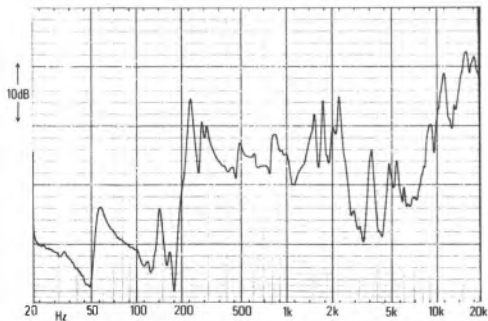
Size/clearance for lid rear..... 42.0(w) x 36.5(d) x 11.3(h)/6cm
 Ease of use..... very good
 Typical acoustic breakthrough and resonances..... fairly good
 Subjective sound quality of complete system..... average + f
 Hum level/acoustic feedback..... good/good
 Vibration sensitivity/shock resistance..... average/good
 Estimated typical purchase price..... £75
 † with better mat substituted



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



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



Structural arm resonances, audio range.

Dual CS 508

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



Features and design

This new Dual model bears no resemblance to their traditional designs, and is closer to the silver-look Japanese models which are so common nowadays. It is supplied with an Audio Technica cartridge specially made for Dual (*ULM 45 E*); possessing a low mass and fitted with an elliptical stylus, it is capable of a pretty good performance, including tracking at a 1.5g downforce.

The light and resonant lid is mechanically linked to the moulded plinth, and thence to the platter and arm. The feet are described as shock absorbers, and carry two stiffness settings which alter the plinth feet resonance distribution to try and alleviate the effects of acoustic feedback, should this occur. For the record, both settings were tried during the assessment of vibration isolation with little resulting change to the graph in the 20 to 500Hz range. Some effects were noted between 8–18Hz, which is an area not shown on the graph, and which might have some effect under particular circumstances.

The drive system is very similar to the 505/6, again using the 16-pole motor with vari-pitch pulley and flat precision ground belt. In this instance the turntable has illumination incorporated for the platter strobe engravings. Like the 505/6, the 508 is manually operated, but all three models incorporate automatic lift at end of side.

In return for abandoning effective isolation, the 508 offers a so-called luxury metallic paint finish, with a cunning hinge design for the lid that requires barely any extra rear clearance when opened. The intention is for this model to compete with the lightweight Japanese units commonly used in rack systems, while incor-

porating a creditable arm and compatible cartridge in the package. The arm was well up to Dual's usual high standard, with a low mass clip-in mounting bracket system and well adjusted gimbal bearings.

Lab report

The motor performance was to true hi-fi standards, with all measured characteristics beyond criticism. At -74dB the rumble level was more than satisfactory despite the presence of some mild rumble noise on the spectrogram. However in common with the 505, the disc impulse response was poor, necessitating X1 scaling and showing minimal control of the narrow-spaced higher frequency components. Almost any solid flat mat would effect a substantial improvement here.

As expected the isolation characteristic was distinctly below average – significantly poorer than for the 505. This model should be kept well away from the loudspeakers, and preferably securely wall-mounted. The supplied cartridge was well-aligned and properly fitted and arm friction levels were excellent, but on our sample the bias force was on the low side, reading 100mg for a 1.5g setting (between 175 and 220 is more appropriate).

The arm resonance characteristic was similar to the 505, with the dominant 200Hz mode plus the return break at 2.5kHz in evidence. But between these two points lay an elevated region of comparatively good control.

Sound quality

Significantly poorer than the 505, particularly when exposed to the live sound field with its vibrations, the 508 did not prove rewarding when

auditioned. The above average arm with its stable tracking characteristic did manage to impart a measure of quality, but overall the sound was mildly confused, lacking in depth or detail, and exhibiting a blurring of transient definition throughout. Improving the mat only resulted in a marginal upgrading.

Conclusion

Despite the adverse findings for sound quality, the 508 emerges as a reasonable package when the cartridge is taken into account, and if carefully sited could work quite well. Perhaps a guarded 'worthy of consideration' is the best comment to make, although I would not like to be held responsible for the sound if the deck were poorly positioned in a rack on a bouncy floor between two loudspeakers!



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

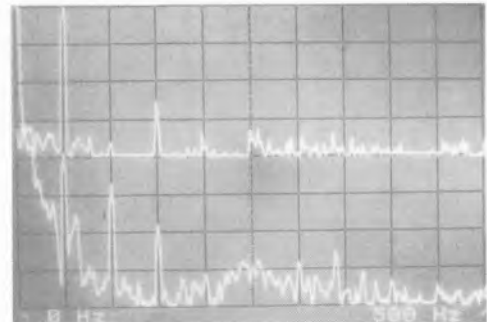
Type..... belt drive, manual with auto lift
 Platter mass/damping 1 kg/lair
 Finish and engineering..... very good/good
 Type of mains lead/connecting leads... 2 core/phonos + earth
 Speed options variable 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2)..... 0.08%
 Wow and flutter(LIN peak wtd 0.2-6Hz/6-300Hz) ... 0.15%/<0.05%
 Absolute speed error..... variable pitch
 Speed drift 1 hour/load variation..... synchronous/-0.02%
 Start up time to audible stabilisation..... 1.6secs
 Rumble: DIN B wtd L/R av (see spectrum)..... -74dB

Arm Section

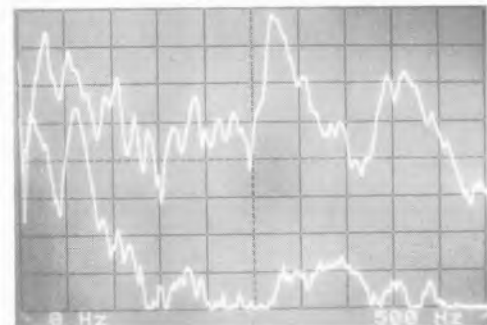
Approximate effective mass inc screws, excl cartridge 6g
 Type/mass of headshell special bracket detachable/N/A
 Geometric accuracy..... good
 Adjustments provided..... overhang, lateral angle
 Finish and engineering..... very good/good
 Ease of assembly/setting up/use..... very good/very good/very good
 Friction: typical lateral/vertical..... less than 20mg/less than 20mg
 Bias compensation method..... internal spring
 Bias force: rim/centre (set to 1.5g elliptical)..... 100mg/100mg
 Downforce calibration error: 1g/2g..... +0.05g/0g
 Cue drift/8mm ascent/descent... negligible/<1.5secs/<1.5secs
 Arm resonances..... fairly good
 Lead capacitance/damping method... 150pF/seismic counterweight

System as a whole

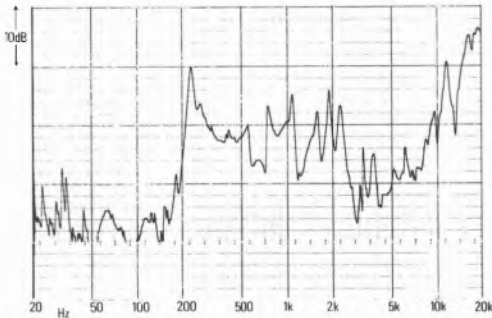
Size/clearance for lid rear..... 43.5(w) x 38.5(d) x 11.5(h)/1.0cm
 Ease of use..... good
 Typical acoustic breakthrough and resonances..... poor
 Subjective sound quality of complete system..... below average
 Hum level/acoustic feedback..... very good/below average
 Vibration sensitivity/shock resistance..... poor/good
 Estimated typical purchase price..... £80



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



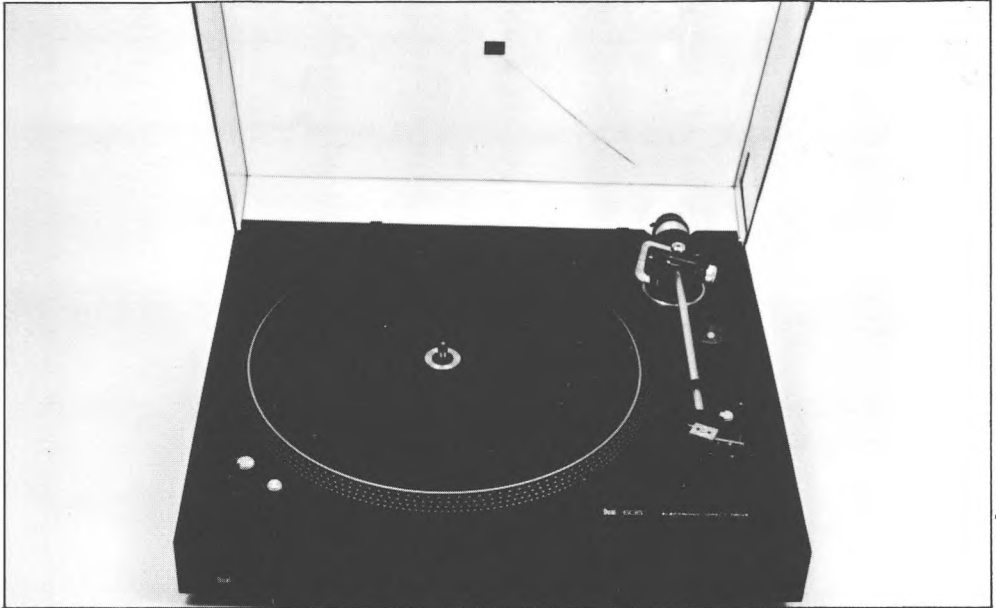
Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Structural arm resonances, audio range.

Dual 606 (revised & reprinted)

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



Features, facilities, setting up and use

This manual direct drive model was fitted with a moderate mass pressed platter of poorer than average edge-weave and centration, although the steel chassis/deck plate gave a reasonably low suspension resonance of 6Hz on its damped coil springs. Once again, with this technique lid-borne feedback was not coupled to the arm, thereby reducing acoustic breakthrough. Not quartz locked, the motor offered two speeds plus fine variable control with the usual mains illuminated strobe reference, and as with the 506, an automatic version is also available at a slightly higher price (626).

The effective mass of the arm read 7g, but this was taken in conjunction with the test cartridge and mounting plate, and it is estimated that the entire effective mass with ULM fitted is barely greater, thereby endowing the system with good stability and a sensibly high subsonic resonance.

Lab performance

A good wow and flutter result was recorded despite a higher than average wow only figure. Speed accuracy and stability were fine, with the

slowing under load negligible despite the moderate torque output, the latter offering a 3.5 second start up. A trace of wow overshoot was detected but was not considered to be subjectively significant, while the weighted rumble reading was quite acceptable at an average 72dB. Part of this was due to static electrical induced breakthrough in the test cartridge output, although other motor components were also present — for example at 36, 72 and 140Hz, with the 60Hz line probably representing a resonance effect traceable to the tonearm.

The arm itself proved well adjusted and aligned, with low pivot frictions, and the biasing was effective, adding no additional friction; however, on our sample it did give rim/centre values in the inverse ratio, although of about the right sort of magnitude. Downforce calibration was fairly accurate and cue drift negligible, with sensible rates. Despite the 60Hz counterweight mode, the tidy and relatively continuous nature of the arm resonance curve merited an above average rating, and with a conventional cartridge the excitation of those resonances will in fact be less, due to lower mechanical resistance compared with

the lab test model (a Dynavecator 10X).

Judged good on acoustic breakthrough, the 606 improved on the 506 vibration isolation by achieving an above average rating, some 10dB better, for example, at 100Hz. Both feedback and impact shock resistance were well above average.

Sound quality

Despite our misgivings concerning the quality of the platter mat, the 606 rated above average, and sounded quite similar to the 506, but offered marginal improvement in stereo focus and bass clarity, although these differences were in fact small. We wondered whether a simple counter-weight rather than the 506 resonator type would have effected a further improvement?

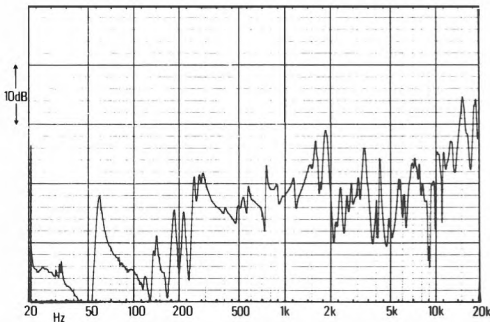
Conclusion

In many respects this turntable was above average, and in its latest form it is available at a much lower price than when this review was prepared, albeit without a fitted cartridge. Although not quite as good value as the newer 505, the overall price-vs-performance ensures recommendation in the context of the project as a whole.

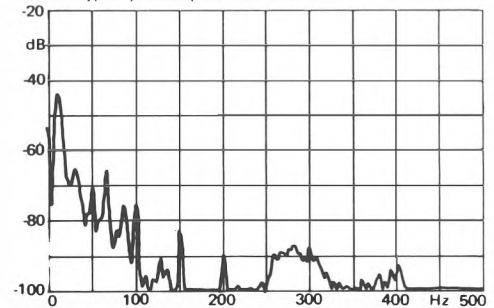
GENERAL DATA

Integrated Turntable

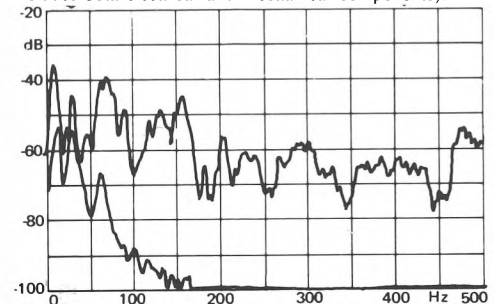
Motor Section	
Type	direct drive
Platter mass/damping	1.40kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33 $\frac{1}{3}$, 45 rpm
Wow and flutter (DIN peak wtd sigma 2)	0.08%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.18%/0.06%
Absolute speed error	+0.15%
Speed drift 1 hour/load variation	<0.15%/0.05%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	71/73dB
Arm Section	
Approximate effective mass inc screws, excl cartridge	7g
Type/mass of headshell	special detachable/N/A
Geometric accuracy	very good
Adjustments provided	lateral angle, overhang
Finish and engineering	very good/good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	20mg/<10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	250mg/175mg
Downforce calibration error: 1g/2g	-0.1g/-0.15g
Cue drift/8mm ascent/descent	negligible/1.8secs/0.8secs
Arm resonances	above average
Subjective sound quality	above average
Lead capacitance/damping method	175pF/seismic weight in c/wt
System as a whole	
Size/clearance for lid rear	42.5(w) x 37(d) x 15.5(h)/5cm
Ease of use	good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level/acoustic feedback	very good/above average
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£95 (excl cart)



Arm resonances



Rumble Spectrum (ref 10cm/s @ 1kHz; includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Dual CS741Q

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



Features and design

Described as 'Dual's latest flagship' the 741Q appears to have abandoned the traditional softly sprung floating subchassis in favour of a more fashionable silver finished moulded plinth in common with the 508. A form of internal subchassis has been retained however, although this is very heavily damped (mistakenly so in our opinion) in order to provide the maximum impact shock resistance, at the expense of broadband isolation requirements.

An important feature of the design is the integration of arm and cartridge, resulting in a claimed effective mass of 8g. The cartridge is the outcome of co-operative development on the part of Dual and Shure Electronics; designated the *TKS390E*, it tracks at a low 1g downforce and outwardly does not relate to any existing Shure model, although the internal components have some design similarities with the *M97* and *V15 IV*. A Shure Bi-Radial or 'pseudo elliptical' stylus tip is fitted to this moving magnet design, which claims a low 0.3mg tip mass for good high frequency trackability.

Damping is the keynote to the 741, a philosophy applied to all of the following areas: two way adjustable plinth feet, the internal subchassis springing, the tonearm tube (special *XM300* alloy), and the counterweight which incorporates a viscous fluid well to damp a seismic internal component – a technique we first encountered on the Technics *EPA100*. But despite all this emphasis on damping, Dual have not seen fit to look after the record support, as the X1 scaled impulse graph testifies.

Fully automatic in operation, the controls are presented on the front of the plinth, clear of a lid which requires no extra rear clearance for elevation. The quartz-locked direct drive motor carries a die cast 1.5kg platter with bold strobe markings; synthesiser-controlled variable pitch is also in-

cluded, together with a speed display indicator in coloured LEDs. The arm is adjustable for height, and uses a massive precision gimbal bearing assembly.

Lab results

Dual have been capable of producing truly excellent direct drive motors for some time now, and the one fitted to the 741 belongs to that category. In all respects its performance was state of the art in terms of paper measurements, although our rumble spectrogram did reveal one component, -70dB at 123Hz, unrelated to mains frequency.

The disc impulse response showed poor damping, but the low frequency platter rocking noted with the less expensive models was better controlled here. A decent mat would however undoubtedly prove worthwhile. Above 100Hz the acoustic and vibration isolation was quite good, but it deteriorated at low frequencies; as a point of comparison, the vibration rejection at 70Hz was 45dB, whereas the Thorens 160CIII (by no means the best of the tested models) was nearly 20dB better.

The tonearm was very well adjusted and calibrated, with an effective mass of 6g (10g complete with cartridge). A lateral low frequency resonance of 9.5Hz was observed, whereas Dual recommend an anti-resonator setting of 11.5 (Hz), thereby implying a compliance discrepancy of some 50% unless they intend the damper for use in the vertical plane only. Audio range resonances were similar to the other Dual models with the marked breakup at 200Hz well defined, but the upper range behaviour was marginally better than the cheaper models.

Sound quality

Showing some tendencies to low frequency feedback, with a 'light' and 'softened' bass sound,

the 741 gave slightly better stereo than its cheaper cousins, although it still exhibited some upper treble 'roughness'. Stereo depth and general definition were about average for the type, and the cartridge sound, though not extensively auditioned, seemed on a par with the recommended M97 type models from Shure.

Conclusion

While possessing additional facilities as well as an admittedly good 'footfall' shock immunity, the 741Q offers very little extra sound improvement over Dual's less expensive models, and does not justify recommendation. The 505 should not have been so good!

GENERAL DATA

Integrated Turntable

Motor Section

Type..... quartz direct drive, fully automatic
 Platter mass/damping 1.45kg/good
 Finish and engineering..... 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 <1.5secs
 Rumble: DIN B wtd L/R av (see spectrum) -77dB

Arm Section

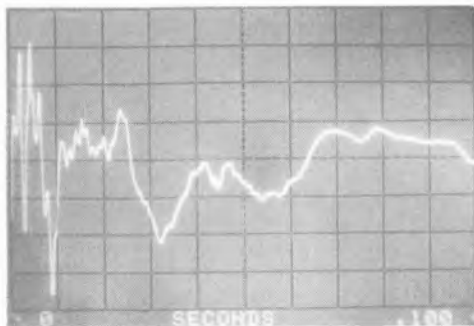
Approximate effective mass inc screws, excl cartridge 6g
 Type/mass of headshell special bracket detachable/N/A
 Geometric accuracy very good
 Adjustments provided arm height, overhang, lateral angle
 Finish and engineering very good/good
 Ease of assembly/setting up/use very good/very good/very good
 Friction: typical lateral/vertical less than 20mg/less than 20mg
 Bias compensation method internal spring
 Bias force: rim/centre (set to 1.5g elliptical) less than 200mg/150mg

Downforce calibration error: 1g/2g +0.05g/correct
 Cue drift/8mm ascent/descent negligible/1.5-4 (var) secs/approx 1.5secs

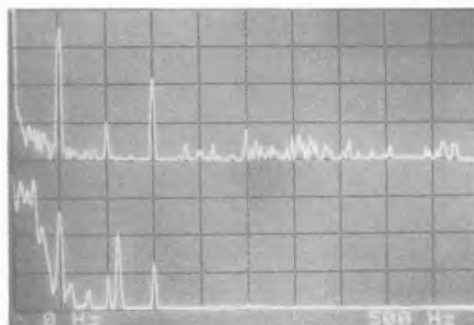
Arm resonances fairly good
 Subjective sound quality..... fairly good
 Lead capacitance/damping method 150pF/tuneable dynamic damper (vertical plane)

System as a whole

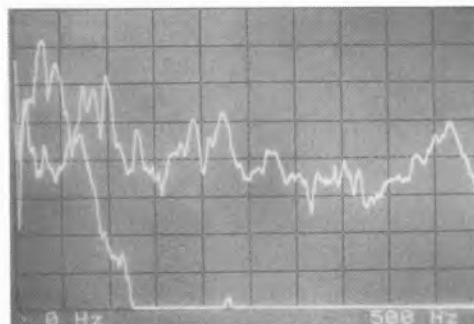
Size/clearance for lid rear 44.0(w) x 38.0(d) x 11.0(h)/0cm
 Ease of use..... good
 Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system average +
 Hum level/acoustic feedback very good/fairly good
 Vibration sensitivity/shock resistance below average/good
 Estimated typical purchase price £220



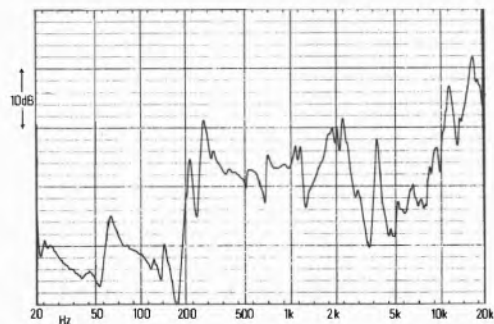
Disc impulse transmission, standard X1.



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



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



Structural arm resonances, audio range.

RECOMMENDED

Dunlop Systemdek (re-assessed)

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



Features and design

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

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

In the latest version the situation has been improved – by the substitution of even more compliant springs! At first sight this might be expected to worsen matters, but in fact when properly adjusted they lie in a state of greater compression and are physically shorter. This has considerably improved lateral stability, which is confirmed by the new low wow figures. Furthermore the tricky special spanner arrangement formerly used for alignment is now avoided by the use of surface mounted alignment crosshead screws, located beneath the top platter.

The fabricated plinth is a well damped wood composite steel structure, with open access for arm lead dressing beneath a detachable arm board, which is secured by two socket head bolts. Improved feet have been fitted and can be adjusted for levelling, while the low resonance lid is retained. The plinth is finished in a *nextel* suede type coating.

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

Lab results

The drive exhibited good torque, with only 0.1% slowing under load, and a fair start up time in view of the heavy platter. Wow and flutter was very satisfactory and better than for earlier samples; likewise the rumble level, which is now at the threshold of measurement. A 100 Hz component was noted on the spectrogram at -70dB, but this proved to be inaudible as a specific effect when auditioned.

The results for vibration isolation and acoustic

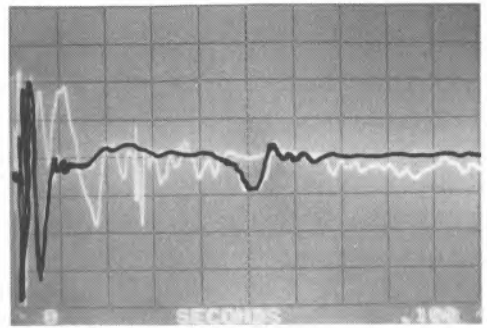
breakthrough were both very good, the slight lumpiness on the acoustic trace attributable to the disc on its supports. Two disc impulse responses were taken. First on X1 scaling and using the mat as supplied, the initial transient was large, but was quickly damped, and the longer term low frequency performance was fine. For comparative purposes the *Audio Ref* mat was also tried, and this reduced the impulse magnitude by almost a factor of 10, allowing X10 scaling for the superimposed (white) presentation – a very fine system response.

Sound quality

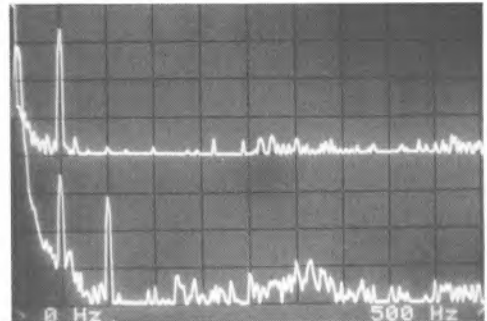
Already setting a top class standard as a motor unit, the *Systemdek* was considered to have been further improved with a slightly firmer and more stable quality imparted to the stereo image than before. The bass register was open, deep but slightly 'heavy' in balance, while coloration was very good,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

Conclusion

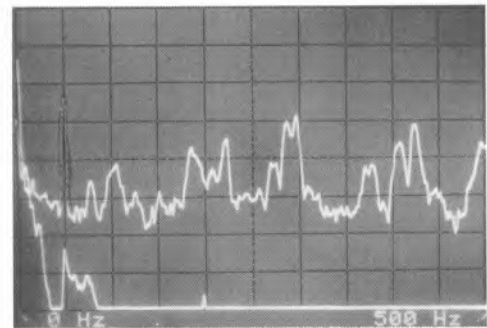
The *Systemdek* continues to set an enviable standard for its price, and can be confidently recommended as representing fine engineering and acoustic value for money. Compared with its established competitors, it can offer the two speed option, simpler alignment procedures, leveling feet, and easier arm fitting. But in common with many other motor units it lacks some of the special benefits resulting from the complete system design of an integrated/optimised player.



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



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

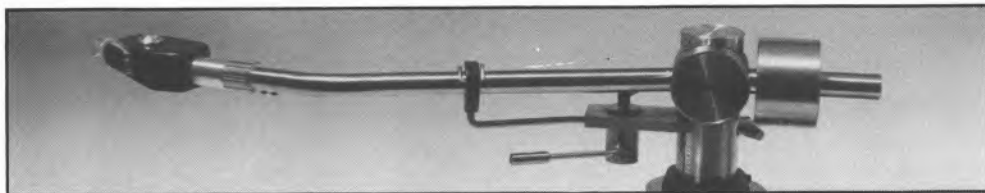


Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

GENERAL DATA	Motor Unit
Type	belt drive
Platter mass/damping	4.8kg/fairly good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core/1V/A
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.13%/0.09%
Absolute speed error	+0.15%
Speed drift 1 hour/load variation	negligible/-0.01%
Start up time to audible stabilisation	4.5 secs
Rumble: DIN B wtd L/R av (see spectrum)	-78/77dB
Size/clearance for lid rear	46.0(w) x 37.0(d) x 15.5(h)/4.0cm
Ease of use	fairly good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	very good+
Hum level/acoustic feedback	good/excellent
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£300

Fidelity Research FR64 FX/FR64S (re-assessed)

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



Features and design

Fidelity Research is a Japanese company with a good reputation for high quality moving-coil cartridges. As a natural adjunct they also manufacture tonearms, in the past usually of the heavy construction/high mass variety.

Currently there appear to be two diametrically opposed yet justifiable views on tonearm design. The European approach is characterised by a target of mechanical system compatibility, leading to optimum cartridge/arm resonance placement and consequent tracking consistency, benefits can include better shock resistance, stable stereo imaging, minimal frequency shift and intermodulation distortion. In the context of quality cartridges traditionally possessing medium to high compliances (20-60cu), mechanical compatibility has been achieved by reduction of the effective moving mass as seen by the stylus. The epitome of this approach is perhaps the elegant Ortofon/SME *Concorde* integration at just over 4g total effective mass, while B&O and Technics have employed this technique for their integrated combinations (effective masses in the 6-9g range).

Conversely, the pursuit of subsonic resonance control requires a reduction in arm strength and rigidity, which can in some cases worsen resonances and colorations. This is strikingly apparent with some of the very lightest designs (cf: *Black Widow*, now obsolete). And if using medium to low compliance cartridges, particularly moving-coils, the low mass requirement becomes less pressing, and instead arm coloration may be considered the top priority. While undoubtedly an oversimplification, higher mass allows greater strength and better audio range resonance

control, and this particular goal has clearly led to the development of the top FR design, the 64S, one of the highest mass arms in current production. This mass, together with the form and choice of the materials used, provides a firm high inertia platform, and gives a solidity and cleanliness to the sound reproduced by suitable cartridges, a benefit which for some listeners may outweigh the known compromise involved with respect to the subsonic arm/cartridge resonance.

The 64S possesses a 35g effective mass, and on grounds of compatibility alone should partner a cartridge in the 5-10cu range. There are only a few of these, and none from FR, whose own models tend to be about twice this value. Even with the thick 20g headshell removed, the arm alone with its stainless steel beam provides 15g, so except those of low compliance there is not much scope for integrated headshell cartridges.

Perhaps in recognition of this problem, the 64S has now acquired a partner, the 64FX, whose effective mass is almost halved to 20g. In contrast to the 'S' which is all silver, the 'FX' is immediately distinguishable by its handsome matt black finish. In mechanical terms the two arms do however have quite a lot in common: for example, the pillar diameters are the same for both, although the external size of the pillar mount is different for each. They also share a universal detachable headshell system, with finely tooled fixings to provide an unusually tight grip. The headshells may be interchanged, which allowed us scope for arm resonance investigation, to see how much of the behaviour was determined by the shell alone.

Both arms use pure silver internal wiring (for what it is worth); the size and locking of the counterweights differ, the 64S uses stainless steel while the FX uses aluminium alloy for the main tube; a thread-linked weighted bias lever is fitted to the 'FX instead of the simple lever in the 'S; in fact the FX lever sticks out in the direction of the platter, which caused some problems when fitting the arm to the Image with its large platter, for example. Interestingly the geometry for the 'FX has been revised to obtain optimum low distortion tracking, by increasing the offset angle by a little less than two degrees.

Lab results

The friction levels of the 'S were excellently low, and the bias compensator worked well although the values were a little high. Downforce calibration set by a large dial with an internal spring was very accurate, and lead capacitance was low at 80pF, allowing maximum freedom for matching load-critical cartridges. A clamping screw is provided for the counterweight, and two audio resonance graphs were taken to assess the effect of this clamping, on the performance. From the results one might consider the loose counterweight to be superior, since the energy trend is smoother and the resonances are of smaller amplitude; however there are good reasons why this is not in fact the case. The damping afforded is of an uncontrolled and intermittent variety, as shown by the random 'noisy' nature of the fine resonance structure, and this cannot be to the arm's sonic advantage. With the counterweight screwed down, the behaviour is cleaner up to the first mode at 200Hz, while the resonances themselves are fewer in number and more clearly defined. Moreover the characteristically uniform energy trend is retained, suggesting good tonal balance.

Turning to the 'FX, the bias settings were less satisfactory, being excessive at the rim (X2) and slightly low as well as in the wrong ratio towards the centre; the user will have to find some compromise here. The resonance graph was different from the 'S in the higher magnitude of the resonances and the slightly less uniform energy trend, though general similarities still exist. When the heavy 64S shell was substituted for the more open formed shell of the 'FX, the combination closely mimicked the 64S characteristic above 2kHz, but appeared to worsen the behaviour below this frequency. It was found that tight headshell clamping was essential to ensure repeatability of the curves as well as a consistent sound quality.

However, none of the graphs indicate that the arms are as rigid as their physical structures might suggest, and their quality clearly owes more to fine bearings and sheer inertia than anything else.

Sound quality

In the context of detachable headshell designs, the 64 models came out the best of all those tried this time round – but they were also the most expensive. Difficult to convey in precise terms, the sound of both models was comparable, with the 'FX sounding a little more secure in terms of focus and image stability, the 'S a little cleaner in coloration terms and possessing greater 'bass weight'. Both proved more tolerant of arm mounting arrangements than, for example, the *Ittok*, but their high mass led to problems with the suspension arrangements of some turntables.

Possessing a neutral and relaxed character with good integration of the various frequency ranges, space and ambience were well reproduced. However both models lacked the final degree of incisive precision, clarity and focus offered by the best super-rigid fixed headshell designs. This was noticeable both in the mid-range and also in the bass, where detail was 'softened' and lacked impact.

Conclusion

These arms have their own special qualities, but in real terms cannot be said to offer very good value for money. In combination with the right motor unit however they can give a very good sound, our preference being for the high mass composite types such as the Marantz or big Luxman, rather than the more 'nervous' sub-chassis models. The detachable headshell is of course a convenience if the purchaser wishes to use more than one cartridge.

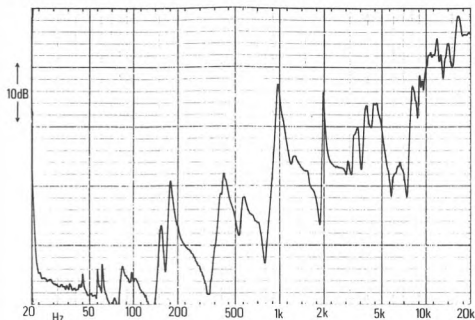
GENERAL DATA

	Tonearm
Approximate effective mass inc screws, excl cartridge	..... 20g
Type/mass of headshell	..... universal detachable/14g
Geometric accuracy	..... very good
Adjustments provided	..... arm height, overhang, lateral angle
Finish and engineering	..... excellent/excellent
Ease of assembly/setting up/use	..... very good/very good/good
Friction: typical lateral/vertical	..... less than 10mg/less than 10mg
Bias compensation method	..... weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	..... 375mg/165mg
Downforce calibration error: 1g/2g	..... -0.15g/-0.1g
Cue drift/8mm ascent/descent	..... negligible/lever controlled/3.5secs
Arm resonances	..... good
Subjective sound quality	..... good +
Lead capacitance/damping method	.....
	80pF/slight decoupling on counterweight
Estimated typical purchase price	..... £270

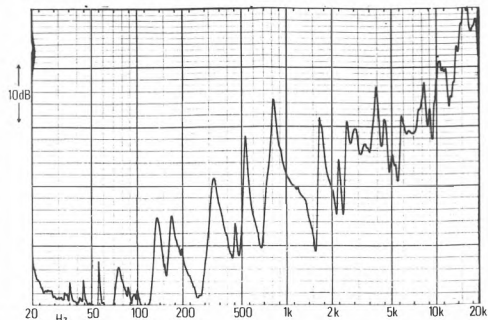
GENERAL DATA

	FR64S
Approximate effective mass inc screws, excl cartridge	..... 35g
Type/mass of headshell	..... universal detachable/20.5g
Geometric accuracy	..... very good
Adjustments provided	..... overhang, lateral angle, height
Finish and engineering	..... excellent/excellent
Ease of assembly/setting up/use	..... very good/very good/very good
Friction: typical lateral/vertical	..... less than 10mg/15mg
Bias compensation method	..... weighted lever
Bias force: rim/centre (set to 1.5g elliptical)	..... 250mg/250mg
Downforce calibration error: 1g/2g	..... 0.02g/0.05g
Cue drift/8mm ascent/descent	..... negligible/0.5sec/3.0secs
Arm resonances	..... good
Subjective sound quality	..... good+
Lead capacitance/damping method	.....
	80pF/slight counterweight absorption
Estimated typical purchase price £300

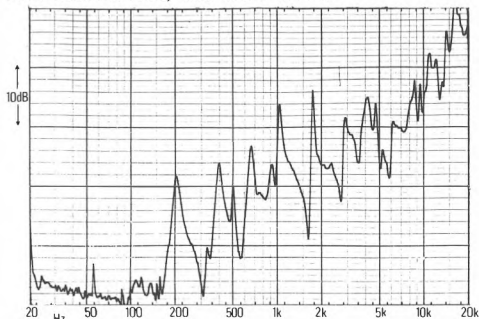
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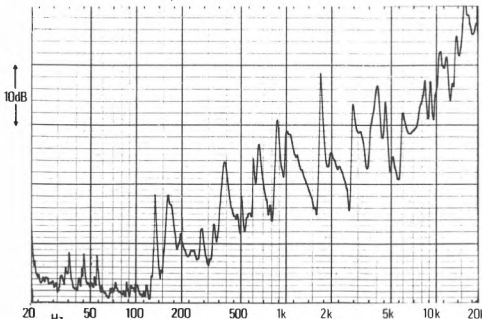
Arm resonances, standard '64FX.



Arm resonances, 'FX with '64S shell substituted.



Arm resonances, FR64S, tight counterweight.



Arm resonances, FR64S, loose counterweight.

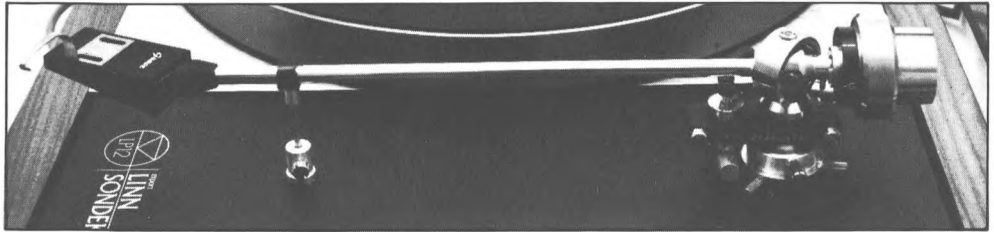


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This retested arm is a rigid yet low mass design with a fixed plastic headshell (adjustable for tilt) and employs a straight chromed alloy tube with secure gimbal bearings free of play. Essentially little decoupling was provided on the rotating counterweight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

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

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

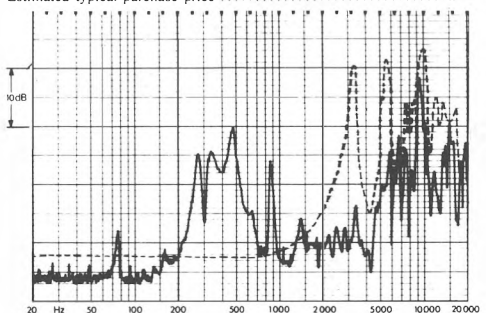
In agreement with the previous issue a 'very good' rating was established using either a *LP12* or an ATR deck. The bass register was considered

tight extended and powerful, with accurate placement while stereo was detailed with good depth and precision. The arm presented an interesting contrast to the *SME III*, which we felt to be on the rich side of neutrality, the *G707* conversely sounding slightly on the bright and coarse side of this balance. These facts are of considerable importance at this high quality level, when choosing a matching cartridge.

Though the *G707* remains worth considering, more recent introductions (including those from Linn Products themselves) have reduced its competitiveness a little.

GENERAL DATA

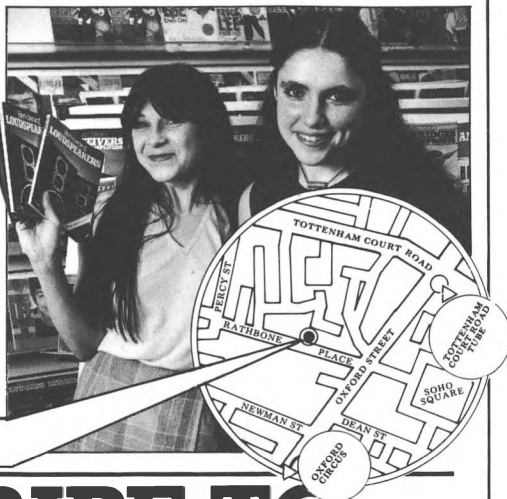
	Tonearm
Approximate effective moving mass (excl cart. inc screws)	7g
Type of headshell	Fixed
Headshell mass (inc screws)	N/A
Geometric accuracy	very good
Facilities for adjustment	tilt, height, overhang
Finish and engineering	very good
Ease of assembly/setting up	very good
Ease of use	very good
Friction 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).

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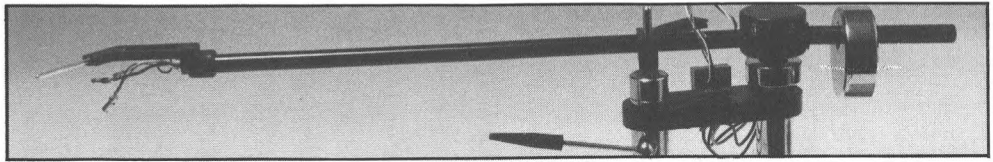
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HFC1

Hadcock GH 228 Export (re-assessed)

G.F.C. Hadcock, The Old Vicarage, Doveridge, Derby DE6 5NN. Tel (08893) 2452



Features and design

The earlier fixed-head versions of this unipivot tonearm have been discontinued, and the 228 is now only available in the detachable top-section format. The lead-out wires are attached to a 'free' five pin miniature plug, and the entire balanced arm section may be lifted away from the unipivot and pillar, with care cartridges can thus be set up in the carriers and interchanged with relative ease.

The counterweight assembly has been simplified, with a more secure friction-locked double sliding weight arrangement, offering vaguely accurate downforce calibration. But despite improvements to the finish, the standard is still well below that which can be obtained from other manufacturers at a similar price, and the packaging also leaves much to be desired. Two main points of criticism emerged: first the rider balance weight had so much glue inside it that it would not fit on the matching part; secondly, the critical cone section of the unipivot was poorly finished, despite being hard plated. Although this cannot excuse the finish, it so happened that the revised ball assembly in the carrier section offered such a good friction performance, that the pivot roughness was of little consequence. However with one sample of headshell it did prove all too easy to strip the locking thread, thereby preventing its secure fixing; another shell had to be substituted.

Lab results

Possessing very good geometric accuracy with all the required adjustments, this sample also offered very good friction levels as well as effective biasing, if a little on the low side. The headshell finger-lift was however suspected of inducing a resonance at 1.2kHz (see *GH220*), and was shortened by some 60% (thereby entirely removing this mode). As has been noted before, this low mass arm gives good measurements on audio range resonances; significant breakups are only visible at 2.8 and 4.0kHz, the other modes being suppressed by the unipivot design.

Sound quality

This particular arm has consistently sounded

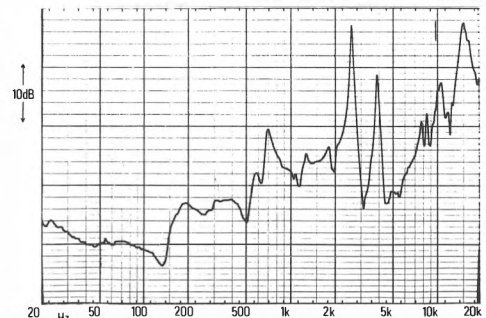
good over the years despite numerous detail changes. The combination of alloy tube, shell and pivot makes for a neutral and clear tonal balance with only slight upper range sharpness. But while the bass is pleasant enough, the full depth and impact of percussion is lost, and even with fluid damping, some coherence and stereo image focus is missing. Ambience is however naturally portrayed.

Conclusion

Reservations about the quality and consistency still remain, making our recommendation of this product somewhat muted. It is versatile in that its low mass (reassessed as 7.5g) allows the use of both moving magnet and moving-coil cartridges, and the sound quality is good for the price. If the user is patient as well as enthusiastic, good results can be obtained.

GENERAL DATA

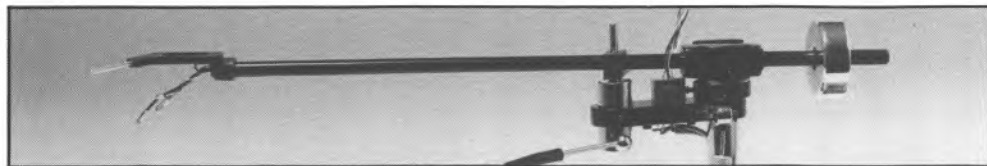
	Tonearm
Approximate effective mass inc screws, excl cartridge	7.5g
Type/mass of headshell	whole carrier special detachable/N/A
Geometric accuracy	very good
Adjustments provided	overhang, tilt, height
Finish and engineering	both fairly good
Ease of assembly/setting up/use	fair/fairly good/fairly good
Friction: typical lateral/vertical	less than 10mg/less than 10mg
Bias compensation method	pulley, weighted
Bias force: rim/centre (set to 1.5g elliptical)	130mg/150mg
Downforce calibration error: 1g/2g	+0.2g/+0.3g
Cue drift/8mm ascent/descent	satisfactory/0.7sec/2.7sec
Arm resonances	good
Subjective sound quality	good
Lead capacitance/damping method	140pF/a little via silicone well
Estimated typical purchase price	£75



Arm resonances with shortened fingerlift.

Hadcock GH220 SS

G.F.C. Hadcock, The Old Vicarage, Doveridge, Derby DE6 5NN. Tel (08893) 2452



Features and design

Having consistently followed the unipivot principle in the past, Hadcock's new up-market introduction has abandoned this system in favour of a rigid bearing assembly, based on four precision pre-loaded stainless steel ballrace bearings.

Two versions of the 220 are available. One possesses a low effective mass (8g including screws), and is based on the established black finish aluminium alloy tube. Alternatively an 11.5g medium mass brushed finish stainless steel tube version is available. A socket head screw locks these detachable-head plug-in tube/carrier assemblies into the upper pivot block. The price difference between the two versions is an insignificant £4, with the stainless tube the more expensive. The standard cast aluminium headshell bracket has been retained, together with its long thin finger lift (which I recommend cutting short). Likewise the established small Hadcock pillar is still in evidence, adjustable for height and held more or less securely by a socket head screw; the fit and tolerances could be improved to ensure more consistent locking-in position.

The output lead has been split into two sections: a short flexible length attached to the arm to aid turntable lead dressing; and a plug in proprietary cable assembly (*Gold ENS*) with gold plated plugs and sockets. The carrier signal plug comes fitted with fairly stiff lead-out wires, which proved quite difficult to dress to achieve a satisfactory low level of lead torque, making friction and bias measurement difficult.

Described as double decoupled, the counterweight has two rubber bush interfaces, one between the pivot block and the rear bar, the other as a friction ring lining the cylindrical counterweight, neither seemed closely controlled or tolerated.

Lab results

Possessing a full range of adjustments bar cartridge lateral angle, the geometric alignment was considered very good. The bearings were in a fine state of adjustment, with no detachable play, and showed excellent low friction levels, which in the (artificial) absence of lead torque

were 10mg or less. The biasing was both correctly dimensioned and in the desirable ratio increasing towards end of side. Lead torque was however a problem, and I feel the leads should be made more compliant. Downforce calibration was also rather rough and ready, and an accessory gauge is worth using.

Audio range resonances were plotted for the alloy tube using the standard and the shortened version of the finger lift, the former showing the 1.2kHz resonance whereas in the latter instance this disappeared. The main flexure occurred at 400Hz with another at 3kHz, and as a whole it looks less tidy than the 228 graph. One reason for this is that torsional modes present here, are suppressed in the unipivot design due to its zero torsional reaction restraint. The stainless steel tube showed slightly greater rigidity despite its higher mass, and was also slightly better controlled at high frequencies; note again the finger lift resonance on this carrier.

Sound quality

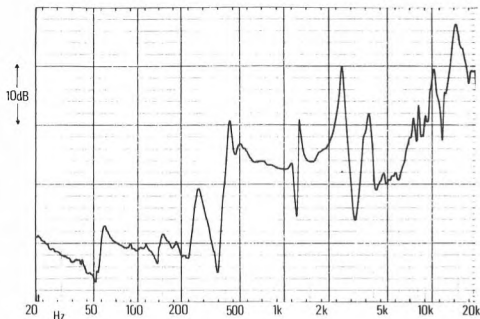
Definitely above average, this latest Hadcock demonstrated its newfound bearing rigidity in a degree of stereo image stability and central focus not available from the 228. Bass definition was improved and now attained a good standard, and while it appeared a shade 'harder' and 'coarser' than the 228 in terms of coloration and tonal balance, on balance, the rewards outweighed the drawbacks.

Conclusion

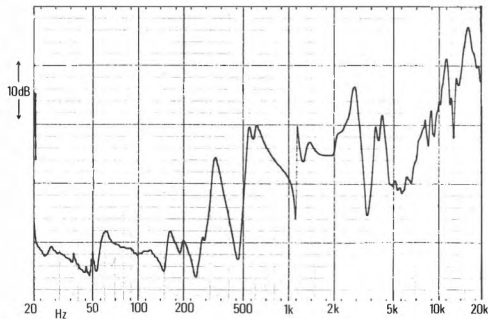
The finish and quality control are not quite good enough for an unreserved recommendation, but the design is good value for money in terms of the sound it delivers. Where low mass is desirable the aluminium version is the best, accepting most moving magnet and high compliance moving-coil models (such as the Denons, *Karat* and Audio Technicas). The stainless steel version is marginally better suited to the more robust moving-coils. Both were uncritical of accompanying turntable, and a wide range of good quality examples are suitable: for example, Thorens *TD160*, Ariston *RD80* and the new Walker *CJ55* designs.

GENERAL DATA

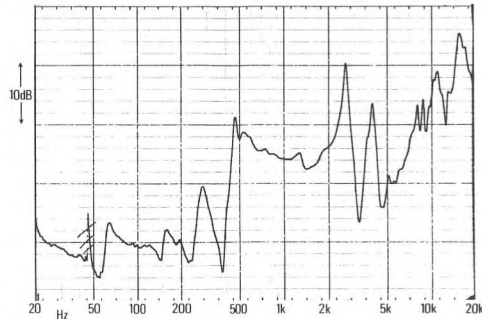
Tonearm
 Approximate effective mass inc screws, excl cartridge... (8g) 11.5g
 Type/mass of headshell special detachable carrier/N/A
 Geometric accuracy very good
 Adjustments provided overhang, tilt, height
 Finish and engineering fairly good/fairly good
 Ease of assembly/setting up/use fairly good/fair/good
 Friction: typical lateral/vertical... less than 10mg/less than 10mg*
 Bias compensation method weighted lever
 Bias force: rim/centre (set to 1.5g elliptical) 140mg/180mg
 Downforce calibration error: 1g/2g -0.1g/-0.5g
 Cue drift/8mm ascent/descent negligible/0.5sec/2.0secs
 Arm resonances good
 Subjective sound quality good
 Lead capacitance/damping method
 275pF/decoupled counterweight
 Estimated typical purchase price £100
 Aluminium tube version bracketed. *Some leadout wire torque.



Arm resonances, alloy tube, as supplied.



Arm resonances, stainless steel tube, as supplied.



Arm resonances with shortened fingerlift.

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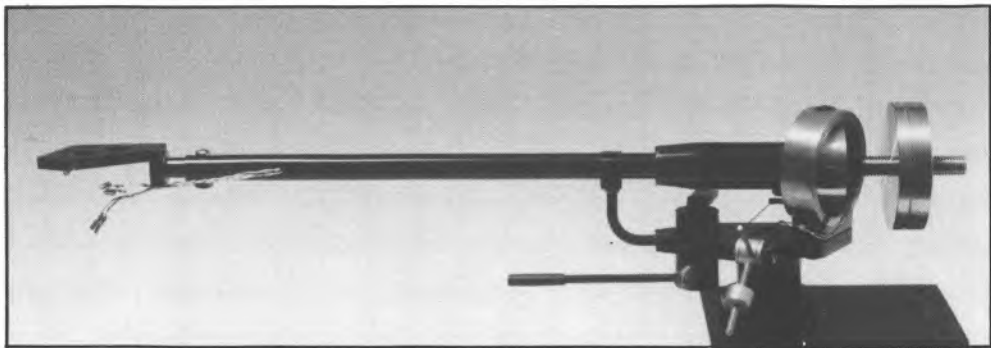


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RECOMMENDED

Helius

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



Features and design

A recent British introduction, the Helius belongs to the middle group of audiophile tonearms, and costs a not inconsiderable £150. As a result it has to be pretty good, and on the basis of the performance of our review sample, the price is justified. (Our example used new bearings, different from those employed when the arm was first marketed.)

The design aims to provide a moderate effective mass, with sufficient material employed to maintain the strength and rigidity of the product. Nominally a fixed headshell design, the front cartridge platform may be detached, but is normally held in position by a split section of arm tube, clamped by a vertical nut and bolt. In practice this is rather more secure than the description might suggest, and the joint provides for limited cartridge tilt as well as overhang adjustment.

The thick alloy cartridge platform has permanent fixing centres, and is arranged to offer secure contact (typically 70%) with the cartridge mounting surface. The geometry is intended to provide minimum distortion over the playing area, and the bearing axis passes through the stylus tip; as the designer put it: 'reducing the torsional excitation of the tube/beam, the latter approximating to a sectioned taper in order to break up even harmonic bending modes such as $\frac{1}{2}$ - and $\frac{1}{4}$ -waves'. The finish is good, although the lacquer on the brass counterweights proved easy to mark. Large and small counterweights are provided, and when balanced these are contra-locked on the threaded rear section of the arm (a separate stylus scale is required to set downforce). The whole is suspended on generous gimbal bearings, pre-loaded to eliminate play, and a special lubricant is used to provide a trace of resistive damping.

The bias is uncalibrated, and we have taken test readings with the weight centred on its rod: these are appropriate for 1.5g elliptical stylus tracking. The maximum downforce obtainable is appropriate for 2.5g downforce, the minimum corresponds to 1g – a sensibly proportioned range.

Lab results

Possessing an estimated effective mass of 12g, this arm is suited to cartridges in the 10–25cu range on compatibility grounds. Geometry was excellent and the mechanics worked well, including the cue control which offered variable rate descent. Friction was genuinely low, and measured better than 25mg in all planes, with no 'notching'.

The resonance behaviour in the audio range was promising, though exhibiting the complex fine detail which is characteristic of arms with rigid counterweights (see also Syrinx). The 140Hz mode was confirmed as the counterweight mounting flexure (shown by its absence on a graph taken with an experimental decoupled counterweight). The long rod finger lift was suspected of causing the resonance at 1 kHz: this was confirmed by cutting off some 70% of the rod, which caused this mode to disappear entirely on the second graph (Helius have now modified the lift). In fact the main tube was quite rigid, as shown by the first flexure at 600Hz.

Sound quality

This arm made a good impression using a number of cartridges, including the notoriously 'difficult' Asak. Sounding slightly 'live', the tonal balance was more open than average, showing some similarities with the Ittok. The bass register was firm and clear, with solid extension and just a little clouding in the upper registers – perhaps

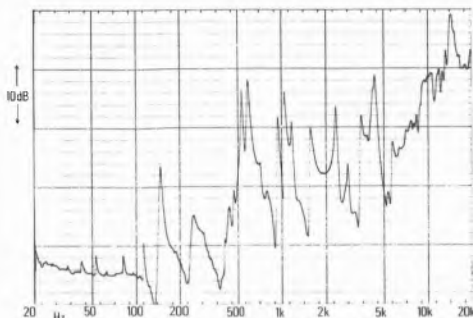
this is the counterweight mode we noted. Stereo was stable and well-focused, and vocal coloration in the upper range was at a moderately low level, and was further improved with the amended finger lift. One listener felt that the sound conveyed something of both the Mission and the IITok.

Conclusion

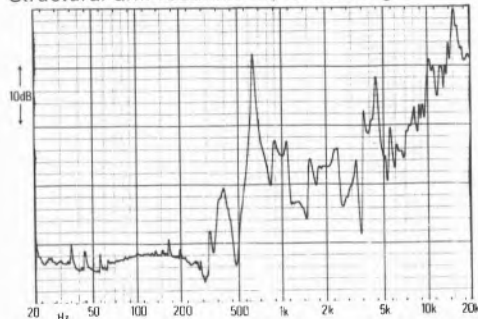
The Helius is rather expensive, and at the time of this review (June '81) lacked proper documentation. No calibrations are provided, so the user/dealer must use accessory scales to set it up, as well as needing to estimate the appropriate biasing. However, it can be recommended on performance-vs-price grounds, as the sound quality is very good, it has been intelligently designed, and is well engineered.

GENERAL DATA

Approximate effective mass inc screws, excl cartridge.....	12g	Tonearm
Type/mass of headshell.....	special/N/A	
Geometric accuracy.....	excellent	
Adjustments provided.....	tilt, height, overhang	
Finish and engineering.....	very good	
Ease of assembly/setting up/use.....	very good/good/very good	
Friction: typical lateral/vertical.....	less than 25 mg/less than 25mg	
Bias compensation method.....	optimum angle weighted lever	
Bias force: rim/centre (set to 1.5g elliptical).....	160mg/220mg	
Downforce calibration error: 1g/2g.....	N/A	
Cue drift/8mm ascent/descent.....	negligible/(var) 0.5sec/1.5secs	
Arm resonances.....	good to very good	
Subjective sound quality.....	very good	
Lead capacitance/damping method.....	95 pF/negligible	
Estimated typical purchase price.....	£150	



Structural arm resonances, audio range.



Arm resonances, shortened fingerlift and experimental absorptive c/w.

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Features, facilities, setting up and use

This top-of-the-line quartz-lock direct drive turntable possessed an interesting arm feature, whereby the complete arm/pillar assembly could be raised or lowered to provide cartridge rake adjustment, an unusual feature within the confines of an automatic mechanism. Employing the usual detachable universal headshell, the effective mass was fairly high at 18g and is therefore suited to low compliance cartridges; the lead capacitance of 155pF was about average. The first sample demonstrated excessive arm lateral friction at about 0.3g, which was much improved with the second sample, but still on the high side at 100mg.

The substantial platter was well damped by a sensible mat and the motor section well engineered and finished. Two fixed speeds were provided, both of which were quartz referenced, with smooth acting micro-switch buttons on the forward section of the plinth clear of the lid to control the mechanisms. The lid, though of a resonant variety, was at least of a quite substantial thickness. The resonances of the foot/plinth system were widely displaced at 6.3Hz lateral and 16Hz vertical, thus clever cartridge selection can keep these well clear of the arm/cartridge range.

Lab performance

A good rating for combined wow and flutter was obtained though the linear wow was a little high at 0.15% considering the price level. As expected, the speed error was negligible under all conditions of drift and loading, while start up was a typical 3 seconds. A trace of mild wow overshoot was detected in the lab although at the measured level it is unlikely to be audible. A better result was anticipated for rumble than the nonetheless good 72dB recorded; the 50Hz component on the spectrogram was of an electrical nature, but the others were motor generated.

Essentially well aligned, finished and engineered, the arm downforce calibration was accurate, cue operation commendable and vertical friction fine. It did however possess some play in the bearings and gave poor readings for lateral friction, and it was impossible to read the bias levels on the first sample as the friction exceeded the bias. The second deck's biasing was still poor, only just beginning to operate at the 1.5g dial setting.

Rated as average for arm resonances in the audible range, the rising energy trend was reasonably uniform if distorted by resonances at 150, 220, 500, 900 and 4500Hz. The breakthrough

graphs showed a clear dominant resonance region for the system centred on 250Hz, which imbalance denoted a just average rating for acoustic sensitivity, though the vibration isolation still warranted an above average judgment. Hum levels were good and so was acoustic feedback at the listening location, while impact shock resistance was also above average.

Sound quality

Classed as 'average', the frequency balance was a trifle thin with some depth ambience loss. The bass lacked definition with softened transients and a restriction in the lower registers, while the high treble range sounded a little ragged with more sibilance than usual on voice.

Conclusion

Overall this model proved unexceptional, with a below par arm performance in terms of friction and bias which requires the manufacturers attention. In any case the modest sound quality precludes recommendation at this price level.

GENERAL DATA

Motor Section

Type	fully automatic direct drive quartz
Platter mass/damping	2.0kg/good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	3 core/2 phonos + earth
Speed options	33 $\frac{1}{3}$, 45rpm
Wow and flutter (DIN peak wid sigma 2)	0.1%
Wow and flutter (LIN peak wid 0.2-6Hz/6-300Hz)	0.15%/0.07%
Absolute speed error	< 0.05%
Speed drift 1 hour/load variation	quartz/< 0.05%
Start up time to audible stabilisation	3.0secs
Rumble: DIN B wtd L/R av (see spectrum)	71/73dB

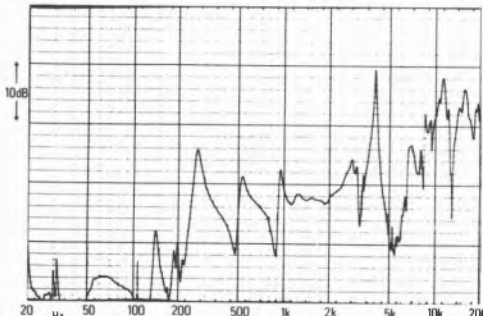
Arm Section

Approximate effective mass inc screws, excel cartridge	18g
Type/mass of headshell	universal detachable/9.5g
Geometric accuracy	very good
Adjustments provided	lateral angle, height, overhang
Finish and engineering	very good/very good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	(100 2nd sample) 300mg/< 15mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	not measurable/not measurable
Downforce calibration error: 1g/2g	< 0.05g/< 0.05g
Cue drift/8mm ascent/descent	negligible/1.0sec/1.0sec
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	155pF/slightly decoupled c/wt

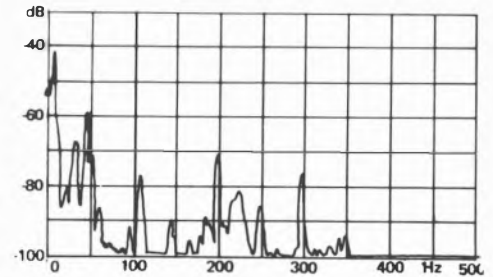
System as a whole

Size/clearance for lid rear	45.4(w) x 39.1(d) x 14.0(h) 4.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	average
Hum level/acoustic feedback	good/good
Vibration sensitivity/shock resistance	above average/above average
Estimated typical purchase price	£180

Integrated Turntable

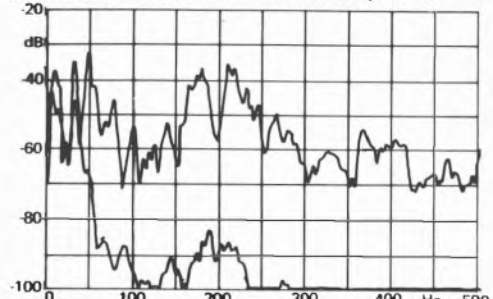


Arm resonances



Rumble Spectrum (ref 10cm/s @ 1kHz:

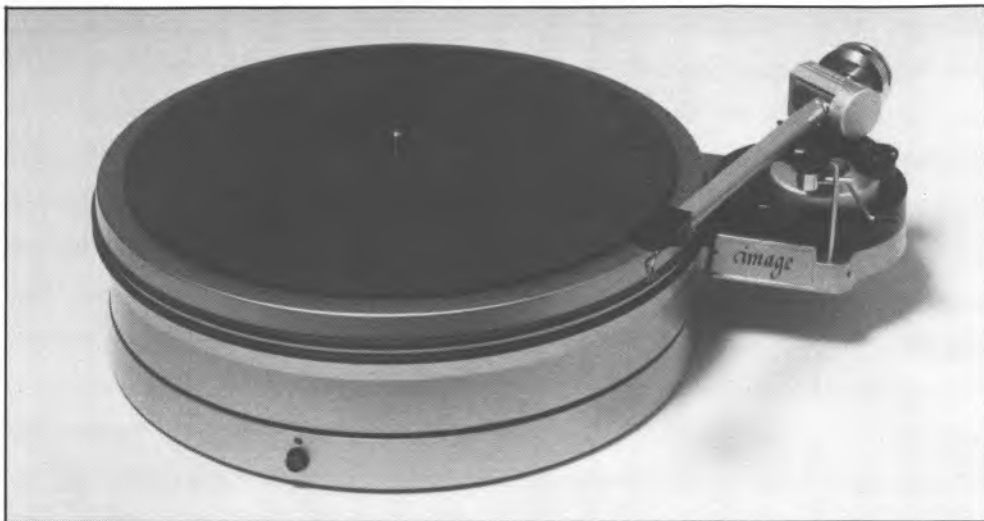
includes both electrical and mechanical components).



Acoustic breakthrough (upper) and vibration breakthrough

Image

Profi Ltd., 8 Harford Street, Norwich. Tel (0603) 616221



Features and design

A brand new British motor unit of unusual and distinctive appearance, the Image shape conceals a fully suspended floating subchassis, although in this case the word 'sub' scarcely applies, since the entire upper section of the turntable comprises a floating chassis. Manufactured by New Line Engineering, the deck is sold as a universal motor unit with several arm board options, including SME and *Ittok*, and has an open arm gantry to facilitate mounting and lead wire dressing. The latter is also helped by a convenient clamp spring at the rear.

Three finishes are available – black, gold and silver – and drive is provided by a synchronous motor *via* a silicone rubber cord. Two speeds are offered, with simple manual change necessitating removal of the outer platter. Gravity cast in aluminium, the plinth includes 11-ply laminated wood for damping/reinforcement, making a strong and acoustically 'dead' mechanical assembly. When set up, it is awkward to move, and requires alignment *in situ*; the subchassis may be levelled with top mounted socket head screws (under the platter), but no provision has been made for levelling the base, which may give rise to some problems.

Resonating at around 3–3.5Hz, the suspension is composed of three sparsely coiled high tensile steel springs: their low self resonance theoretically provides maximum vibration isolation. One point noted on our sample was a

tendency for the arm assembly to rotate around the platter's centre of mass at frequencies up to 8Hz, this occurring when the platter was vibration excited in the vertical plane. This destabilisation results in stylus for-and-aft 'scrubbing' on the disc, causing frequency modulation distortion. It is however possible to minimise this rotation by careful adjustment of the arm leads, which can be effected without seriously sacrificing the isolation.

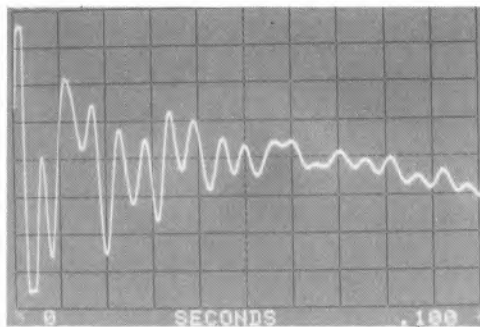
The oversize platter may conflict with some arms (for example the *FR 64FX* gave some problems), and the turntable came fitted with a flat rubber mat (Avon Rubber). No lid is provided, the platter section alone having a clear disc cover to keep the mat dust free; I would have thought that the arm bearings would have benefited from a similar provision.

Lab results

One or two idiosyncracies were noted, which may well have been due to the fact that our sample was effectively pre-production. Weighted wow and flutter was very good at 0.1%, with low flutter assured by the high mass 4.4kg platter, but pure wow was slightly high at 0.2%, attributable to the chassis stability factor and/or the drive belt, which was end-joined on our sample. Stable start up took five seconds – longer than claimed – and the absolute speed was too far out for comfort at +1.5%. Experience has shown that a difference of as little as 0.3% between two

models makes comparative auditioning difficult, due to obvious tempo and pitch differences. It possessed good torque with a near state of the art rumble result of -77 dB weighted, but the spectrogram betrayed the presence of a 100Hz motor component only 70dB down, with related harmonics at 200 and 250Hz (-90 dB).

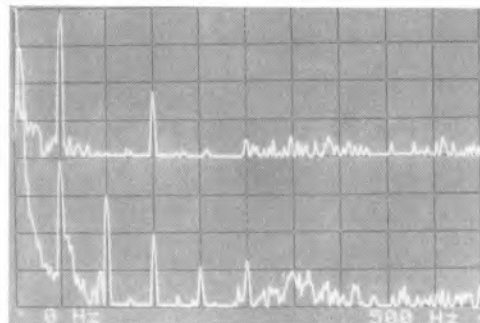
The acoustic and vibration isolation responses were quite excellent, showing that a high-mass inert structure of low 'acoustic window area', suspended on simple springs, is the optimum solution. In this respect the Image is unsurpassed. Disc impulses were well enough damped for the expanded X10 presentation, the Avon mat giving a well ordered result; substitution of the *Audio Ref* gave a similar result, with slightly better high frequency damping.



Disc impulse, *Audio Ref* mat (X10 scaling).

Sound quality

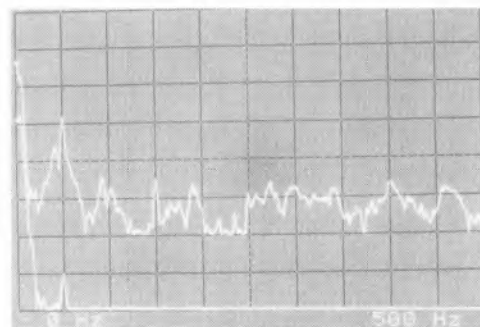
The reproduction was tonally well balanced, and demonstrated a powerful and deep bass but with a slightly 'heavy' character. Using an *FR64FX*, the sound was felt to be too 'rich', and an *Ittok* brought the balance to life, giving better transient clarity and 'attack'. While coloration levels were clearly very good, a shade less central stereo image focus and stability was present compared with the finest combinations we tried. For the closest comparisons, a variable speed turntable had to be used in order to match the slight excess speed of the *Image*.



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

Conclusion

Offering its own brand of optimisation, this model majors on low coloration and high inertia, and provides a very good result albeit at a high price. A slight doubts remains with respect to chassis suspension stability and its longer than average recovery time, while clearly some pre-production problems such as speed accuracy and mains related motor breakthrough need sorting out. However the potential is clearly present to produce a top flight model.



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

GENERAL DATA

	Motor Unit
Type	belt drive
Platter mass/damping	4.4kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core/-
Speed options	manual change 33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.1%
Wow and flutter (LIN peak wtd 0.2-5Hz/6-300Hz)	0.2%/0.09%
Absolute speed error	+1.5%
Speed drift 1 hour/load variation	synchronous/-0.15%
Start up time to audible stabilisation	5secs
Rumble: DIN B wtd L/R av (see spectrum)	-77 dB
Size/clearance for lid rear	circular: 46.0(w) x 33.0(d) x 13.0(h)/N/A
Ease of use	fairly good
Typical acoustic breakthrough and resonances	excellent
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	good/excellent
Vibration sensitivity/shock resistance	excellent/fairly good
Estimated typical purchase price	£500

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 sub-sonic 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.

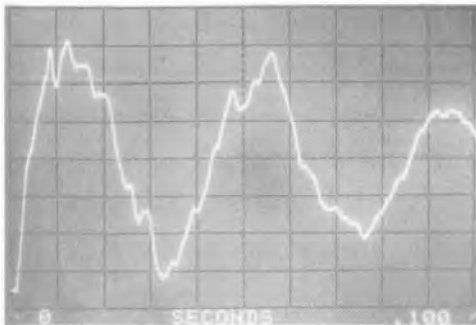
Sound quality

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

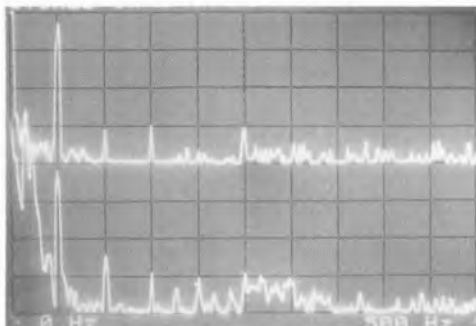
Type quartz direct drive, fully automatic
 Platter mass/damping 2.6 kg/fairly good
 Finish and engineering very good/very good
 Type of mains lead/connecting leads 2 core/phonos + earth
 Speed options variable 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) <0.05%
 Wow and flutter(LIN peakwtd 0.2-6Hz/6-300Hz) <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

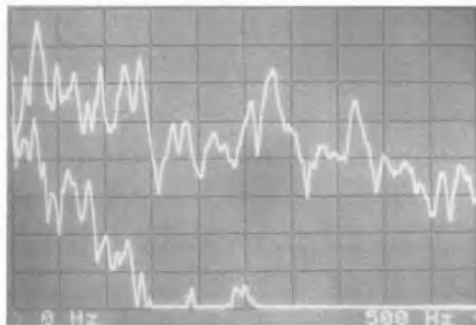
Approximate effective mass inc screws, excl cartridge 17g
 Type/mass of headshell universal detachable/11g
 Geometric accuracy very good
 Adjustments provided overhang, lateral angle, arm height, tilt
 Finish and engineering very good/very good
 Ease of assembly/setting up/use very good/very good/very 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

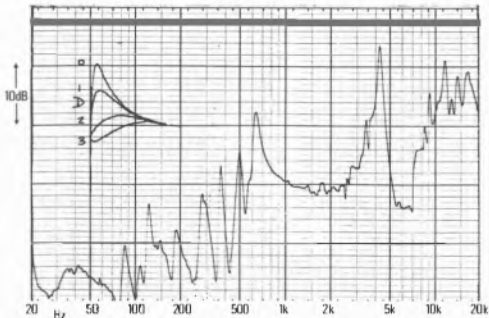
Size/clearance for lid rear 48.0(w) x 43.5(d) x 14.5(h)/7cm
 Ease of use excellent
 Typical acoustic breakthrough and resonances average
 Subjective sound quality of complete system average
 Hum level/acoustic feedback very good/fair only
 Vibration sensitivity/shock resistance fair/good +
 Estimated typical purchase price £210



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



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



Arm resonances and damping.

JVC QLF6 (revised and reprinted)

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



Features, facilities, setting up and use

This fairly prestigious model costs around £230.00 and sported some interesting features. The main plinth was an alloy die casting with the remaining section moulded in a high quality density loaded plastic. A quartz locked design, the motor used direct drive frequency synchronisation rather than the usual proportional voltage control, and potentially this offers even greater speed stability both in the long and short term. It also incorporated some torque and efficiency improvements, these later confirmed under test.

A fully automatic design, the arm employed a universal detachable headshell and was of medium/high effective mass (15g), being more suited to low compliance cartridges, although this compatibility recommendation is moderated by the incorporation of a viscous damping device in the bearings. Provision was made for independent dialled adjustment in both the lateral and vertical planes, this damping proving quite effective in moderating the resonance of high 'Q' over-compliant cartridges; for example, it reduced a 15dB rise to 9dB or so, but had much less effect on better damped low compliance models such as a moving-coil type. The damping was also found to increase the

apparent static bearing friction by 50mg or so.

Two speeds were provided plus fine variable control of $\pm 6\%$, this obtained when the quartz lock was disengaged, and with the deviation from nominal shown by a centre zero indicator meter. In general the unit was well engineered, very well finished, and the arm bearings were quite well adjusted with only slight play.

Lab performance

The motor was quite excellent, with (on our test rig) unmeasurable wow and flutter, superb speed accuracy and negligible speed variation under load, or with time. The stability in the variable speed mode was also excellent. Start up was rapid at 1.1 seconds for the reasonably heavy 2.1kg platter, indicative of ample torque. The DIN rumble was very good at -77dB with the spectrum analysis composed of electrical components at 50Hz and 150Hz plus some residual motor noise, the latter mainly appearing below 50Hz. At 15g the arm was of medium/high effective mass and a low lead capacitance of 80pF was noted, allowing scope for flexible cartridge/amplifier electrical matching.

Arm friction was satisfactory at 50mg lateral with the damper off, but virtually doubled with it

engaged – not really good enough at this price level. On the other hand, the bias compensation was accurate and effective, while downforce was well calibrated and cue operation fine, as were all the automatic play facilities.

Rated just average on arm resonances in the 20Hz–20kHz audio range, a minor counterweight mode was present at 100Hz followed by a severe arm/shell mode at 180Hz, the latter repeated harmonically at 360Hz. Further resonances were also present and the result looked none too promising. Rated as average on acoustic breakthrough, some ‘peakiness’ was observed, while the ineffective insulator feet provided below average vibration immunity. With average impact shock resistance and less satisfactory average feedback resistance in the listening location, at least the hum levels were good.

Sound quality

Rated a disappointing ‘below average’, the *QLF6* sounded somewhat coloured with clearly deficient low frequency definition and extension, and only moderate stereo depth and ambience, although frontal stereo imaging was satisfactory.

Conclusion

Despite the excellent motor quality, the key areas of arm and plinth coloration have not been adequately dealt with. A reasonable sound quality is in fact obtained with solid shelf mounting, but the overall quality is inadequate for a recommendation, considering the relatively high price involved.

GENERAL DATA

Motor Section

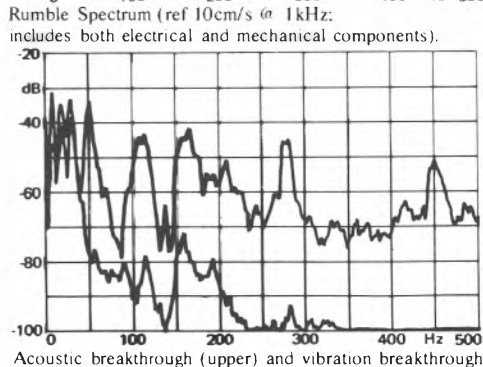
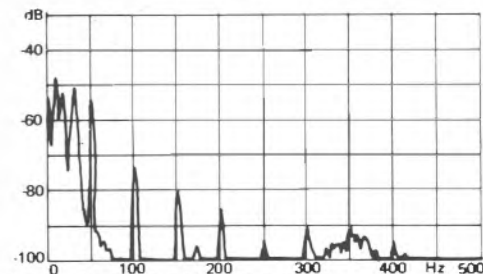
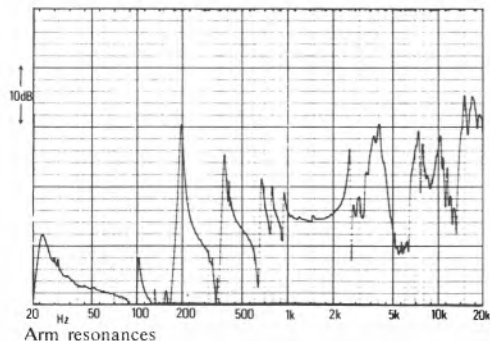
Type	fully automatic, quartz direct drive
Platter mass/damping	2.1kg/fairly good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	variable, 33, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	< 0.04%
Wow and flutter (LIN peak wtd 0.2 6Hz/6–300Hz)	0.08%/< 0.04%
Absolute speed error	< 0.05%
Speed drift 1 hour/load variation	quartz < 0.05%/< 0.05%
Start up time to audible stabilisation	1.1secs
Rumble: DIN B wtd L/R av (see spectrum)	76/78dB

Arm Section

Approximate effective mass inc screws, excl cartridge	15g
Type/mass of headshell	universal detachable/11g
Geometric accuracy	good
Adjustments provided	overhang, tilt
Finish and engineering	very good/very good
Ease of assembly/setting up/use	very good/good/very good
Friction: typical lateral/vertical	50mg/20mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	175mg/225mg
Downforce calibration error: 1g/2g	< 0.05g/< 0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs/1.4secs
Arm resonances	average
Subjective sound quality	average
Lead capacitance/damping method	80pF/separate horiz & vert oil damping + decoupled counterweight

System as a whole

Size/clearance for lid rear	45.6(w) x 39.5(d) x 14.3(h)/5.0cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	average
Subjective sound quality of complete system	below average
Hum level/acoustic feedback	good/below average
Vibration sensitivity/shock resistance	below average/average
Estimated typical purchase price	£230



RECOMMENDED

Linn Sondek LP 12 (re-assessed)

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



Features and design

Since the last edition minor revisions have been made to this contentious but legendary design, which have not only resulted in an improvement in quality, but have also helped to make setting up easier and the set-up condition more stable. This *Nirvana* kit modification can be retro-fitted, and is standard on current production. It involves a number of details, such as high tensile screws for firm cartridge mounting; a better drive-belt; modified socket-head screws for the motor and main bearing mountings; and revised springs plus rubber seatings. The subchassis stability has also been improved (usually), with better centring and control of drive-belt tension.

Briefly summarising, the *LP12* is a long established belt drive turntable, based on a heavy two-part *Mazak* platter, running on a rigid single-point bearing of high quality. The 4.5kg platter dominates the dynamics of the lightweight flanged and reinforced steel subchassis, the latter asymmetrically suspended on three adjustable coil springs.

Alignment and adjustment is a nuisance, since the bottom cover must be removed, and the under-chassis clearance is limited, suggesting the use of side entry arms to attain successful lead dressing. Three tiny screws fix the wood composition armboard in place surprisingly firmly. Linn have tailored the subchassis design towards minimising stylus movement, rather

than to satisfy a simplified theory of perfect chassis dynamic balance in one or two modes of freedom only.

A modified version of a Philips synchronous low speed motor provides power, and the mounting arrangements are carefully designed so that vibration in the motor frame is dissipated harmlessly in the plinth system, and not allowed to vibrate the drive pulley, thereby feeding energy to the disc via the belt. Good at blocking high frequency pole 'cogging', belt drive is less effective at coping with frame vibration; however, it may be seen that the 100Hz rumble component in the spectrogram for the *LP12* is lower than for almost any other synchronous-powered belt drive model in the report.

The current acrylic plastic lid now has sprung hinges to balance its weight, and offers some additional acoustic isolation when lowered. The plinth is built from seasoned hardwood, and the base is intentionally cut from a soft grade of hardboard, chosen for its energy absorptive properties.

Lab results

Whether weighted or separately assessed, wow and flutter readings were all the lowest yet measured for an *LP12*, confirming the worth of the *Nirvana* kit. The deck ran very close to speed, with a satisfactory slowing under load, while start up was improved to 3.8 seconds. Rumble was

also better by several dB, measuring a near threshold $-77/-78$ dB and with the conspicuous absence of the 100Hz component already mentioned.

The large but rapidly damped initial transient on the disc impulse test necessitated X1 scaling, and the X10 presentation with the standard felt mat is also included for comparison with the response using the *Audio Ref* substitute: the latter changed neither the low frequency mode (14Hz) or the fine ringing at 300Hz, but was much better at damping the transient start. For interest's sake, the Fourier transformed frequency responses of the two impulse conditions has also been plotted: the felt mat shows a higher amplitude but a more even characteristic. Very good acoustic and vibration isolation which further improved with the lid down was shown.

Sound quality

During the course of testing it was found that the *Ittok* arm was the best match for the *LP12*, and so the two were auditioned together. Furthermore (surprise, surprise!) we discovered that this arm was optimised for the *Asak* cartridge, and when installed the complete player offered a level of disc reproduction that was difficult to equal; random changes to any part of this system significantly upset the balance. The *Asak* was a recommended product in the last *Choice: Cartridges* book, but we found that if properly fitted in the latest *Sondek/Ittok*, it could successfully compete with far more expensive models such as the *Koetsu*.

The Linn sounds likeable and musical, with a quality of 'liveliness', pleasing tonal balance, 'drive' and detail that produced good listener reactions. Stereo imaging showed exceptional focus and stability with great resolution of detail.

In the limit the upper bass was slightly 'weighty' and 'forward', and the midrange a trifle 'loud' and 'boxy', but this did not spoil the impression of a coherent integration of frequencies throughout the audible range.

Conclusion

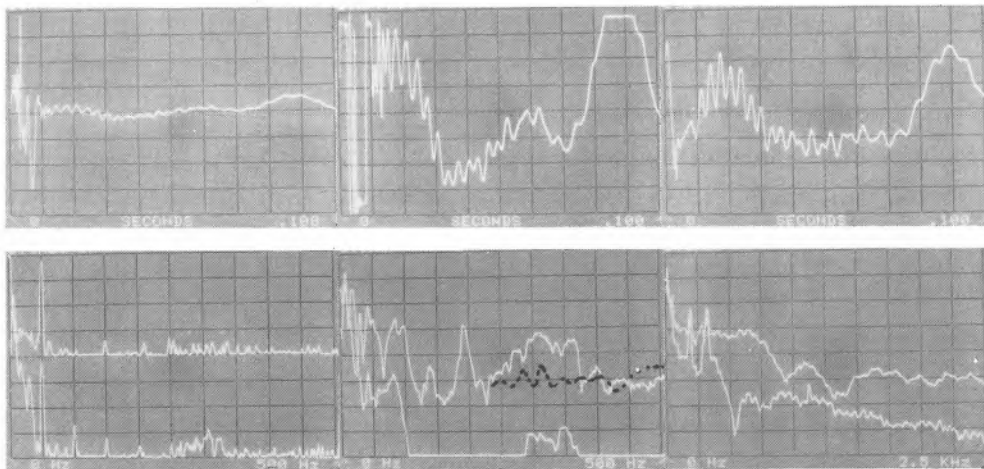
The *LP12* is a fine motor unit in highly refined state of development, and will give its best when partnered by its matched components, where the compatibility and mutual compensation has reached a remarkable level. The system is undoubtedly good value, and even taken on its own the *LP12* has continued to maintain its competitiveness.

GENERAL DATA

Type	Motor Unit
Platter mass/damping	belt drive
Finish and engineering	4.1 kg/good
Type of mains lead/connecting leads	both excellent
Speed options	3 core/-
Wow and flutter (DIN peak wtd sigma 2)	33 $\frac{1}{3}$ rpm only
Wow and flutter (LIN peak wtd 0.2-6 Hz/6-300 Hz)	0.075%
Absolute speed error	0.1%/0.08%
Speed drift 1 hour/load variation	<0.1%
Start up time to audible stabilisation	synchronous/-0.3%
Rumble: DIN B wtd L/R av (see spectrum)	3.8secs
Size/clearance for lid rear	-78/-77dB
Ease of use	44.5(w) x 35.8(d) x 14.9(h)/5.7cm
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	very good
Hum level/acoustic feedback	excellent*
Vibration sensitivity/shock resistance	very good/very good
Estimated typical purchase price	very good/good
	£340

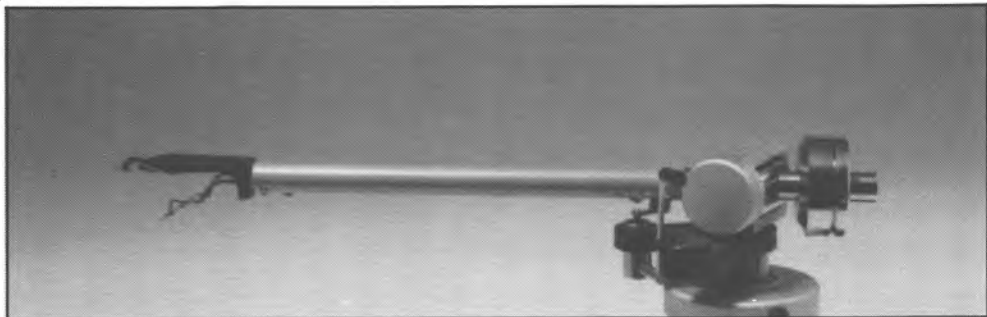
*see text

Spectrogram Captions (L to R): (top row) *Disc Impulse Transmission* (a) standard X1; (b) magnified X10; (c) *Audio Ref* mat, X10; (bottom-row), (a) *Rumble* (electrical/total); (e) *Breakthrough, acoustic* (white, lid up, black, lid down)/ *vibration*; (f) *FFT frequency responses from Disc Impulses, felt mat above Audio Ref mat.*



Linn Ittok LV11 (re-assessed)

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



Features and design

This Linn-designed and Japanese-built tonearm won immediate acceptance upon its introduction and *Choice* were amongst the first to try it, in the last issue. Located at the upper end of the middleweight class, it has an estimated 14g effective mass including the steel fixing bolts, and it is suited to low compliance cartridges with some low frequency damping; *ie* compliances in the 8–16cu range and up to 10dB LF resonance rise.

The arm appears more weighty than the effective mass would suggest, and the metal used for its construction has been optimised for maximum strength. In the context of the average tonearm, Linn's label 'direct coupled' is not so very far from the truth, as the *Ittok's* rigidity is so good that it strongly couples broadband energy from the stylus to the arm mounting board. The large area die-cast magnesium headshell is itself one of the strongest made, and offers excellent contact for cartridge mounting, while the generous alloy tube is securely locked at its fixing points, offering no tilt adjustment in case this would prejudice stiffness.

The counterweight is decoupled, but not in the usual loose manner which imparts clear resonances below 100Hz; rather the fit is sufficiently tight for the counterweight and its lossy synthetic liner to act as a wave termination to resonances in the midband. To illustrate this, a curve was run with a softly decoupled counterweight and the low frequency resonance suppressed by damping; compared with the normal condition the resonances above 200Hz were more severe and more numerous (notably at 400Hz, 900Hz and 1.6kHz).

The arm proved convenient to use, and is fitted with a cueing system controlled by a long lever with a roller at the tip, assisting shock-free action on subchassis turntables. Well-calibrated dials

are fitted for bias and downforce, and since the latter is based on a spring mechanism, dynamic balance is attained after alignment.

Improvements noted with the latest sample include revisions to the pillar locking socket-head bolt and the main arm pillar itself, both much increased in size. The arm tube is now hard-anodised in a grey finish coated with a surface lacquer, and while the lead-out cable has been reduced in stiffness to aid chassis isolation, the same strong three-point-contact pillar locking is retained.

Lab results

Virtually a textbook example of tonearm design, the lab performance was excellent. Possessing fine geometric accuracy, setting up was however complicated by the need to remove the arm to finally tighten a cartridge before use, as the force required to do this properly with the arm *in situ* might otherwise damage the precisely adjusted 'zero play' bearings. Friction was excellently low, downforce calibration very accurate, and the biasing effective – of the correct values and in the right ratio.

The audio resonance trace was improved over the original model in the uniformity of the general energy trend, particularly in the area around 600Hz. The main beam mode did not appear until 900Hz, which is a further improvement in rigidity over the original 800Hz, and represents an exceptional performance. A graph of the acceleration at the arm base taken on the *Sondek* mounting board shows the coupling factor. For comparative purposes, the trace above this represents the same situation, but with the *Ittok* mounted on a heavy rigid sub-chassis and arm plate (*Lux PD300*), demonstrating much reduced excitation. However the resonant behaviour of the arm as seen by the cartridge was now worse, with significant exag-

geration of several modes pointing to increased coloration, particularly at 110Hz, 300Hz and 1kHz.

Sound quality

Possessing a trace of hardness in the upper midrange – the high soprano region – where a suspicion of stereo vagueness was occasionally detectable, the sound was otherwise of exceptional quality. The tonal balance was on the 'open' side, and had a detailed transparency over the whole spectrum which proved revealing of all components including discs. The bass was tighter than before, with fine transients and good extension. Stereo precision was outstanding, and in our view is as yet unmatched by any other model.

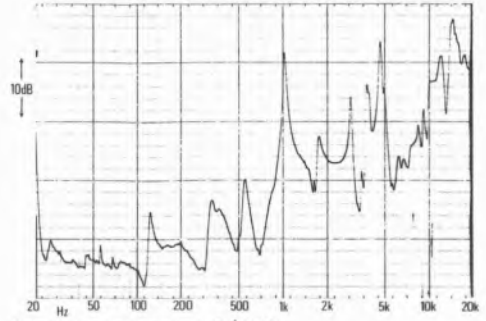
It performed well on all players we tried but undoubtedly sounded tonally the most neutral with the *Sondek*, especially as regards the mid-range area, where the pillar termination is crucial. In the *Lux PD300* it was found necessary to use a 'softer' balanced cartridge than the *Koetsu* if the mid-harshness was to be controlled, for example.

Conclusion

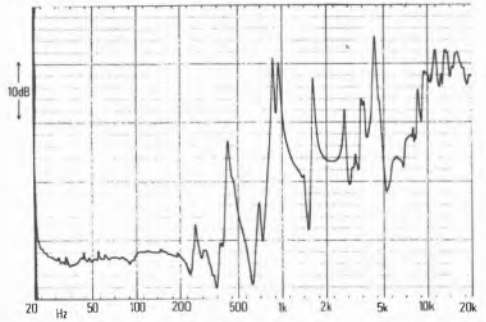
This excellent product carries a mandatory recommendation, despite its high price. But as it is so revealing, every care should be taken to establish a complementary and compatible system of motor unit, arm and cartridge in order to get the best results.

GENERAL DATA

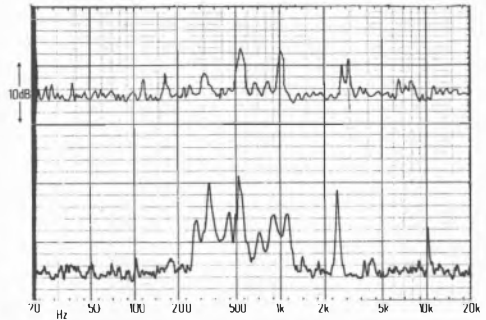
Approximate effective mass inc screws, excl cartridge	... 13.5g	Tonearm
Type/mass of headshell	... rigidly fixed/N/A	
Geometric accuracy	... excellent	
Adjustments provided	... height, overhang, lateral angle	
Finish and engineering	... excellent/excellent	
Ease of assembly/setting up/use	... very good/very good/very good	
Friction: typical lateral/vertical	... less than 10mg/less than 10mg	
Bias compensation method	... frictionless internal spring	
Bias force: rim/centre (set to 1.5g elliptical)	... 175mg/195mg	
Downforce calibration error: 1g/2g	... <0.03g/<0.035g	
Cue drift/8mm ascent/descent	... negligible/0.8sec/1.7sec	
Arm resonances	... very good	
Subjective sound quality	... very good	
Lead capacitance/damping method	... 85pF/none	
Estimated typical purchase price	... £230	



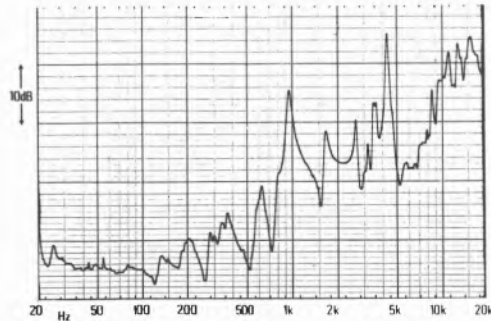
Arm resonances on PD300.



Arm resonances, new arm, loosely decoupled counterweight.



Acceleration of Ittok arm board near pillar: above, *Lux 300*; below, *Sondek*.

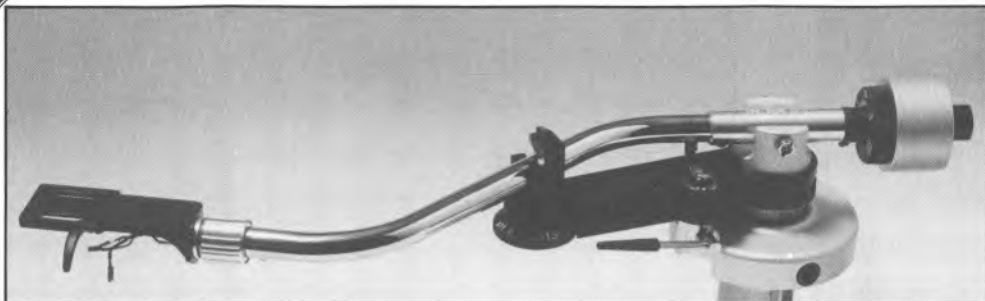


Structural arm resonances, audio band.

RECOMMENDED

Linn Basik

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



Features and design

For years Linn have been plagued with requests for a less expensive turntable, and while experimental designs have been produced, so far they have found the compromises involved unacceptable. However a positive step in the direction of economy has now been taken with the introduction of a less expensive alternative to their pricey tonearms, aptly called the *Basik*. A tolerably good, compatible cartridge is also thrown in for good measure.

There are several points of interest, including the massive arm pillar (of latest *Ittok* diameter and dimensionally compatible), which fits a version of the familiar *Ittok* base. The bearing assembly and 'S' arm tube resemble those on the ADC 1500 (both arms originate from Japan), although the bearing quality on the *Basik* is much better. A visually flimsy universal detachable pressed alloy headshell is fitted, which does not accept the *Asak* (probably intentional on the part of Linn); interestingly the substitution of a 'better' shell worsened the results (see graphs), so the one supplied must be a good match.

A new set of fixing holes are required for mounting the *Basik* on the Linn, rotated from *Ittok* requirements using the same centre; the base also has a cut-out to accept the arm-lift cylinder. A rotating scale counterweight is fitted and the biasing uses internal spring mechanism.

The *Basik* cartridge is an inexpensive moving magnet affair with a shank-mounted spherical tip stylus of good alignment. The moderate compliance gives rise to a satisfactory 7.8Hz, +10dB subsonic resonance in the *Basik* arm, at a 1.8g tracking force. However the output is slightly on the low side, and may not give full power with preamps possessing a low sensitivity.

Lab results

With a medium to high effective mass of 13.5g, including steel screws, the arm is best suited to

cartridges in the 8-20cu range. The geometry was fine, and the headshell locking was more secure than is usually found in this price range. The arm was well finished with accurately set bearings, and was both easy to set up and use. In view of the intended tracking force of 1.5 to 2.5g, friction levels were tolerably low, while the bias accuracy and trend were just right. Downforce calibration was accurate to within 8% (slightly on the low side), and the cue worked well, while the same low 100pF capacitance *Ittok* cable was used.

Plotted as supplied, the resonance graph showed good counterweight control and relatively few resonances (the headshell socket flexure at 200Hz is obvious, of course). Interestingly, substitution of a more rigid *ATH-8* headshell gave a different result, showing more numerous breaks and on balance proving less favourable.

In the bass and midrange at least the cartridge was a surprisingly good tracker, providing Supex-like response, but with rather poor channel balance on our sample. Separation was quite good, as was the generator geometry, giving well balanced distortion readings. It proved relatively unaffected by electrical loading.

Sound quality

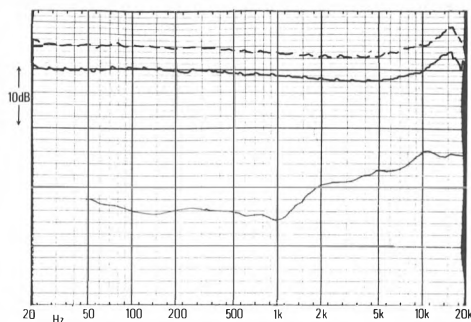
Augmented using an *EPC205* cartridge the *Basik* gave a fine account of itself. The tonal balance was pretty good, with a pleasant midrange rendition of vocals, while the stereo image was fairly well developed. The bass, though slightly softened, was more than satisfactory in terms of both definition and extension.

Using the supplied cartridge there was clearly a touch of the '*Asak/Ittok*' sound, though with a degree of veiling in terms of detail and transient 'sharpness'. The combination was quite truthful in the bass, had a pleasant vocal register, but tended to brashness and slurred sibilants in the

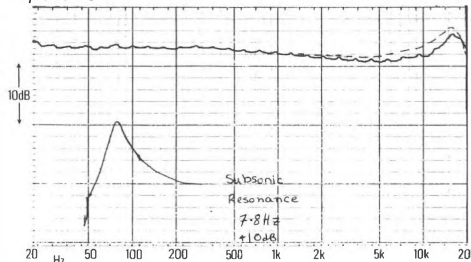
high treble, although not unacceptably so. Considering the 10:1 price difference involved, the *Basik* with its supplied cartridge stands up well.

Conclusion

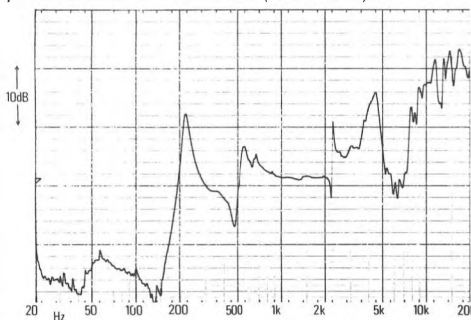
The *Basik* can be recommended, and will win many friends amongst prospective Linn customers, as well as purchasers of other manufacturer's turntables. In its own right the *Basik* is a fine value for money arm, and the supplied cartridge provides a convenient and compatible starting point.



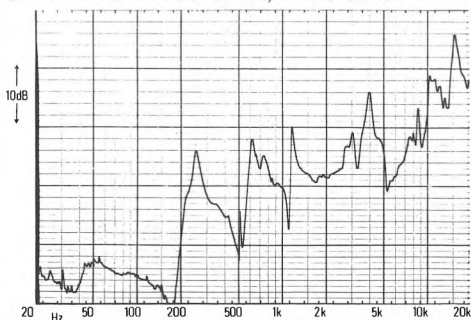
Cartridge response, channel balance and separation.



Cartridge response: solid 130pF, dotted 500pF, plus subsonic resonance (X decade).



Structural arm resonances, audio band



Arm resonances with ATH-8 shell substituted.

GENERAL DATA

Approximate effective mass inc screws, excl cartridge.....	13.5g	Tonearm
Type/mass of headshell incl 'S' cartridge.....	universal detachable/7g	
Geometric accuracy.....	very good	
Adjustments provided.....	overhang, lateral angle, height	
Finish and engineering.....	excellent/very good	
Ease of assembly/setting up/use.....	good/very good/very good	
Friction: typical lateral/vertical.....	60mg/35mg	
Bias compensation method.....	dial and internal spring	
Bias force: rim/centre (set to 1.5g elliptical).....	180mg/220mg	
Downforce calibration error: 1g/2g.....	-0.08g/-0.17g	
Cue drift/8mm ascent/descent.....	negligible/0.7 sec/2.8secs	
Arm resonances.....	good	
Subjective sound quality.....	good	
Lead capacitance/damping method.....	100pF/some counterweight decoupling	
Estimated typical purchase price.....	including cartridge £45	

BASIK CARTRIDGE

Cartridge type.....	moving magnet
Cartridge mass.....	5g
Estimated dynamic compliance at 10Hz.....	23cu (X10 ⁻⁶ cm/dyne)
Specified downforce: range.....	1.75g to 2.25g; tested at 1.8g
LF resonance in Basik arm.....	+10dB at 7.8Hz
Sensitivity at 1kHz.....	approx 0.65mV/cm/sec
Relative output (0dB=1mV/cm/sec).....	-3.5dB
Subjective sound quality.....	satisfactory
Recommended loading.....	47K ohms plus 500pF*
Recommended arm mass.....	6-12g
Recommended arm damping.....	not essential
Induced hum level.....	good

Stylus data

Stylus type.....	shank mounted, spherical
HF resonance (tip mass/vinyl).....	16kHz
Frequency response, separation and balance	
30Hz-20kHz±.....	+3, -2dB
100Hz- 5kHz±.....	+0, -2dB
Stereo separation, 100Hz, 1kHz, 10kHz.....	24dB, 25dB, 15dB
Channel difference at 1kHz, 10kHz.....	4dB, 4dB

Trackability

300Hz lateral ±15dB.....	1.5g
300Hz vertical ±12dB.....	1.1g
300Hz lateral +18dB ('Supertrack').....	1.85g

Distortion

300Hz lateral +9dB.....	0.6%
300Hz vertical +6dB.....	3.0%
High frequency waveform quality.....	fair
Typical selling price incl VAT.....	Free with Basik Arm

*Uncritical of loading in practice

Logic DM101

Logic Ltd., 6 Guy Street, Leamington Spa, Warwickshire CV32 4RT. Tel (0926) 20302



Features and design

Released shortly after the completion of the last edition, the Logic has since been available in somewhat limited numbers, and the findings of this review are best taken as indicating the design's potential. In several respects the performance is very good indeed, but a weakness is present in the subchassis springing which is believed to have limited the ultimate performance attained. Logic have had this matter in hand, but they have not so far provided us with a solution.

The subchassis is open, fitting in a recess in the upper surface of the semi-solid plinth. Sawed 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'. Vertical movement is stable, and the lateral rocking mode almost as good, but a significant torsional component extends up to 12Hz, well above the fundamental suspension resonances in the 3-4Hz range. This torsional mode gave rise to doubts concerning chassis stability, and it certainly seems to affect stylus dynamics.

A useful feature 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

So far all the Logics I have seen produced quite a strong smell when running; this has been identified as hot resistors in the lamp and motor

control circuitry, and although no danger is involved I personally do not like the odour. Some audible hum is also produced by the synchronous motor.

Lab results

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 0.5% 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.

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. However shock was not well handled, due to the excitation of the destabilising torsional mode. 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 standard disc support gave quite good transient damping, but the alternative *Audio Ref* showed a superior control in the mid/treble range.

Sound quality

The sonic performance showed that the Logic has the makings of a fine turntable. 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 *Heliuss* or *Mission* gave 'sweeter' results. With brighter and more 'forward' cartridges such as the *Technics 205* and *Karat*, the *Audio Ref* mat helped to control the musical balance, and the only significant point of criticism which could be made referred to a small loss of image stability and central focus, which was probably the result of chassis nervousness, allied to the torsional mode.

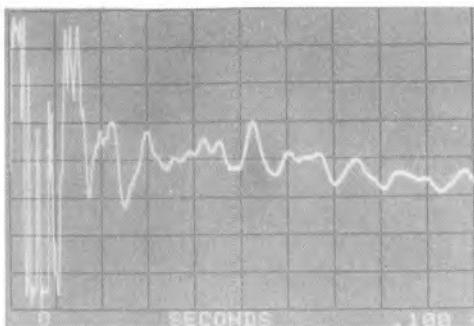
Conclusion

The Logic demonstrated many strong points in its technical and subjective performance, and can be recommended for its exceptional bass neutrality and good isolation. If the manufacturers can solve the marginal suspension problem (and the smell too if possible!), they will have a very good deck on their hands. But until this is done any recommendation must be provisional.

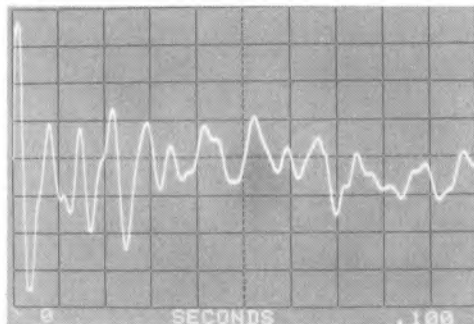
GENERAL DATA

Type	Motor Unit
Platter mass/damping	belt drive
Finish and engineering	3.0kg/good
Type of mains lead/connecting leads	very good/very good
Speed options	2 core/-
Wow and flutter (DIN peak wtd sigma 2)	33/45 rpm (manual belt change)
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.06%
Absolute speed error	-0.11%/0.07%
Speed drift 1 hour/load variation	-0.5%
Start up time to audible stabilisation	synchronous/-0.35%
Rumble: DIN B wtd L/R av (see spectrum)	5secs*
Size/clearance for lid rear	-78/-77dB
Ease of use	48.0(w) x 38.0(d) x 14.0(h)/6cm
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	excellent
Hum level/acoustic feedback	very good
Vibration sensitivity/shock resistance	very good/excellent
Estimated typical purchase price	excellent/fair only
	£300

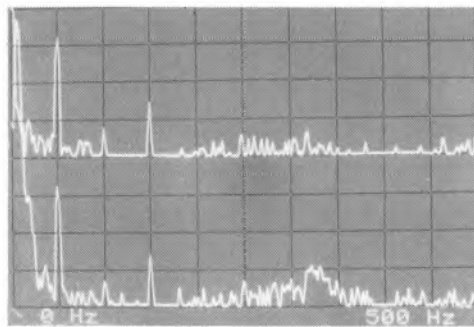
* to full stability



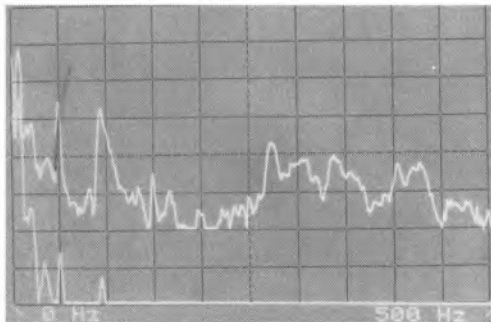
Disc impulse transmission, magnified X10.



Disc impulse, Audio Ref mat (X10 scaling).



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



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

Lux PD 300

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



Features and design

Following the introduction of the costly *PD555*, Lux have released an 'economy' model, which nonetheless costs a substantial £500. A completely new design, this 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 a simple and relatively quick modification which freed the 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 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. We used a disc with a quiet surface for repeated tests without any pre-cleaning of the platter, and it turned out to have become noisier when the underside was played later.

Lab report

With its substantial 3.4 kg platter and high torque drive, the wow and flutter, torque and rumble results were all excellent. Speed drift was more than I would like at the price level, but start up was fine at 2.8 seconds, with no overshoot effects. Rated as good on shock prior to the modification, the acoustic and vibration isolation were also very good above 75Hz, while freeing the suspension produced 10–12dB acoustic improvement from 25 to 75Hz, and an even better 15 to 20dB improvement in vibration isolation; as a result, however, 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 transmission 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 it best – for example, something like the *Breuer* or *Sumiko* sound perhaps.

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 exhibited by the modified model.

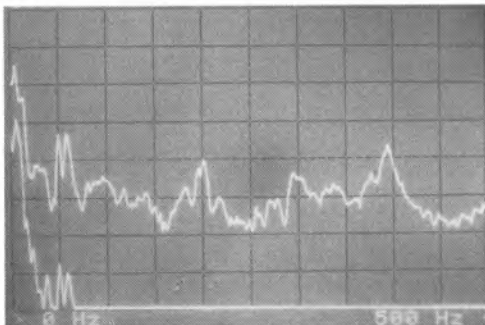
Conclusion

Potentially this is one of the cleanest and most transparent sounding decks we tested, and it can be recommended. In engineering terms the £500 is justified, although various compromises need to be worked out concerning its use and appropriate matching components. Performance tests suggest that if an *Ittok* is to be used, it would benefit from an absorptive interface rather than the ultra-strong metal platforms supplied – perhaps a laminated wood arm base would be suitable if possessing a suitably matched resilience. Finally, the risk of damaging dirty discs remains a slight disincentive.

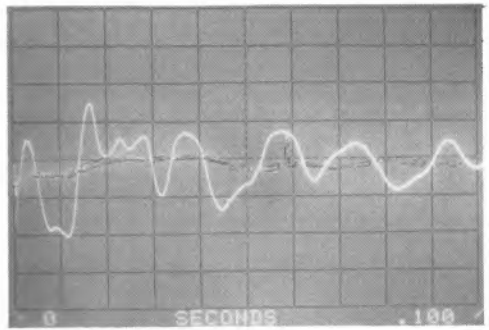
GENERAL DATA

	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
Estimated typical purchase price	£500

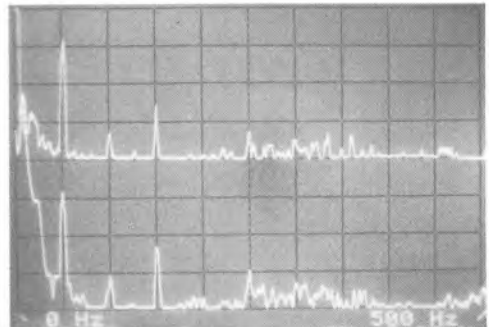
*see text



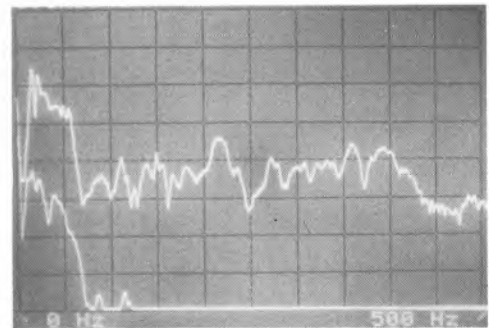
Breakthrough as modified (see text): above, acoustic; below, vibration.



Disc impulse transmission, magnified X10.



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



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

Lux PD 555

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



Features and design

Of limited availability, the PD555 is the most exotic turntable Lux have produced to date. It achieved worldwide fame on its introduction by featuring a domestic innovation in the form of a platter equipped with a vacuum operated record flattening system, similar in principle to that employed in studio cutting lathes. It uses an auxiliary vacuum pump which is interfaced pneumatically and electronically with the turntable, to allow easy operation *via* the usual stop/start controls. The platter is exceptionally heavy at 8.5kg, providing 1.2 ton/cm inertia, which is many times the average. Two screw-in handles are supplied for fitting temporarily to the platter in order to lift and lower it onto the main bearing and its support plate. The three speeds provided include 78rpm, and when under vacuum the record is clamped by atmospheric pressure to a claimed 250kg over the surface, the vacuum quality indicated by a dial gauge mounted in the plinth.

The large solid plinth offers facilities for two tonearms, and the arm sub bases are alloy sections which slide on runners to give easy geometric alignment, and which can then be locked in place. A problem did however arise with SME arms, since the 'oval' arm mount hole runs along the width axis, resulting in awkward placement of the bias mechanism and other parts; clearly the arm must be chosen with this in mind.

The overall quality of construction and engineering was excellent – as indeed it should be considering the high price. Lux have forsaken direct drive for this design, probably because of the difficulties involved in arranging the airways and seals required as well as a drive motor coincident with the main bearing. The strobe is

accurately referenced to a quartz oscillator, but the drive is *via* a polyurethane belt from a large and quiet DC Servo motor.

Lab results

The vacuum hold down occasionally needed some assistance to sufficiently flatten a record in order to engage the rubber sealing rings. Once 'caught', however, the discs were strongly clamped, effectively bonding them to the massive platter for several hours without need for any further pumping. Wow and flutter results were very good, speed drift was low, and variation under load negligible. Despite the platter inertia, stable speed was attained in under 4 seconds for 33 $\frac{1}{3}$ rpm, but 78 rpm understandably took longer. Rumble was excellent at -77dB or better (DIN B weighted), and the spectrogram revealed little of significance; electrical components were present but there was nothing mechanical of importance above -95dB, referred to 10cm/sec at 1kHz.

Succeeding more by sheer inertia and rigidity than by design, the acoustic breakthrough was quite good, the low resonance heavy acrylic lid being helpful here. Working well above 150Hz, the complex silicone-damped feet were 10 to 15dB less effective than a good sprung sub-chassis at lower frequencies. The feedback contribution of the lid was revealed by the second acoustic graph, which portrays the breakthrough in the turntable with and without the lid fitted, showing up to 10dB of improvement in certain areas. Shock resistance was very good, the X10 disc impulse testifying to the magnificent disc damping and termination offered – clearly the best in the issue, and contributing to a very clean 'vinyl' sound.

Sound quality

In the 'coffee table' location the sound was marred by a degree of softness in the bass register, caused by floor-borne vibration breakthrough. But transfer to a large rigid wall-mounted shelf restored the bass clarity, and provided fine quality in this range. Sounding better with the lid off, in the latter condition the subjective quality was excellent, with a power and solidity that was unrivalled by other models in the issue. The sound was distinctly clean in terms of coloration, providing great ambience, depth, transparency and musical detail, plus stable, clear stereo focusing.

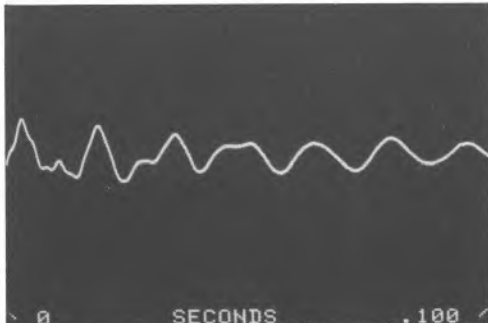
Conclusion

The PD555 is a very good turntable when optimally sited, and in absolute terms it can be recommended on the basis of its performance. In real life the price makes value for money recommendation impossible to justify, but this was clearly neither part of the designers brief, nor their intention. As a flagship in a luxury range of hi-fi equipment it succeeds pretty well. It has its particular strengths, and might well suit a millionaire audiophile with space, a valued 78 rpm record collection, and the desire to run more than one pickup arm!

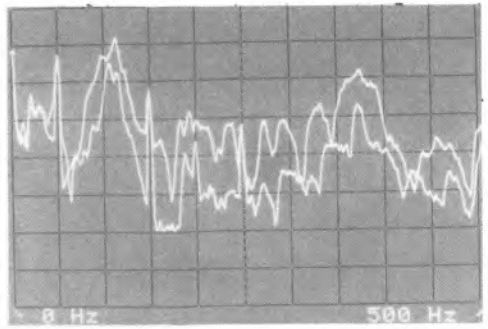
GENERAL DATA

Type	Motor Unit belt drive, suction platter, 2 arms
Platter mass/damping	8.5kg/excellent
Finish and engineering	both very good
Type of mains lead/connecting leads	3 core/+ pneumatics
Speed options	variable, 78, 45, 33rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.09%
Absolute speed error	quartz referenced Strobe
Speed drift 1 hour/load variation	+0.1%/-0.2%
Start up time to audible stabilisation	3.8secs
Rumble: DIN B wtd L/R av (see spectrum)	-7.7dB
Size/clearance for lid rear	66.4(w) x 39.2(d) x 17.5(h)4cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	excellent*
Hum level/acoustic feedback	excellent/very good
Vibration sensitivity/shock resistance	fairly good/very good
Estimated typical purchase price	£1700

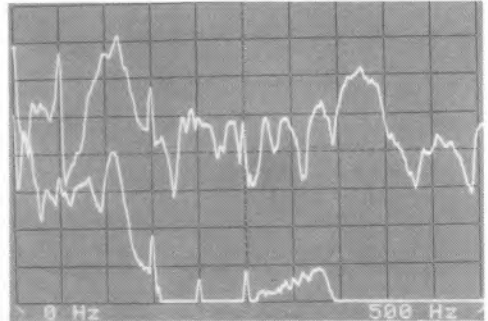
*if well sited



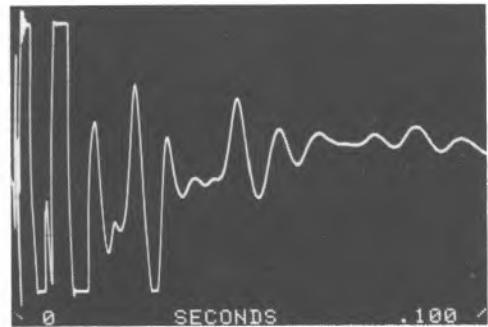
Disc impulse transmission with vacuum (X10) (graticule not shown).



Acoustic breakthrough, lid up/down (see text).



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



Disc impulse transmission without vacuum (X10) (graticule not shown).

Marantz Esotec TT 1000

Marantz Audio UK Ltd., Debmarc House, 193 London Road, Staines, Middx. Tel (0784) 50132



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

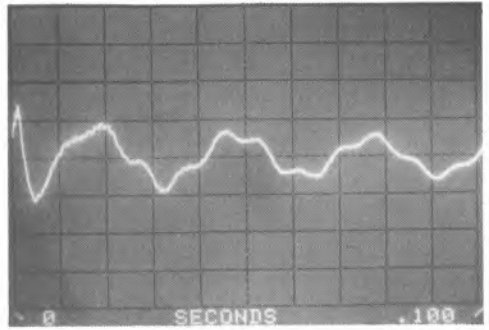
Tried with several tonearms including the Mission 774, the Helius and SME III, the TT1000 performed very well subjectively. Demonstrating very good stability with regard to low frequency floor movements, some loss of bass attack and low frequency extension was apparent on our coffee table location, but 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

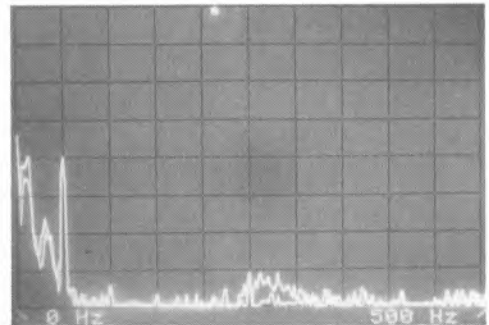
Admittedly very costly, the TT1000 offers a high quality shock resistant motor platform which is tolerant of tonearms. Well sited, the reproduction is excellent, demonstrating low coloration levels. If you can afford it and like its looks, there are few objections that can be raised against its purchase, 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

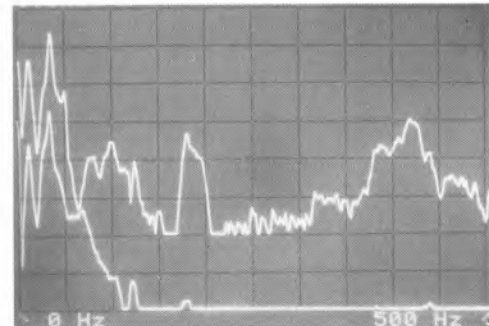
	Motor Unit
Type	direct drive, manual quartz lock
Platter mass/damping	3.4kg/fairly good
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	2 core, power box/N/A
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	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	£1000



Disc impulse transmission, magnified X10.



Rumble (0-500Hz line), (electrical component superimposed).



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

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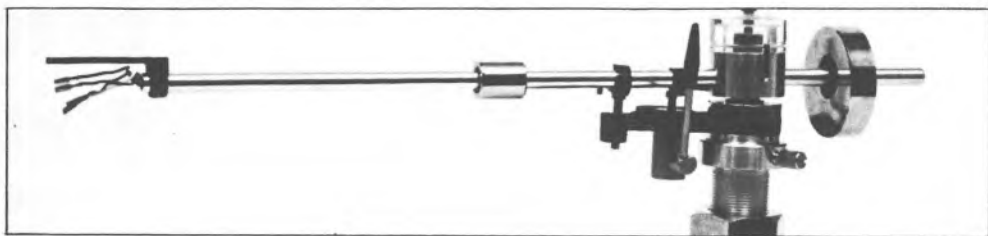
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Marantz Audio (UK) Ltd., Debmarc House, 193 London Road, Staines, Middlesex. Freefone 2347.



Features, facilities, setting up and use

This Japanese made arm was one of the first low mass component tonearms to be produced for an independent distributor, in this case the British firm Mayware. Since its introduction a few years ago a number of improvements have taken place. In pursuit of very low mass a rather flexible alloy sheet was used for the headshell in the original model, and this has now been replaced by a substantial strong casting; nonetheless the effective mass remains low at 7.5g.

A beautifully engineered and finished unipivot design, the *MK III* offers variable damping at subsonic frequencies using a silicone fluid well around the unipivot, with convenient access via a removable pillar cap made of clear acrylic. The counterweight was decoupled on a rubber bush and afforded some upper range damping, while a calibrated downforce scale using a rider weight on the main tube was also incorporated, and proved a trifle loose on our sample. The thread/pulley/lever bias compensator was also calibrated, the arm proving easy to set up and align, and offering full geometric adjustments; a tracking protractor was provided. Readers may recall this arm being recommended in the last issue when it cost around £70.00, and as the price is now £58.00 despite inflation (a petrocurrency benefit?), things looked promising indeed.

Lab performance

At 4.5g the effective mass was low, as was the lead capacitance at 85pF, thus rendering the matching flexibility good. As with other low mass arms extra mass may be added if required by using a backing plate on the cartridge, and this may well prove worthwhile with some low compliance moving-coil models. The *MK III* also proved very well aligned, and delivered excellently low friction. Although the bias compensator gave high values, these were easily corrected and the mechanism added little extra friction. Downforce was accurately calibrated and cueing fine, if a trifle slow in descent.

Numerous 'breaks' were apparent, but resonances were classed as above average due to the maintenance of the correct energy trend. The upper register was a bit 'scrappy': the mode at 62Hz was due to the counterweight bush and that at 600Hz to the arm tube, the latter also related to the smaller amplitude flexure at 300Hz. In sequence a 1.2kHz mode was also present, with that at 2.4kHz possibly related, though it could have been coincidental.

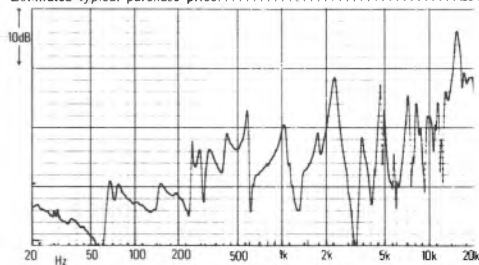
Sound quality

Rated as 'good', the arm gave fine stereo, clean bass and a generally well integrated sound. The upper range tended to slight roughness and forwardness, but not unduly so.

Conclusion

This arm represents a complete and highly versatile product, whose good standard of engineering, as well as its good sound quality ensure a firm recommendation at its current price.

GENERAL DATA		Tonearm
Approximate effective mass inc screws, excl cartridge	7.5g	
Type/mass of headshell	special detachable/N/A	
Geometric accuracy	.....	excellent
Adjustments provided	..... tilt, height, overhang, lateral angle	
Finish and engineering	.....	excellent/very good
Ease of assembly/setting up/use	.....	very good/good/very good
Friction: typical lateral/vertical	..... < 20mg/< 15mg	
Bias compensation method	..... thread and lever	
Bias force: rim/centre (set to 1.5g elliptical)	..... 250mg/265mg	
Downforce calibration error: 1g/2g	..... < 0.02g/< 0.03g	
Cue drift/8mm ascent/descent	..... negligible/0.8secs/2.2secs	
Arm resonances	.....	above average
Subjective sound quality	.....	good
Lead capacitance/damping method	..... 85pF/fluid well unipivot	
Estimated typical purchase price	.....	£58



Michell Focus Motor (re-assessed)

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.

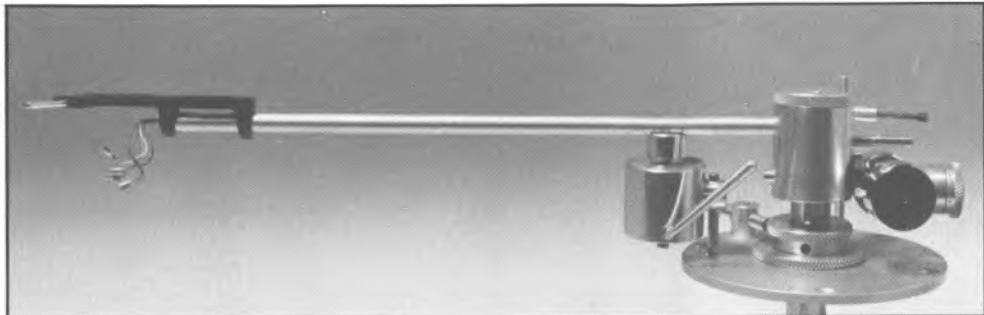
Conclusion

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.

continued p 126

Michell Focus Arm (re-assessed)

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



Features and design

The *Focus* tonearm suffered some problems in early production and consequently encountered some criticism in previous editions of *Choice*. When first manufactured, the tube had a rather high 'Q' factor, resulting in numerous audio band resonances; problems were also encountered with pivot friction and lead torque within the arm. Fortunately all these have now been largely resolved, and improved output cables have also been fitted, with gold plated phono plugs as standard.

A low mass fluid-damped unipivot design, the arm essentially carries a fixed skeletal headshell, offering a low effective mass of 6g. Geometric accuracy is excellent, ensured by the wide range of adjustments provided for correct cartridge alignment. The main tube now comprises a double layer assembly, one controlling and damping the other. The lead possesses a low 65pF capacitance, but it is rather stiff and will cause some problems with free-suspended subchassis turntables.

Lab results

In general the finish and engineering were to a very high standard, but the counterweight area had been somewhat neglected, with a rather sloppy fit of parts, and this was reflected by the resonance graph which exhibited a strong break at 50Hz. No single tube resonance could be identified, two occurring at 330 and 600Hz, with an energy jump of 10dB separating the upper and lower regions. Although better than before, the 1.5 to 4.0kHz range was none too clean.

Other parameters were fine, with accurate bias compensation and downforce calibration, together with exemplary friction levels. Cue descent was slow at 3 seconds.

Sound quality

Using low compliance moving-coil cartridges the sound tended to 'brashness' and 'grain' in the lower treble range, though the standard attained elsewhere in the band was quite presentable. Higher compliance and less temperamental moving magnet models of up to 35cu sounded cleaner and better balanced, and the fluid damping was beneficial in maintaining unipivot stability.

Conclusion

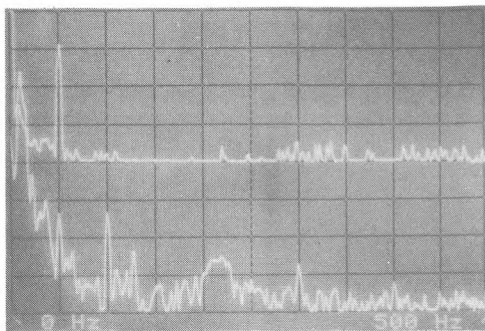
Although packed with engineering features and adjustments, this low mass arm is not particularly competitive in terms of the sound quality it delivers for the price. Despite this reservation it is worthy of consideration, especially for moving magnet cartridges needing low capacitance loading, and those which would benefit from damping.

continued overleaf

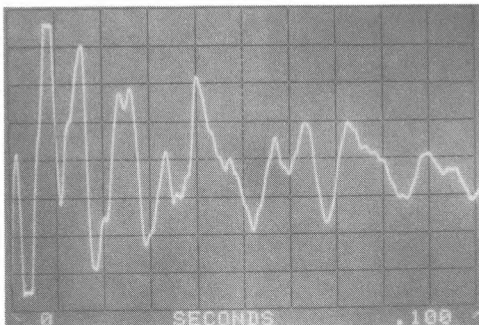
FOCUS MOTOR CONT.

GENERAL DATA

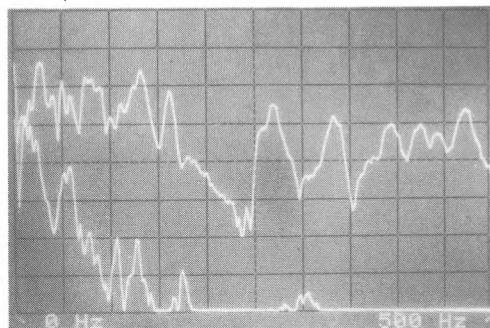
	Motor Unit
Type.....	belt drive
Platter mass/damping.....	2.0kg/good
Finish and engineering.....	very good/very good
Type of mains lead/connecting leads.....	3 core + earth/—
Speed options.....	33/45rpm
Wow and flutter (DIN peak wtd sigma 2).....	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz).....	<0.1%/<0.05%
Absolute speed error.....	<0.1%
Speed drift 1 hour/load variation.....	synchronous/±0.3%
Start up time to audible stabilisation.....	3secs
Rumble: DIN B wtd L/R av (see spectrum).....	-74.5dB
Size/clearance for lid rear.....	43.0(w) x 37.0(d) x 13.0(h)/9cm
Ease of use.....	good
Typical acoustic breakthrough and resonances.....	above average
Subjective sound quality of complete system.....	good
Hum level/acoustic feedback.....	very good/good
Vibration sensitivity/shock resistance.....	good/fairly good
Estimated typical purchase price.....	£130 (£170 incl Basic)



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



Disc impulse transmission, magnified X10.

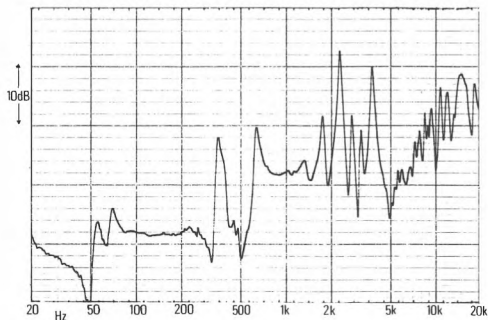


Breakthrough (0-500Hz lin): above, acoustic; below, vibration.

FOCUS ARM CONT.

GENERAL DATA

	Focus Tonearm
Approximate effective mass inc screws, excl cartridge.....	6.0g
Type/mass of headshell.....	special detachable/N/A
Geometric accuracy.....	excellent
Adjustments provided.....	overhang, tilt, lateral angle, height
Finish and engineering.....	excellent/very good
Ease of assembly/setting up/use.....	very good/some skill necessary/good
Friction: typical lateral/vertical.....	less than 10mg/less than 10mg
Bias compensation method.....	threaded weight
Bias force: rim/centre (set to 1.5g elliptical).....	180mg/190mg
Downforce calibration error 1g/2g.....	0.02g/0.00g
Cue drift/8mm ascent/descent.....	negligible/0.8sec/3secs
Arm resonances.....	fairly good
Subjective sound quality.....	good
Lead capacitance/damping method.....	65pF/fluid well around unipivot
Estimated typical purchase price.....	£85



Structural arm resonances, audio band.

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Michell Marble Electronic

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



Features and design

An upgraded version of the standard Michell *Reference Electronic* the *Marble* decks cost some 20% more and provide a higher mass deck plate plus a different arrangement for support. The open leaf-spring 'legs' of the standard model are replaced here by three elegant gold plated double cone feet possessing a near zero compliance; these are not attached to the deck but are placed on a surface and the turntable lowered onto them. The earlier turntable platter with its distributed rubber record supports of small area attached to surface weights has also been supplanted, giving way to a flat 2.0kg aluminium platter with a very thin layer of suede leather bonded to it for disc support (this mat is also used in the less expensive Focus).

Belt driven via a quiet DC motor, this is mounted with its power supply and control unit components, in a moulded rubber case, the whole forming a press fit into an aperture in the deck panel. Variable fine speed control is offered, and the speed itself is referenced to a mains frequency illuminated strobe wheel, driven peripherally from the belt.

If this unit is compared to the Marantz *TT1000*, its total mass can be seen to be much lower, thereby keeping it further removed from the theoretical realisation of a high mass inert loop. And while the Marantz did have some isolation at higher frequencies and had dispensed with a lid, the *Marble Electronic* has virtually no shelf isolation; furthermore, its large acrylic lid, although of high quality, is coupled directly to the chassis/deck. While the shock resistance will be good, almost any structure on which the deck is placed will form part of its vibration coupling characteristics. A light compliant shelf, for example, might help with the unit's mass distribution, by decoupling it from floor-borne vibration; but a heavy rigid shelf conversely would suffer less from the internal vibration resulting from incident airborne energy. It is likely that the sound quality will vary greatly with environment, deck support, and location.

Lab results

Measuring better than previous examples, this *Electronic* provided an excellent wow and flutter performance. While speed drift was low, speed

slowing under load was just acceptable at -0.45% , using a clean belt (earlier belts came dressed with talc and measured -0.6% under the same test loading). Start up was rapid at 1.5 seconds, and a fine -76dB weighted rumble was recorded, also better than before. One odd harmonic was however noted in the rumble spectrogram at 60Hz , originating from the motor.

For the disc impulse X10 scaling was just possible, and was dominated by low frequency platter rocking at 21Hz , attributable to the rather slim main bearing. Acoustic isolation was remarkably good above 50Hz , worsening at lower frequencies, and the vibration isolation was also below average over the range, much poorer than with the leaf-spring suspension of the standard model.

Sound quality

Some experiments were conducted during the auditioning in order to assess the effects produced by siting. On our substantial coffee table the *Electronic* sounded rather better than expected: leaving aside the low frequency register, the overall balance was pleasantly neutral, with reasonably good stereo focus and good rendition of ambient effects. As far as the mid and treble were concerned, the platter and mat provided effective termination and support, and the lack of isolation was most apparent in the bass, which was 'soft' and lacking in definition and uniformity. 'Paving stone' wall-mounting gave the best result, but even then the low frequency range never attained the standard demonstrated by the best models.

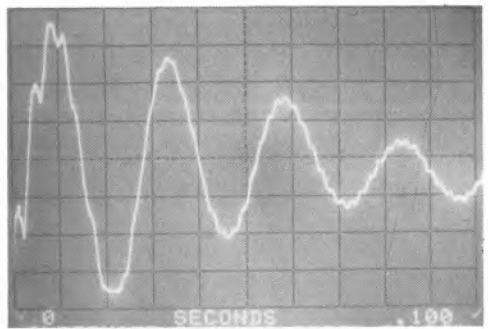
Conclusion

On balance, unless a suitable site is predetermined, the purchase of a *Marble Electronic* involves some uncertainty concerning the quality of the sound finally arrived at; in this respect, the less expensive version will be less of a risk. I suspect that this type of turntable needs to be very much heavier for optimum results, and that some isolation is still advisable.

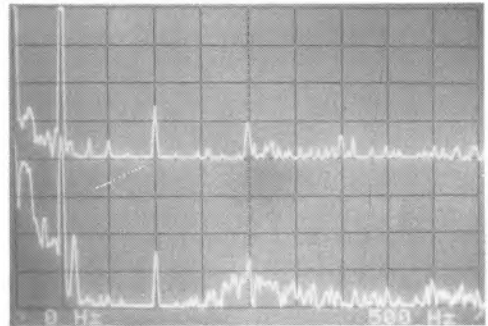
GENERAL DATA

Type	Motor Unit belt drive
Platter mass/damping	2.0kg/good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core + earthy—
Speed options	fine variable, 33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	<0.11%/<0.06%
Absolute speed error	variable
Speed drift 1 hour/load variation	<0.2%/-0.45%
Start up time to audible stabilisation	approx 1.5secs
Rumble: DIN B wtd L/R av (see spectrum)	-76dB
Size/clearance for lid rear	45.0(w) x 44.0(d) x 15.0(h)/10.5cm
Ease of use	good
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	good
Hum level/acoustic feedback	good/fairly good*
Vibration sensitivity/shock resistance	below average/good
Estimated typical purchase price	£250

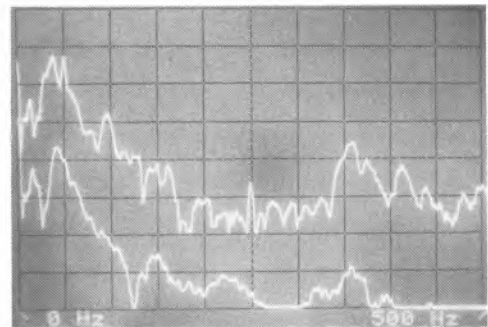
*depends on siting



Disc impulse transmission, magnified X10.



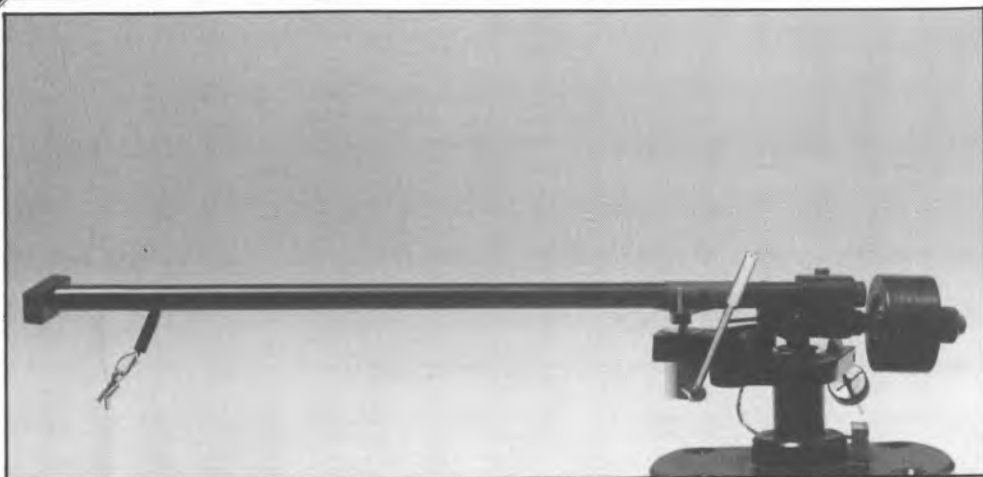
Rumble (0-500Hz lin): above, electrical only; below, total.



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

Mission 774 (re-assessed)

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



Features and design

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

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

A rigid arm design, all the components are tightly clamped together, and the precision ball-race bearings are pre-stressed by an offset

technique which eliminates play. The counterweight resonance problem encountered with many tonearms has been solved here by the use of a new synthetic engineering polymer called *Sorbothane*, a cast insert of this decoupling the counterweight from its threaded adjustment bush. The very high loss characteristics of the insert provide strong damping of the main resonance as well as some secondary beam effects.

Lab results

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

The resonance graph showed excellent control over a wide range, with a notably even energy

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

Sound quality

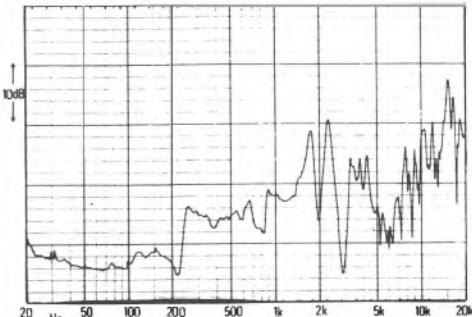
Perhaps due to its low mass the 774 showed an ability to provide a consistently good standard of reproduction using a wide range of motor units from a Linn to a Thorens, from a Marantz *TT1000* to a Lux *PD555*. Many tonearms have a strong tonal character, exhibiting 'richness', 'brightness' or simple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

Conclusion

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

GENERAL DATA

Approximate effective mass inc screws, excl cartridge	5.5g	Tonearm
Type/mass of headshell	special detachable arm/N/A	
Geometric accuracy	excellent	
Adjustments provided	tilt, height, overhang, damping	
Finish and engineering	good/very good	
Ease of assembly/setting up/use	fair/requires care and skill/very good	
Friction: typical lateral/vertical	less than 15mg/less than 10mg	
Bias compensation method	lever, thread, pulley	
Bias force: rim/centre (set to 1.5g elliptical)	uncalibrated	
Downforce calibration error: 1g/2g	<0.05g/<0.05g	
Cue drift/8mm ascent/descent	negligible/1sec/1.2sec	
Arm resonances	good	
Subjective sound quality	very good	
Lead capacitance/damping method	180pF/variable, silicone fluid well	
Estimated typical purchase price	£157	



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Mitsubishi DPEC 7

Mitsubishi Electric UK Ltd., Otterspool Way, Watford, Herts. WD2 8LD. Tel (0923) 40566



Features and design

Mitsubishi supplies a modest Audio Technica AT12E cartridge with this model. This is ready fitted in a universal detachable headshell, uses a 0.4 x 0.7 'thou' shank-mounted elliptical diamond and tracks at a nominal 1.5g downforce. The cartridge was misaligned by a degree or so, and using a protractor rather than the less accurate overhang method specified, we reset it for optimum geometric accuracy. Made of fibre reinforced plastic, the headshell weighs 7.5g, contributing to a medium-heavy total effective mass of 14g, which is suited to low compliance cartridges in the 8–16cu range.

Powered by a direct drive motor, described as an 8 pole coreless type, this highly automated model uses optically actuated sensors to detect record size; with that information, a microprocessor then sets the arm cueing lead-in position as well as the record speeds. The arm lacks the power traverse of the '5V but may be positioned manually when the automatics are overridden.

Of solid plinth construction, the finish is very good, and the resilient feet offer some mid frequency vibration isolation, but have little effect at low frequencies due to their high stiffness and excessive damping. Conversely this damping will prove helpful in terms of good shock immunity. The usual resonant tinted plastic lid is fitted, which will adversely affect the reproduction via its close coupling to the plinth and thence to the arm.

Lab results

Measurement showed that the motor possessed very good technical performance characteristics. Excellent wow and flutter was recorded, and the unit was fairly powerful in view of the 2.5 second start up for the 1.4kg platter weight. Speed was quite stable, little affected by loading and free of dynamic wow or overshoot.

When DIN B weighted a fine -74dB rumble was achieved, although analysis revealed some random noise and a 100Hz mains harmonic at a fairly harmless -80dB . The platter disc interface damping was insufficient for expanded resolution and the trace has X1 scaling. A strong low frequency mode was apparent at 20Hz (probably platter rocking), and a delayed reflection of the initial impulse was also present half way through the 100mS measurement interval. Acoustic breakthrough was poorer than average, particularly below 150Hz, and the vibration isolation was little better at low frequencies.

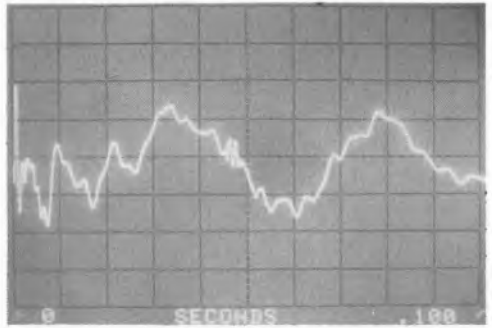
The general mechanics of the arm were quite good, although the low bearing frictions were attained at the expense of some play. Biasing was on the low side, but in the correct ratio, proving easy to correct by adding 0.5g or so on the dial. Headshell flexure dominated the audio resonance characteristic at a rather low figure of 140Hz, resulting in a deleterious energy displacement of 20dB. The resonance was severe enough to excite bearing 'chatter', seen as 'noise' at 180Hz, but the upper range was uneventful due to the effective decoupling at the headshell junction.

Sound quality

Fairly satisfactory, the sound was characterised by a thickened and muddled bass register with little apparent extension. The mid and treble ranges were superficially pleasant enough, but stereo depth and detail were lacking, and care needed to be taken when siting the deck in order to avoid feedback at high gain settings.

Conclusion

Honest enough in its approach and constructional quality, and offering an essentially fool-proof technical performance with automated operation, the *DPEC-7* comes with an appropriate and fairly compatible cartridge, but does not provide anything special in terms of sound quality versus price.



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

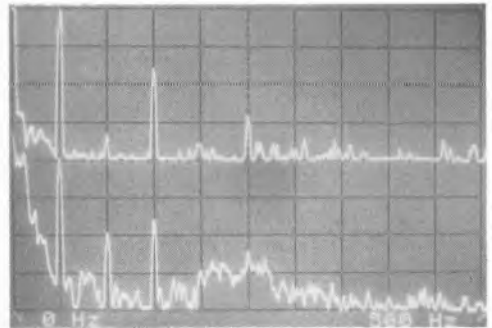
Type direct drive, fully automatic
 Platter mass/damping 1.4kg/fairly good
 Finish and engineering very good/very good
 Type of mains lead/connecting leads ... 2 core/phonos + earth
 Speed options variable 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) <0.06%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ... <0.1%/<0.07%
 Absolute speed error referred to mains stroboscope
 Speed drift 1 hour/load variation -0.15%/-0.2%
 Start up time to audible stabilisation 2.5secs
 Rumble: DIN B wtd L/R av (see spectrum) -74dB

Arm Section

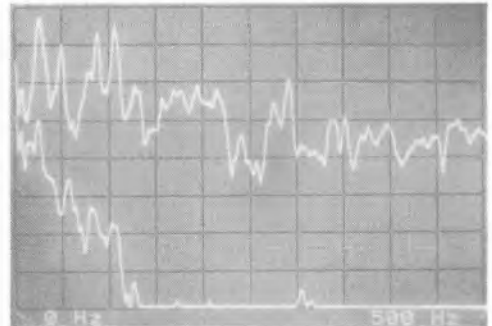
Approximate effective mass inc screws, excl cartridge 14g
 Type/mass of headshell universal detachable/7.5g
 Geometric accuracy fairly good
 Adjustments provided overhang
 Finish and engineering good/fairly good
 Ease of assembly/setting up/use very good/very good
 Friction: typical lateral/vertical less than 25mg/less than 25mg
 Bias compensation method internal spring
 Bias force: rim/centre (set to 1.5g elliptical) 100mg/150mg
 Downforce calibration error: 1g/2g 0.0g/+0.05g
 Cue drift/8mm ascent/descent negligible/1.0sec/2.0secs
 Arm resonances fairly good
 Lead capacitance/damping method 80pF/none

System as a whole

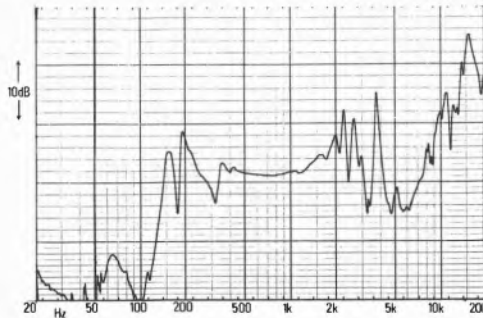
Size/clearance for lid rear 45.5(w) x 39.0(d) x 12.0(h)/5cm
 Ease of use very good
 Typical acoustic breakthrough and resonances average -
 Subjective sound quality of complete system average +
 Hum level/acoustic feedback very good/fairly good
 Vibration sensitivity/shock resistance below average/good
 Estimated typical purchase price £180



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



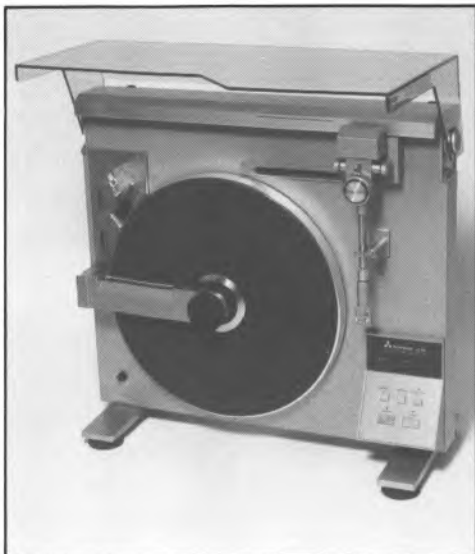
Breakthrough (0-500Hz lin): above, acoustic; below, vibration.



Structural arm resonances, audio range.

Mitsubishi LT-5V

Mitsubishi Electric UK Ltd., Otterspool Way, Watford, Herts. WD2 8LD. Tel (0923) 40566



Features and design

This vertically presented turntable created quite a stir when it was first released, and continues to fascinate, having a particular advantage for those who do not have a wide enough shelf or cabinet on which to place a conventional machine. A competitor has now been released by Sharp, which has the ability to play both sides of a record without turning it over, but in doing so sacrifices both platter and mat which the LT5V does not. Theoretically at least, the Mitsubishi should benefit from their retention.

An Audio Technica AT12E cartridge is fitted to the unit, offering fair compatibility, though it should be appreciated nonetheless that this is a cheap model. Belt driven via a DC motor with fine variable speed control, speed reference was provided by a mains frequency illuminated strobe, but some motor noise was audible if the deck was sited near the listener position. The parallel tracking arm runs along the upper section of the deck and is protected by a light plastic half cover. This swings upwards to allow fitting of the disc, which is clamped under a light action locking arm, hinged horizontally. A universal detachable headshell is fitted, giving a total arm effective mass of approximately 15g, suited to lower compliance cartridges.

The gravity hanging design of the tonearm complicated measurements and a lacquer test record had to be used for rumble measurement,

since the more accurate bridge was unsuitable. Automated in many respects, the 5V offers push-button power cueing, plus traverse and lift/lower. Disc size is automatically detected and programmed for speed and arm entry position, but it must be said that little has been done to incorporate either acoustic or vibration isolation from the environment. In addition to its freestanding mode, the unit is also available in a larger cabinet which includes a stereo receiver.

Lab results

Taking rumble first, and remembering that the test lacquer has more intrinsic noise than the usual measurements, the spectrum analysis showed a 100Hz breakthrough at just 70dB down; however the other products were better than 80dB down, and a good rumble figure of better than -72dB DIN B weighted was recorded. The combined wow and flutter reading was also fine when DIN weighted, but on its own the linear wow was on the high side at 0.3%; the vertical orientation of the test disc may have been a complicating factor here. The drive showed good torque, and the 1.7kg platter attained a stable speed in a moderate 3.5 seconds.

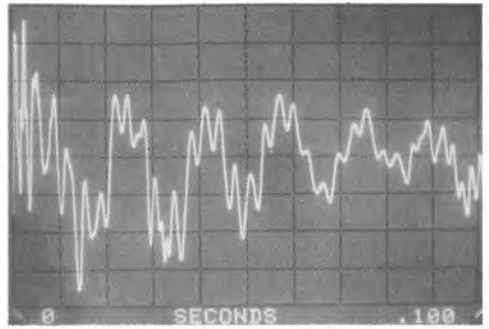
The platter disc damping was just sufficient to allow X10 scaling for the impulse response, although numerous spurious frequencies may be seen in a rather uncontrolled form. Fortunately, while the level of acoustic breakthrough was unexceptional, it was fairly evenly distributed, and will in any case be modified by close wall mounting. The vibration breakthrough was clearly below average, and the heavy gravity-balanced arm proved somewhat susceptible to footfall shock - a rigid shelf mounting is recommended. In general the arm performance was satisfactory, though the downforce weight was a rather loose fit, and on resonance behaviour the response was dominated by a severe flexure at a low 140Hz with a 20dB jump in level. At higher frequencies the arm was more or less decoupled from the cartridge, and hence beyond its influence.

Sound quality

While in high fidelity terms the sound quality was no better than might be expected, showing a muddled bass, a lack of midrange depth and detail, as well as a 'dulled' treble, at least this deck did not exhibit unpleasant harshness or coloration in the mid register. The sound in fact was just average for the type of deck, and in context the supplied cartridge was a fair choice.

Conclusion

If chosen this model should be bought on the basis of its unique format and convenient automation. The sound is acceptable, and improves a little with a firm foundation free of vibration and shock. But it would win no hi-fi awards, and on balance is best suited to the near music centre role in its combination receiver format.



Disc impulse transmission, magnified X10.

GENERAL DATA

Integrated Turntable

Motor Section

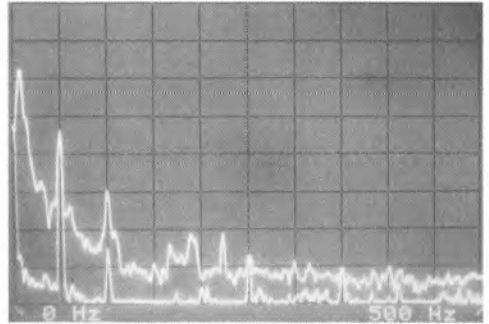
Type parallel tracking, belt drive, automatic
 Platter mass/damping 1.7 kg/good
 Finish and engineering very good/good
 Type of mains lead/connecting leads ... 2 core/phonos + earth
 Speed options variable 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) 0.07%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) 0.3%/0.06%
 Absolute speed error +0.1%
 Speed drift 1 hour/load variation <0.1%/<0.1%
 Start up time to audible stabilisation 3.5secs
 Rumble: DIN B wtd L/R av (see spectrum) ... better than -72dB

Arm Section

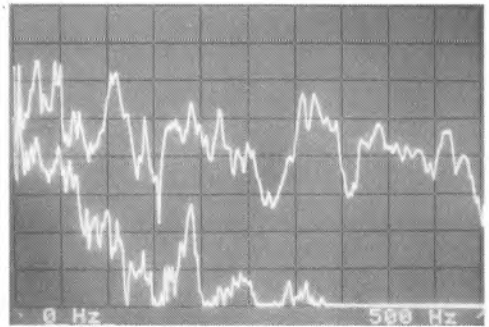
Approximate effective mass inc screws, excl cartridge 15g
 Type/mass of headshell universal detachable/7g
 Geometric accuracy very good
 Adjustments provided overhang
 Finish and engineering good/fairly good
 Ease of assembly/setting up/use very good/very good
 Friction: typical lateral/vertical less than 30mg/less than 30mg
 Bias compensation method non required
 Downforce calibration error: 1g/2g -0.15g/-0.1g
 Cue drift/8mm ascent/descent negligible/3secs/3secs
 Arm resonances poor
 Lead capacitance/damping method 200pF/none

System as a whole

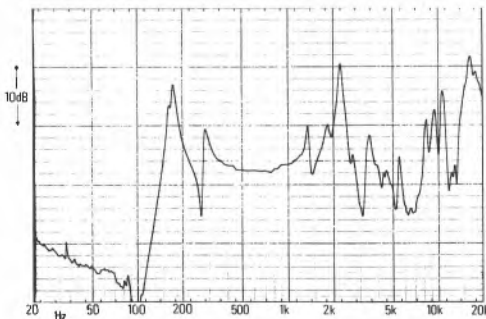
Size/clearance for lid rear
 466mm(w) x 200mm(d) x 430mm(h)/6cm height
 Ease of use very good
 Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system average -
 Hum level/acoustic feedback good/average
 Vibration sensitivity/shock resistance ... below average/average
 Estimated typical purchase price £200



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



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



Structural arm resonances, audio range.

Optonica RP 7100

Sharp Electronics Ltd., Sharp House, Thorp Road, Manchester M10 9BE. Tel 061-205 2333



Features and design

This elaborate turntable is an advanced development of the 5100 previously reviewed in *Choice*. Its major operating feature comprises a sensor for the detection of gaps between music tracks, which Sharp call *APLD* or 'automatic program locate device'. By entering the total number of spaces preceding a chosen track, the arm will automatically skip that number and set down as desired. Personally I am not certain how useful this feature is in practice, since it is achieved at considerable cost to the pocket as well as the performance of the deck. The problem lies in the fact that Sharp have chosen to build the sensor into a second arm alongside and coupled to the vertical bearing section of the existing arm. In consequence dynamic balance is very poor, with an extreme sensitivity to levelling and shock (an out-of-level position is in fact required for correct biasing), while the secondary arm also adds a serious resonance to the arm structure at 50Hz.

The deck is also unusual in employing a recessed area in the plinth allowing the use of an acoustically superior lid – a single sheet of plate glass, which requires virtually no rear clearance for elevation. A quartz-locked direct drive motor is used to power an alloy 1.4 kg platter fitted with a sensibly flat mat. Carrying a universal detachable headshell weighing 8g, the effective mass works out at 16g in the vertical plane due to the contribution of the sensor outrigger. So compatible cartridge compliances would range from 8–12cu, with downforces of less than 2g inadvisable due to the dynamic instability of the arm. Low capacitance leads are fitted which could aid

the electrical matching of some cartridges.

Vibration isolation has clearly not been given much thought in this design, as the rather stiff feet, which lack in this instance essential adjustment for levelling, offer plinth suspension resonances in the region of 12–18Hz.

Lab results

The motor section demonstrated good dynamic characteristics, with low overshoot and very good speed accuracy assured by the quartz lock. Rumble levels were satisfactory though some mains-related components were evident on the spectrum, notably at 100Hz (–65dB), and 200Hz (–70dB); pole related harmonics were absent. The platter disc impulse was unpromising, requiring X1 scaling and demonstrating several mild resonances of long duration. Likewise neither the acoustic or vibration energy rejections held much hope for an exceptional sound quality, as both were significantly below average for the price.

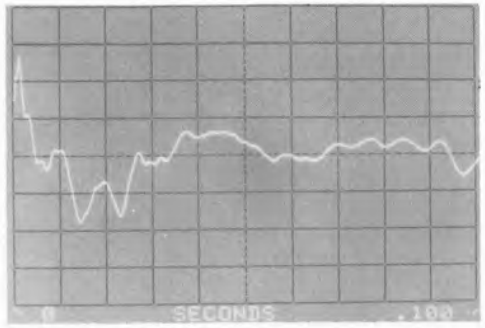
The arm geometry was questionable with the sensor restricting cartridge location; in any case the arm was positioned rather low on the platter. Bearing play was evident, though with good friction levels, and the bias compensation proved inadequate, producing an equivalent to 0.3g on a 1.5g setting; this will have to be set by trial and error upon purchase. Dominated by the 50Hz sensor mode, the multiple arm resonances betray a lack of rigidity in several areas including the headshell junction, but the energy trend was nevertheless fairly even.

Sound quality

Compared with the better examples in this group, the stereo was confused, particularly in terms of central focusing and lack of depth. Feedback could be a problem at higher gain settings, while the low frequency range sounded 'lumpy' and lacking in definition, though coloration in the mid and treble was quite low.

Conclusion

Despite its track selection feature, or perhaps because of it, this turntable cannot be recommended on the basis of either its technical or subjective performance; in fact its less expensive brother the *RP5100* represents much better value for money.



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

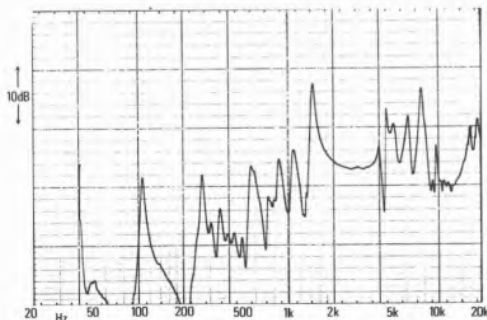
Type quartz, direct drive, special track locator
 Platter mass/damping 1.4kg/very good
 Finish and engineering good/good
 Type of mains lead/connecting leads 2 core/phonos + earth
 Speed options 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) 0.06%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) .. 0.13%/0.06%
 Absolute speed error <0.01%
 Speed drift 1 hour/load variation <0.01%/<0.01%
 Start up time to audible stabilisation approx 2.5secs
 Rumble: DIN B wtd L/R av (see spectrum) 77/68dB

Arm Section

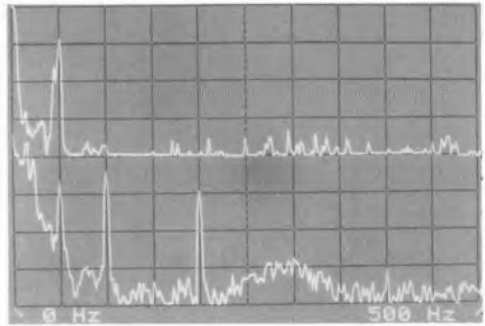
Approximate effective mass inc screws, excl cartridge ... 16.0g
 Type/mass of headshell universal detachable/8g
 Geometric accuracy fair only
 Adjustments provided overhang(limited by ap/d), lateral/angle
 Finish and engineering fairly good/only fair
 Ease of assembly/setting up/use good/good/very good
 Friction: typical lateral/vertical less than 20mg/less than 20mg
 Bias compensation method spring
 Bias force: rim/centre (set to 1.5g elliptical) 50mg/50mg
 Downforce calibration error: 1g/2g +0.2g/<0.1g
 Cue drift/8mm ascent/descent negligible/0.5sec/1.5secs
 Arm resonances poor
 Lead capacitance/damping method 78pF/none

System as a whole

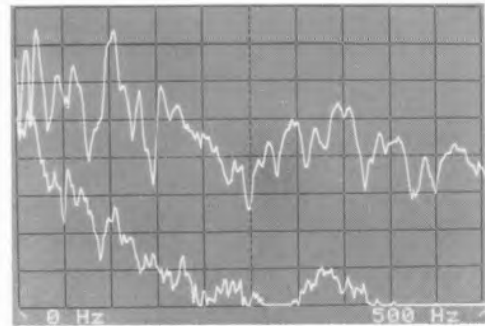
Size/clearance for lid rear 48.0(w) x 38.5(d) x 11.0(h)/0cm
 Ease of use very good
 Typical acoustic breakthrough and resonances fair
 Subjective sound quality of complete system ... below average
 Hum level/acoustic feedback good/poor
 Vibration sensitivity/shock resistance below average/poor
 Estimated typical purchase price £170



Structural arm resonances, audio range.



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



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

Oracle

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



Features and design

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 33 $\frac{1}{3}$ and 45rpm. The power supply is arranged as a separate box, equipped with a mains flying lead for the attachment of a UK plug.

Lab results

During the testing it was discovered that the coil springs in the suspension could act as crude resonant transmission lines, marring the upper range isolation performance. Furthermore the suspension design meant that the subchassis is not very 'free' in the torsional or rotational mode, this higher suspension frequency marginally impairing cartridge stability by intersecting the latter's resonance range. Since our measurements were taken, Oracle (who simultaneously and independently encountered the 'transmission line' problem) have incorporated a felt damping washer fitted within the spring spiral to damp the transmission mode noted, though we have not yet been able to check its effect on isolation.

The vibration breakthrough performance as measured on the new rig was disappointing in the 50Hz to 250Hz range, and can be seen to have also adversely affected the acoustic isolation *via* acoustic coupling of the platform on which the turntable was mounted. To prove that the complex Oracle type spring was responsible, we substituted three simple four-turn springs, which gave the much improved results also shown.

Some speed slowing occurred under load, but the wow and flutter results were good and speed error was small at +0.2%. At an average -76dB DIN weighted the rumble was also very good, though a 100Hz component was present at -65dB. X10 expanded scaling was possible for the disc impulse, showing a good result, though not in the Lux P555 class, for example.

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

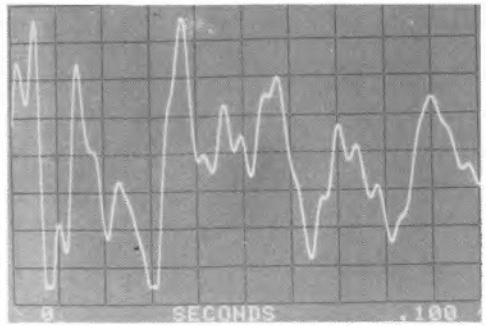
focus were both very good. The bass was 'dry', almost 'lean' in character. Tried with the Sumiko arm, the effect tended to a 'softened richness', which even the liveliness of the Koetsu failed to dispel, but which was nonetheless very pleasant. The *Ittok* is probably not an ideal match but it did provide greater 'liveliness' and 'attack', and when used with the Koetsu Wood, resulted in a fine, albeit costly, turntable, totalling around £1300.

Conclusion

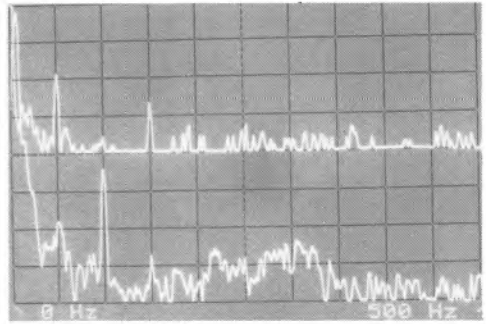
Continued and more detailed test analysis has shown that in common with most products even the Oracle has its own set of compromises, the importance of which need to be assessed along with its strengths as a 'universal' motor unit. In fairness, although this is an exciting product, in the context of this issue it cannot be said to offer particularly good value for money. Furthermore, it needs superlative (expensive) ancillary equipment to give the best results.

GENERAL DATA

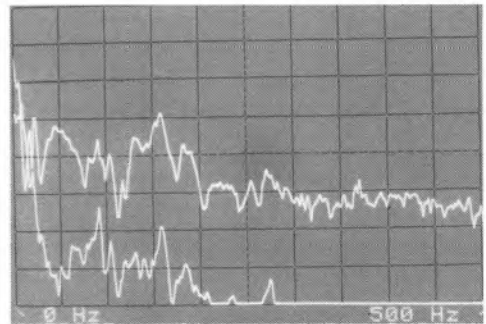
	Motor Unit
Type	belt drive
Platter mass/damping	2.8kg/excellent
Finish and engineering	excellent/excellent
Type of mains lead/connecting leads	2 core + separate transformer
Speed options	33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.09%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.13%/0.1%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	+0.3%/-0.5%
Start up time to audible stabilisation	approx 3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	-77/-75dB
Size/clearance for lid rear	48.2(w) x 36.8(d) x 15.8(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 sensitivity/shock resistance	good*/fairly good
Estimated typical purchase price	£690
*with original springs as tested	



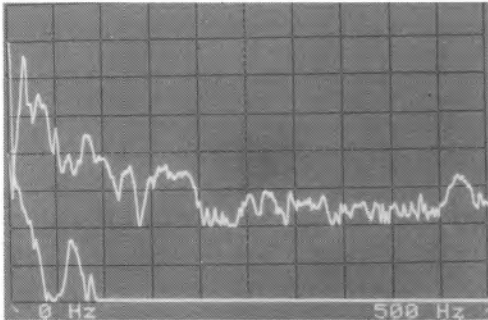
Disc impulse transmission, magnified X10.



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



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



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

WHY THE FOCUS??

SUBJECTIVE AUDIO have been able to evaluate a large number of the current crop of good turntables — and we have had to be highly selective in our final choice. Thus we are of course sympathetic to the task that confronted the editors of this publication!!

We have been with Michell Engineering from our first week of business, many years ago. Their reliability has been near faultless throughout the many hundreds of units we have sold on their behalf; and on the rare occasions that service has been necessary, a “while you wait” or 24hr turnround has been the norm.

John Michell, the designer, is always on hand to meet the public and it is a testament to his pride of workmanship that he keeps spares for every type of deck he has ever built, including units as old as 15 years. The same exceptionally high quality of construction that makes the Electronic Reference a magnificent acquisition is shown in the budget “Focus 1”!

We consider the Focus 1 not only to be an excellent first step into the world of “serious Hi-Fi and a magnificent platform for a wide range of esoteric arms, but a worthy contender when it comes to thinking about a deck for your “better” system. In a nutshell, if you are thinking of spending up to £350.00 on a deck, you MUST consider the Focus at just £135.00 inc VAT.

We make no apologies for the statement printed above. We are convinced that dedication to the customer on the part of the manufacturer must be recognised — and applauded!!

Other decks

But of course!! We’ll be delighted to demonstrate the Focus against any of the following magnificent units:

Linn LP12, Trio L07/D, Oracle, Ariston RD110, JBE Series 3, Logic DM101, Input Designs, CJ/55 ETC.

Demonstrations

Strictly by appointment until 9pm daily.

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- | | |
|--------------------------------------|-----------------|
| a) Focus Mk/2 without tone arm | £135.00 inc VAT |
| b) Focus Mk/2 with Linn Basik arm** | £181.00 |
| c) Focus Mk/2 with Focus Mk/2 arm | £209.00 |
| d) Focus Mk/2 with Hadcock "220" arm | £230.00 |
| e) Focus Mk/2 with Grace G707 Mk2 | £277.00 |
| f) Focus Mk/2 with Linn Ittok arm | £388.00 |

** includes free Linn cartridge

Please note: The above prices include the following:

- 1) Full mounting of the chosen arm by engineers at J.A. Michell Eng Co.
- 2) Delivery carriage paid and insured to your home.
- 3) One J.A. Michell record clamp & Discwasher D/4 record cleaner.
- 4) Years of experience, happily and freely passed on to you by SUBJECTIVE AUDIO when it comes to choosing your cartridge.
- 5) The full 100% backing from the engineers at J.A. Michell Eng Co.

Subject to change and/or alteration without notice. E & D.E.

**SUBJECTIVE AUDIO,
59 Grovelands Road, Palmers Green,
London N13
Tel (01) 886 7289**

Philips 829 (revised & reprinted)

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



Features, facilities, setting up and use

Described as a fully automatic model the *AF-829* is almost Philips' top line model (basically the similar *AF-877* only adds quartz referencing to the speed). Automatic record size detection was derived from a mechanical sensor built into the platter and mat, and a Philips cartridge was ready fitted. Belt driven via a DC motor, the platter was tachogenerator coupled to the servo system so that its speed was under what Philips call *Direct Control*. Fine variable speed control was incorporated, the speed deviation visible on a bar array of LED lamps.

This design is fitted with a sprung subchassis whose action was not free enough, mainly possessing a vertical mode which was spot on the arm/cartridge resonance at 6.3Hz; furthermore in dynamic terms the subchassis was not well balanced.

A special Philips detachable headshell was included, but an extra shell will probably be needed if another cartridge is to be fitted, although it should be noted that there is limited clearance to accommodate deeper cartridge models. Arm effective mass was moderate at 12g, but was still too high for the supplied cartridge, a *GP412 11* with a high compliance elliptical stylus. The subsonic resonance of this combination was excessively low at 6.5Hz (20°C), while the specification claims

10Hz using a 'test cartridge' (unspecified). The measured resonance in fact indicated a serious incompatibility, although it could be tamed by a *Discracker* or other similar stabiliser. The arm bearings showed significant looseness in both planes, but otherwise the engineering and finish were generally good.

Lab performance

The wow and flutter readings were very good with satisfactory speed accuracy, good stability, and minimal slowing under load. Torque was high and the servo system free of dynamic wow or overshoot, while start up time was satisfactory at 2.5 seconds, the platter being a rather light 1.0kg. The DIN weighted rumble was excellent averaging 76dB, but some motor noise was nevertheless apparent on the spectrogram, so it was not quite as clean as the weighted reading would have lead us to believe.

The arm effective mass has already been discussed, but the high lead capacitance also deserves mention as it may need to be borne in mind with many other cartridges. As supplied, the Philips cartridge was well aligned and potentially the geometry was very good. Arm friction was fine, and the bias compensator friction free, but in common with other Philips models it proved excessive, producing almost double the accepted

correction readings. Downforce calibration was quite accurate, cue operation very good if a trifle fast on the 45rpm speed, and arm resonances good. The graph illustrated a respectably well maintained energy trend, albeit with some breaks at 90Hz, 580Hz and 2kHz but overall exhibiting good control.

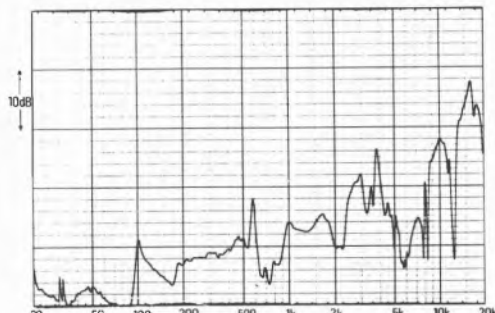
Acoustic breakthrough was promising with a fairly even characteristic apart from a 50Hz prominence, and was rated as good. Above average on vibration isolation, the 130Hz band was not too well rejected, but acoustic feedback was good, hum rejection very good, and shock immunity above average.

Sound quality

Rated as average (not using the supplied *GP412 II* cartridge), the unit was entirely free of subjective rumble or wow. Stereo information was to a reasonable standard, with depth and ambience in evidence, but slight mid coloration was audible and the overall sound did not appear well integrated. Bass quality was fairly good though lacking in the extreme registers.

Conclusion

Had the fairly expensive fitted cartridge proved more compatible with the arm (and subchassis), and hence been more secure on tracking, the unit's generally good performance would have suggested recommendation. As it happens the *GP412 II* has not found particular favour in past issues of *Choice*, and in our estimation, cannot give of its best in the 829 arm in any case. The unit nevertheless remains worth considering, particularly if used with a more compatible cartridge.



Arm resonances

GENERAL DATA

Motor Section

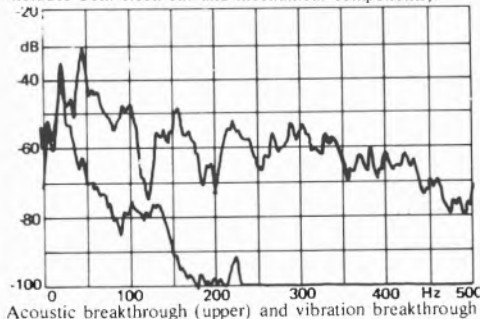
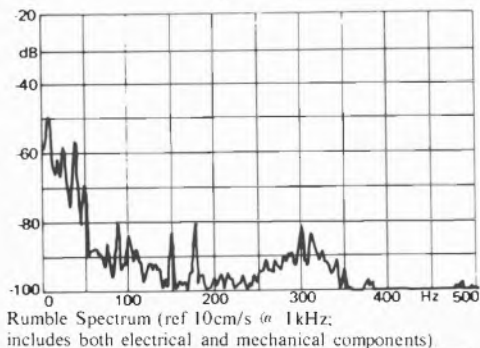
Type	fully automatic, servo belt drive
Platter mass/damping	1.0kg/good
Finish and engineering	good/good
Type of mains lead/connecting leads	2 core/phones + earth
Speed options	variable, 33, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.1%/0.06%
Absolute speed error	variable: -0.3%
Speed drift 1 hour/load variation	-0.2% - 0.05%
Start up time to audible stabilisation	2.5secs
Rumble: DIN B wtd L/R av (see spectrum)	75.77dB

Arm Section

Approximate effective mass inc screws, excel cartridge	12g
Type/mass of headshell	Philips detachable 7g
Geometric accuracy	very good
Adjustments provided	none
Finish and engineering	good/good
Ease of assembly setting up/use	very good/good/very good
Friction: typical lateral/vertical	25mg/15mg
Bias compensation method	internal/spring
Bias force: rim/centre (set to 1.5g elliptical)	275mg/300mg
Downforce calibration error: 1g/2g	-0.05g - 0.1g
Cue drift: 8mm ascent/descent	negligible 1.0sec/0.8secs
Arm resonances	good
Subjective sound quality	above average
Lead capacitance/damping method	270pF/decoupled counterweight

System as a whole

Size/clearance for lid rear	44.7(w) x 36.4(d) x 14.4(h)/7.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	average
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	above average/above average
Estimated typical purchase price	£165



RECOMMENDED

Pink Triangle

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



Features and design

From the outside, the name and distinctive logo may seem all that is remarkable about this new 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. Black or bronze mirror glass may be selected for the upper deck, and can be lifted out in sections to aid alignment or to set the fine speed adjuster which controls the DC micro-motor drive.

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, with two alternatives for the thrust cup, the more expensive one employing an ultra-rigid ruby which adds some £60 to the price. 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 Syrix, 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, accessible to a special nut runner.

An expensively executed slide switch mechanism controls the selection of 33 $\frac{1}{3}$, 45 and off; this is unfortunately unlabelled, so it needs a little practice to memorise the positions. The lid is a low resonance type, hand-fabricated from clear acrylic stock.

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 1.7 kg platter mass, the flywheel effect was lower

than in competing models, and as received the 33 $\frac{1}{3}$ rpm was a little fast (+ 1%), but could easily be corrected using the adjuster.

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

Low coloration and neutrality were the dominant features of this desk. It happily partnered the *Ittok* arm, which can react unfavourably with some turntables, and very secure, stable tracking ensued, with well-focused imaging, plus fine stereo and ambience rendition. The bass was even, slightly 'dry' but vaguely suggestive of a slight 'weight loss' at the very lowest frequencies, and it also demonstrated very good feedback immunity.

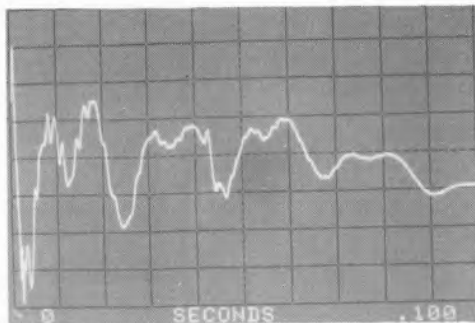
The Koetsu cartridge gave the best system sound, and the new less expensive model should also prove compatible. Thus equipped, the Pink Triangle delivered a clean relaxed and musical performance of the highest quality, and provided a valid if different interpretation of disc sound in comparison to several established reference turntables.

Conclusion

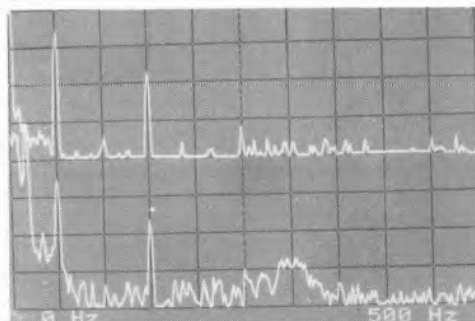
This is a low coloration device best suited to neutral speakers possessing comparatively low levels of coloration. Despite one or two teething and handling troubles which a good dealer should be able to solve (and which also occur with its immediate competition), the Pink Triangle makes a definite contribution to analogue turntable design, and is a high class performer in its own right, worth recommendation.

GENERAL DATA

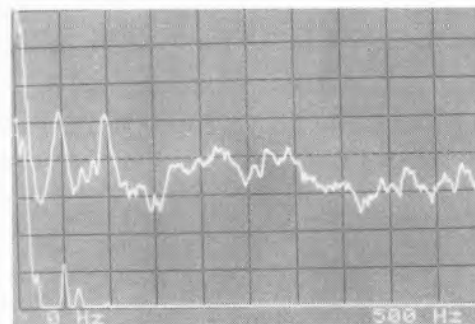
Type	Motor Unit belt drive
Platter mass/damping	1.7 kg/very good
Finish and engineering	very good/very good
Type of mains lead/connecting leads	3 core/—
Speed options	33/45rpm (internally variable)
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	<0.06%/0.07%
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	£300/£360
(depending on choice of platter bearing)	



Disc impulse transmission, magnified X10.



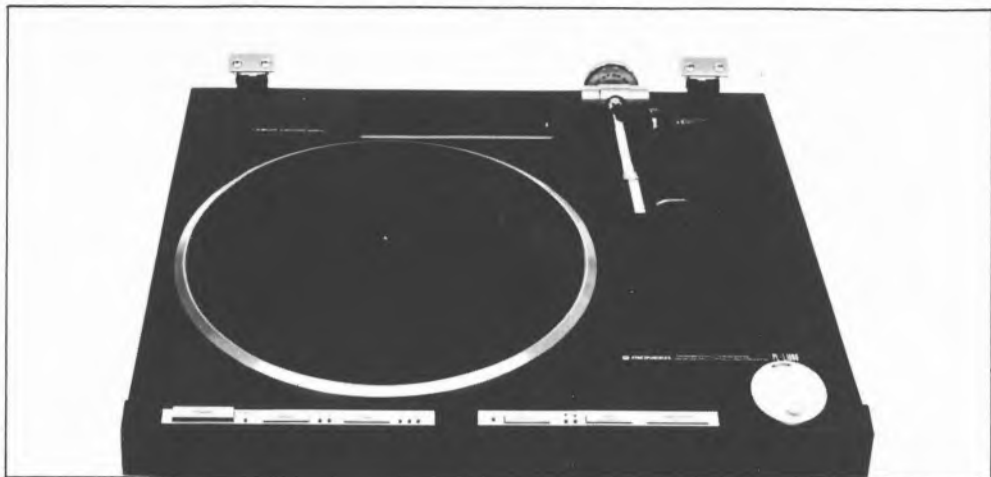
Rumble (0-500Hz lin): above, electrical only; below, total.



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

Pioneer PLL1000 (revised & reprinted)

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



Features, facilities, setting up and use

This exotic creation sported an unusual parallel tracking tonearm, the latter comprising a pair of polished parallel rails with the arm pillar section mounted on precision ball races. Lateral movement was virtually silent and frictionless, the arm powered by a sensitive linear motor. As the arm was 'bi-directional' and controlled by approximately 0.2° of tracking error, it could cope well with disc eccentricities; the majority of other parallel tracking arms are forward error types only, and have a higher tracking error 'dead band' for negative pitch changes.

The arm itself was a fully pivoted design with the usual universal headshell, and although reduced mass was claimed, the 16g measured hardly confirms this, and suggests compatibility with low compliance cartridges. Lead capacitance was higher than expected at 200pF, and also deserves consideration. The arm incorporated automatic start and return functions plus power cueing, while the micro-switch function touch buttons were on the front canted section of the plinth, clear of the lid, with a large rotary control (possessing a fine finger depression) responsible for the power controlled lateral arm shift.

The direct drive motor was Pioneer's own 'hanging rotor' design, with an inverted main bearing (this feature incidentally appearing on many Garrard belt drive decks some five or six years ago). Quartz lock was provided on the motor speed but with no variable control and no need for a

stroboscope. A peculiar, albeit minor fault was present on our sample, whereby the internal arm wiring had a signal inversion on one channel (*ie* it was out of phase). This was identified early on during lab testing and corrected before auditioning, but it was the first time in the testing of several hundred tonearms for *Choice* that such an inversion has been found!

Lab performance

The typical 2.2kg platter mass was well damped by the sensible flat mat, and overall both finish and engineering were excellent. Start up was rapid at 1.2 seconds and entirely free of wow overshoot, while all the following parameters were excellent; wow, flutter, weighted wow and flutter, speed accuracy, speed stability, and last but by no means least, rumble. Averaging 77.5dB DIN, the rumble spectrogram contained two electrical components at 50Hz and 150Hz (the first spike on most graphs being of course the tonearm/cartridge resonance at c.8-10Hz), but in other respects was surprisingly clean.

Geometry and alignment were predictably excellent with vertical and lateral friction almost unmeasurable, and of course no need for bias correction. However downforce calibration was a little high, and while the power cueing essentially worked well, for some reason the switch did not always engage the mechanism. Unfortunately the arm resonances in the audible range proved disappointing, and were rated below average. The

rising energy trend was severely dissected, with a counterweight mode at 80Hz, an arm/headshell mode at 280Hz, and numerous resonances thereafter. That at 1kHz was particularly severe, and no region appeared under complete control.

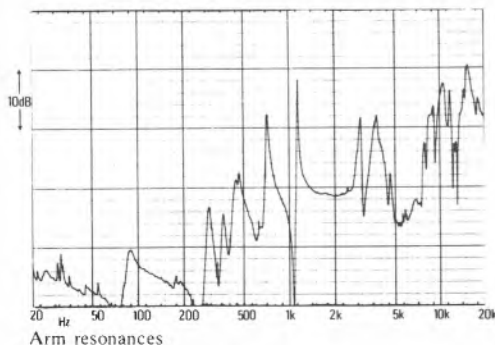
The turntable incorporated a sprung subchassis stiffly suspended at 10Hz, and although this is coincident with the arm resonance, impact shock resistance was quite good and vibration isolation better than average. Acoustic breakthrough was also similarly rated so the system showed good feedback immunity.

Sound quality

Despite the arm resonances which we felt did affect the sound significantly, this deck acquired a 'good' rating. It proved to be a stable tracker (often the case with linear arms), while the motor was subjectively flawless. Lateral stereo information was well presented, and the bass register was reproduced to a good standard, although the arm sound was a little 'broken up' with a slightly coloured and forward quality, accompanied by a treble range exhibiting some emphasis of sibilants and mild spurious treble 'splash' on transients.

Conclusion

The *PL-L1000* was physically quite large, which could be significant if shelf space is limited, and although it was too expensive for a recommendation, it nonetheless had some good points and was pleasant to use. It is however crying out for a better quality low mass tonearm, plus an improvement in the sub-chassis. Nevertheless, it does contain some very fine engineering.



GENERAL DATA

Integrated Player

Motor Section

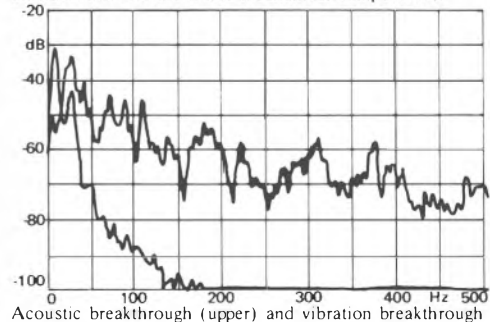
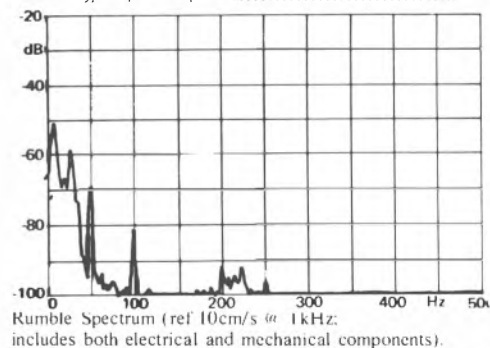
Type	parallel tracking, automatic quartz d/d
Platter mass/damping	2.2kg very good
Finish and engineering	both excellent
Type of main lead/connecting leads	2 core phono, 1 earth
Speed options	33, 45rpm
Wow and flutter (DIN peak w/d sigma 2)	< 0.04%
Wow and flutter (LIN peak w/d 0.2-6Hz/6-300Hz)	0.07% < 0.04%
Absolute speed error	< 0.02%
Speed drift 1 hour load variation	quartz lock < 0.02%
Start up time to audible stabilisation	1.2secs
Rumble (DIN B w/d L/R av (see spectrum))	76-79dB

Arm Section

Approximate effective mass inc screws, excel cartridge	16g
Type/mass of headshell	univocal detachable 11g
Geometric accuracy	excellent
Adjustments provided	height overhang
Finish and engineering	both very good
Ease of assembly/setting up use	very good/excellent
Friction: typical lateral/vertical	< 20mg / 15mg
Bias compensation method	not required
Bias force: mm/centre (set to 1.5g elliptical)	N/A/N/A
Downforce calibration error: 1g, 2g	+0.1g / +0.05g
Cue drift/8mm ascent/descent	negligible/0.8secs / 1.3secs
Arm resonances	below average
Subjective sound quality	average
Lead capacitance damping method	200pF

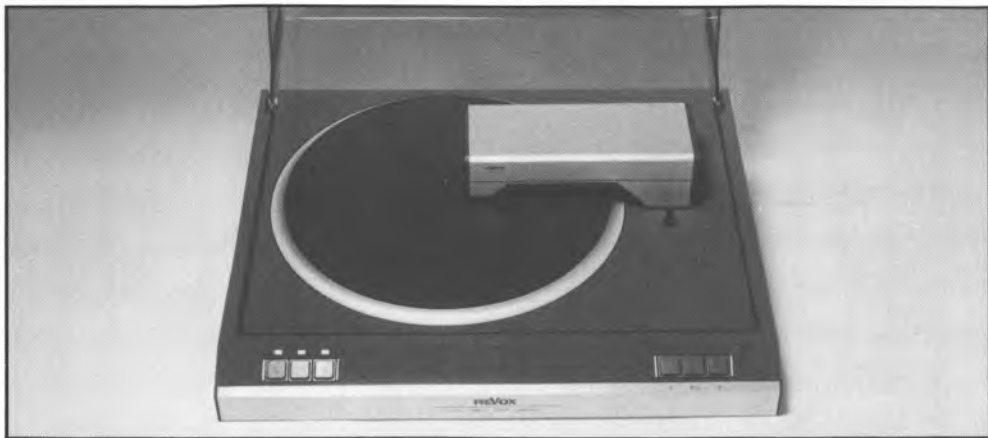
System as a whole

Size (clearance for lid rear)	49.4(w) x 45.6(d) x 15.4(h) 5.5cm
Ease of use	excellent
Typical acoustic breakthrough and resonances	above average
Subjective sound quality of complete system	good
Hum level/acoustic feedback	very good/good
Vibration sensitivity/shock resistance	above average/good
Estimated typical purchase price	£400



Revox B795

FWO Bauch Ltd., 49 Theobald Street, Borehamwood, Herts. WD6 4RZ. Tel 01-953 0091



Features and design

This is the latest Revox turntable, and has almost supplanted their earlier more costly model, offering a very similar performance and only lacking the latter's digital speed readout and fine variable speed facility. A major objective in its design was to achieve a high resistance to shock, and this has been realised. Conversely, the rigidity and resonance characteristics, particularly in the important area of the cartridge support, have been ignored. In consequence the only 'ground' reference for the cartridge is a light 3g skeleton plastic framework. This vestigial arm is mounted within a parallel tracking gantry which is fool-proof in operation and swings over the record for 'play'. A microswitch detects any movement of the gantry, and instantly lifts the cartridge clear of the disc before any damage is done through clumsiness; as the gantry is swung to its rest position, the stylus is automatically cleaned by a brush attached to the deck plate.

A 'Revox' cartridge is fitted, designated *MDR20* and made by AKG. Drawn from the latter's new range, it is a moving magnet type possessing a medium compliance and fitted with an elliptical diamond stylus. Although part of the system, it may with skill be removed, and a variety of alternative cartridges can be fitted using an optional mounting kit. Care must however be taken when removing the stylus not only to avoid straining the arm assembly, but also to avoid the tiny stylus holder flipping over in the fingers and destroying the cantilever (the perils of hi-fi reviewing!)

All the parallel tracking mechanics including its motor are incorporated in the gantry, with the

necessary cables etc, passing through the hollow pivot. The power traverse is essential, and an illuminated view of the cartridge proved ample for accurate visual cueing. An excellent direct drive motor is fitted, offering two speeds to a quartz-locked reference. As the deck plate rests on damped coil-springs, it is isolated from the influence of both plinth and lid. The latter is specially angled, and does not require rear clearance when lifted.

Lab results

The design of this model caused us some laboratory problems, and in particular our usual rumble measurement and spectrogram were impossible. An acetate lacquer whose threshold was around -73dB DIN was used instead of the coupler.

A quite substantial 2.5kg platter was fitted, though the disc damping was only fair due to a minimal contact hard rubber mat, with two concentric rings for support (like the Duals). X1 scaling was required for the impulse response, which showed little damping plus a large and extended initial ring. We understand that Revox are now fitting an improved mat with greater disc contact area, though we have not had the opportunity to evaluate this.

Using the lacquer, the quality of the rumble performance indicated an intrinsic figure of -77dB DIN B weighted or better, and the wow and flutter characteristics of the motor were exemplary, proving free of any overshoot. If they so wished, Revox could make studio machines with this motor. An effective mass of 3g was estimated for the tiny arm, the total figure including cartridge being a little over 7g, therefore

providing a stable high subsonic resonance. The arm worked well physically and offered good trackability.

A resonance graph was taken with the supplied cartridge, and it is thus not directly comparable with the others in the report. However it did not demonstrate a very clean performance, with sharp resonances as low as 110Hz as well as at 240 and 700Hz. Above 100Hz the unit's isolation was pretty good, but deteriorated at low frequencies; by 50Hz it was quite unexceptional for both transmission modes.

Sound quality

Compared with the best in its price class, the Revox offered nearer mainstream than audiophile fidelity. The cartridge is not amongst our favourites, and lent a 'bitty' rather emphasised 'sharpness' to the upper treble. The sound was satisfactory overall but lacked stereo depth, while detail on subtle musical sections was also subdued. The bass spectrum was unexceptional, and in objective terms the unit did not really stand up to the acknowledged quality of other components in the Revox range.

Conclusion

In a severe shock environment this player might appeal to a committed Revox owner, and although we were hopeful after a preliminary look at the B795 in the last issue, the high standards set by others this time round mitigate against it, particularly as a package with the supplied cartridge. With a carefully chosen alternative cartridge, the combination of features and sound quality may well be appealing.

GENERAL DATA

Integrated Turntable

Motor Section

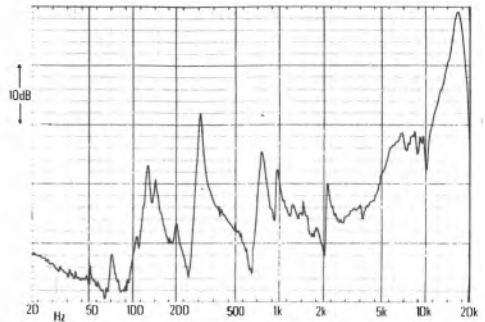
Type..... quartz, direct drive, automatic, parallel tracking
 Platter mass/damping..... 2.5kg/fairly good
 Finish and engineering..... very good/good
 Type of mains lead/connecting leads..... 2 core/phonos + earth
 Speed options..... 33/45rpm non variable
 Wow and flutter (DIN peak wtd sigma 2)..... <0.05%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)..... <0.01%/<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

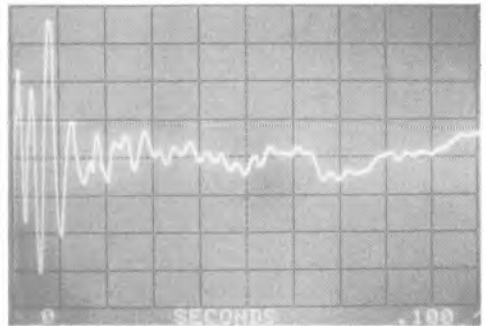
Approximate effective mass inc screws, excl cartridge..... 3.0g
 Type/mass of headshell..... non detachable/N/A
 Geometric accuracy..... very good
 Adjustments provided..... no user adjustment
 Finish and engineering..... very good/fairly good
 Ease of assembly/settling up/use..... excellent/excellent
 Friction: typical lateral/vertical..... N/A / N/A
 Bias compensation method..... non required
 Downforce calibration error: 1g/2g..... preset/preset
 Cue drift/8mm ascent/descent..... negligible/0.5sec/1.5secs
 Lead capacitance/damping method..... N/A/none

System as a whole

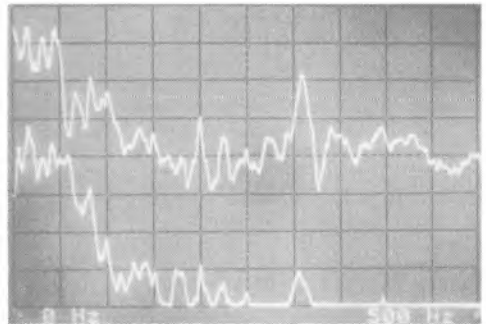
Size/clearance for lid rear..... 45.0(w) x 39.5(d) x 14.5(h)/0cm
 Ease of use..... very good
 Typical acoustic breakthrough and resonances..... above average
 Subjective sound quality of complete system..... fairly good
 Hum level/acoustic feedback..... very good/good
 Vibration sensitivity/shock resistance..... above average/very good
 Estimated typical purchase price..... £340



Arm resonances via PM20DR.



Disc impulse transmission, standard X1.



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

Sansui FRD 35

Sansui UK Ltd., Unit 10A Lyon Industrial Estate, Rockware Avenue, Greenford, Middx. UB6 0AA. Tel 01-575 1133



Features and design

Drawn from early samples of Sansui's new range expressly for the purposes of this review the FRD35 is a comparatively inexpensive turntable. But it is a clear example of a model where mass, rigidity and internal engineering have been sacrificed in favour of technological features, such as a direct drive motor, and convenience factors, such as automatic arm return. How we lament the passing of the elegant, manually operated belt drive SR2221!

The construction is lightweight in all respects, from the 'tinny' 0.8kg alloy platter (although this does carry a beautifully milled outer rim), to the moulded plastic plinth and its light, coupled, and acoustically resonant polystyrene tinted cover. Sansui believe that this is what the mass market wants and they may well be right. But the end result has little to do with the advancement of audio reproduction standards.

A universal detachable headshell is fitted, resulting in an overall effective mass of 16g and suited to low compliance cartridges in the 8-14cu range. Little attention has been paid to feedback suppression or vibration and acoustic isolation, and the feet resonances are too high, intersecting the cartridge resonance range and impairing tracking stability.

Lab results

A major disappointment was the discovery that compared with their better earlier direct drive motors, Sansui have chosen to fit an inferior type to the FRD35, which exhibits that old bugbear, dynamic wow, produced by an overshooting first-order servo system. Fine on a low level continuous test signal, it was estimated that up

to $\pm 0.2\%$ of peak wow was generated on loud modulated passages. Steady state wow read 0.07% DIN peak weighted, while linear weighted flutter was satisfactory at 0.13%. Start up, despite the light platter, took 2.7 seconds, this lengthened by the overshoot recovery, and although weighted rumble was satisfactory at an average of -72.5dB , spectrum analysis revealed a mains harmonic at 200Hz, -70dB , plus spurious motor noise components.

The acoustic isolation was one of the poorest in the group, and undoubtedly resulted from the frail construction as well as the resonant lid. The 180Hz figure shown was the worst of the lot, and was some 40dB poorer than the level attained by the best turntables. Vibration isolation was also poor at around 200Hz, while below 130Hz the result was really inadequate for hi-fi use. Off scale on X10, the X1 expanded disc impulse characteristic was not too bad, showing that the sensibly flat rubber mat at least provided some disc support.

Turning to the tonearm, geometry and bearing friction were satisfactory, although play was perhaps inevitably present in the arm bearings. Bias compensation was excessive by a factor of nearly two at the rim, and appeared in the wrong ratio, though the downforce calibration was spot on. Audio range resonances in the arm showed that it possesses little rigidity, with a counterweight mode at 35Hz followed by headshell flexure at 80Hz, while damping was reasonable at higher frequencies.

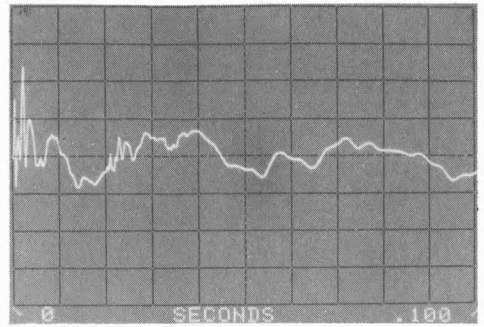
Sound quality

Exhibiting a just detectable level of pitch imprecision on loud transients (dynamic wow), the

FRD35 did not demonstrate a good standard of reproduction. Stereo imaging was diffuse, with a boomy and soft bass, muddled midrange, and an occasionally 'aggressive' treble. Ambience and depth effects were muted, and the unit showed feedback tendencies at only medium to high volume settings.

Conclusion

This turntable cannot be recommended, and is no substitute for the now discontinued SR222 II. Perhaps Sansui could follow Thorens example with the TD 160 series, by bringing back the '222, even if this does mean raising its original price somewhat?



Disc impulse transmission, standard X1.

GENERAL DATA

Integrated Turntable

Motor Section

Type..... direct drive, auto return
 Platter mass/damping 0.8kg/fairly good
 Finish and engineering good/fairly good
 Type of mains lead/connecting leads.... 2 core/phonos + earth
 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) ... 0.13%/0.08%
 Absolute speed error <0.1%
 Speed drift 1 hour/load variation 0.2%/–0.25%
 Start up time to audible stabilisation approx 2.7secs
 Rumble: DIN B wtd L/R av (see spectrum) –72/–73dB

Arm Section

Approximate effective mass inc screws, excl cartridge..... 16g
 Type/mass of headshell universal detachable/7g
 Geometric accuracy good
 Adjustments provided..... overhang, lateral angle
 Finish and engineering good/fairly good
 Ease of assembly/setting up/use good/good/very good
 Friction: typical lateral/vertical..... 50mg/50mg
 Bias compensation method sliding weighted lever
 Bias force: rim/centre (set to 1.5g elliptical) 300mg/200mg
 Downforce calibration error: 1g/2g 0.0g/0.0g
 Cue drift/8mm ascent/descent

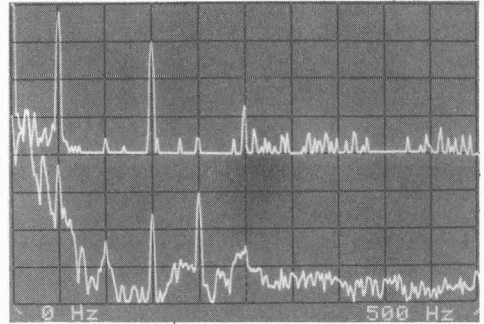
negligible/lever controlled/1.5secs

Arm resonances fairly good

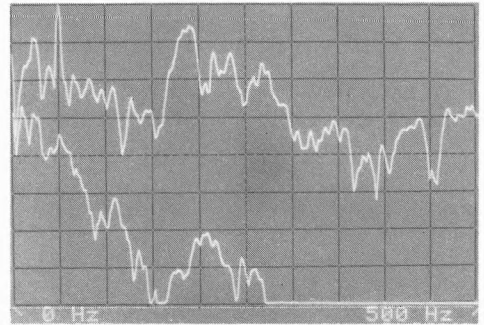
Lead capacitance/damping method
 80pF/some counterweight decoupling

System as a whole

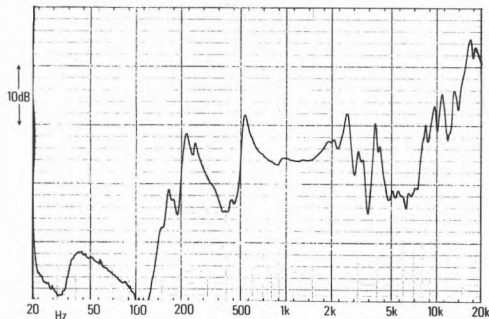
Size/clearance for lid rear 44.0(w) x 37.0(d) x 20.0(h)/5cm
 Ease of use very good
 Typical acoustic breakthrough and resonances..... poor
 Subjective sound quality of complete system poor
 Hum level/acoustic feedback good/poor
 Vibration sensitivity/shock resistance..... poor/good
 Estimated typical purchase price £85



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



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



Structural arm resonances, audio band.

Sansui FRD 55

Sansui UK Ltd., Unit 10A Lyon Industrial Estate, Rockware Avenue, Greenford, Middx. UB6 0AA. Tel 01-575 1133



Features and design

Based on the *FRD45*, the '55 also employs a microprocessor to organise a range of clever facilities. In the case of the '45, an optical sensor detects record size and programmes the automatic play. The 55 possesses an additional sensor head fitted to the tonearm for this and for track selection. The computer allows pre-selection of any track(s) in any order up to a maximum of seven, programmed *via* push buttons on the angled front section of the plinth.

Amazingly the press handout suggests a minimum tracking force of 0.5g for the '45 and '55 tonearms (even the humbler *FRD35* has a claimed 1g minimum). Any cartridge suited to these decks should not in fact attempt to track at less than 1.7 to 2.0g. My recommendation for the '55 is 1.5g, with a cartridge compliance in the 10–18cu range. Both '35 and '55 are in fact supplied with a modest Sansui 'starter' cartridge designated the *SC50*.

Costing around £180, one would expect something reasonably substantial, but this is not the case with the 55. The platter mass at 1kg includes the sensible mat, but is barely heavier than that of the '35; likewise the plinth and lid structures are only marginally deader acoustically.

The '55 has direct drive, apparently using a 20 pole, 30 slot Sansui brushless design. The same servo fault detected on the '35 is also present here. Sansui claim a 72dB signal-to-noise ratio, with which we agreed, but these days much better figures are commonplace at this price level; one cannot help suspecting in this instance that the price reflects the inclusion of clever, but not necessarily essential automatics.

Lab report

The measured data was similar to that recorded for the '35, with wow overshoot effects marginally worse, probably due to the heavier platter producing more error. Rumble spectrum analysis again demonstrated spurious components, plus mains-related hum harmonics at 300, 200 and 100Hz.

The effective mass for this fixed head arm was moderate at 13.5g; a small bracket retained by a screw can be detached to mount the cartridge. The front optical sensor, which is fixed on a little boom section ahead of the cartridge, was suspected of introducing a resonance, and some bearing play was also evident, but friction was low. Bias was excessively high (double the required amount at both rim and centre), while the downforce calibration was 10% low. The arm resonance characteristic was unpromising, despite a special anti-resonance feature claimed for the design, showing a 30Hz counterweight mode and a 20dB energy jump between 100 and 250Hz, the intermediate region defined by a 'noisy' flexure believed to be the sensor. The 1–5kHz band was also below average.

For the disc impulse test, an optimistic X10 scaling was tried, showing clearly the large amount of spurious ringing after the cessation of the initial disc impulse; this is not a good result. Some improvement over the '35 can be seen in the acoustic and vibration isolation graphs, but nonetheless both are rated below average.

Sound quality

On a comparative basis the '55 did sound a little better than the '35, but in fact this is not saying

much. The general feeling was that the performance was not up to the level required at this price, even taking into account the auto programme facilities, the sound being more or less music centre standard. A good cassette deck would probably compare well with this, and might even be superior. Care must also be taken in siting to avoid feedback.

Conclusion

At present Sansui seem to have lost their way in the audio jungle as far as good sound from turntables is concerned, and are attempting to offer decorative features instead. Unless these are of overriding value to the user, the FRD55 cannot be recommended to the audio minded purchaser.

GENERAL DATA

Integrated Turntable

Motor Section

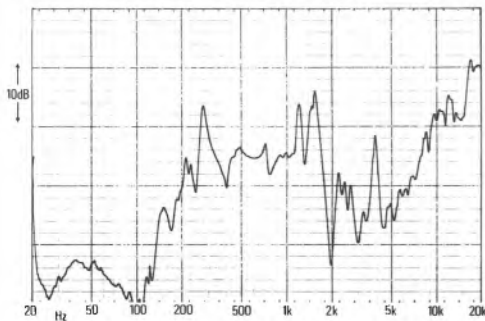
Type direct drive, fully auto, computer programmable
 Platter mass/damping 1.0kg/good
 Finish and engineering good/good
 Type of mains lead/connecting leads 2 core/phonos + earth
 Speed options variable 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) 0.075%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) 0.15%/0.08%
 Absolute speed error <0.1%
 Speed drift 1 hour/load variation 0.25%/-0.3%
 Start up time to audible stabilisation approx 2.8secs
 Rumble: DIN B wtd L/R av (see spectrum) 73/71dB

Arm Section

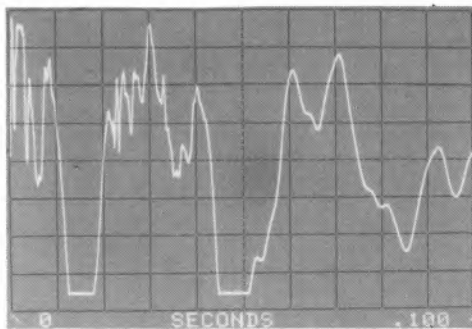
Approximate effective mass inc screws, excl cartridge 13.5g
 Type/mass of headshell fixed/N/A
 Geometric accuracy good
 Adjustments provided overhang, lateral angle
 Finish and engineering good/good
 Ease of assembly/setting up/use very good/good/very good
 Friction: typical lateral/vertical 30mg/30mg
 Bias compensation method weighted lever
 Bias force: rim/centre (set to 1.5g elliptical) 300mg/350mg
 Downforce calibration error 1g/2g -0.1g/-0.2g
 Cue drift/8mm ascent/descent negligible/0.5sec/1.0sec
 Arm resonances below average
 Lead capacitance/damping method 80pF/some counterweight decoupling

System as a whole

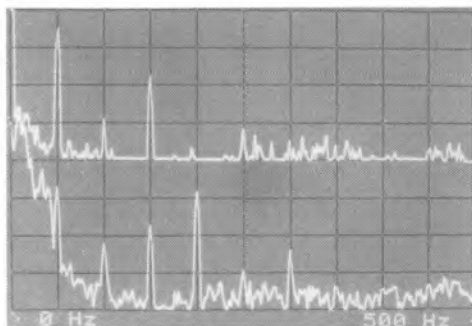
Size/clearance for lid rear 44.0(w) x 37.5(d) x 12.5(h)/3.5cm
 Ease of use good
 Typical acoustic breakthrough and resonances average
 Subjective sound quality of complete system below average
 Hum level/acoustic feedback good/poor
 Vibration sensitivity/shock resistance fair/fairly good
 Cartridge included Sansui SC50
 Estimated typical purchase price £180



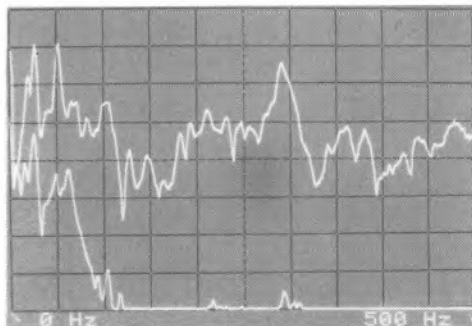
Structural arm resonances, audio band.



Disc impulse transmission, magnified X10.



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



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

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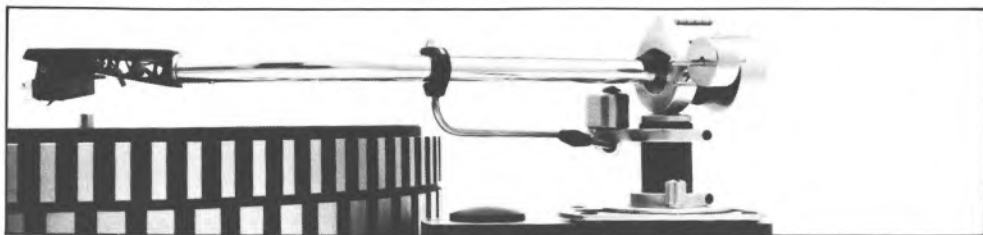
442-444 Cranbrook Road, Gants Hill, Essex IG2 6LL
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ENFIELD 01-363 7981

191 Chase Side, Enfield, Middlesex EN2 0QZ
Monday to Saturday 10.00-18.00

SME 3009 II (revised & reprinted)

SME, SME Ltd., Steyning, Sussex,
BN4 3GY. 0903 814321



Features facilities setting up and use

The review of the SME *II* in the last issue was completed before the introduction of the *FD200* damper unit. This addition, plus a recent SME recommendation to use a quantity of mastic packing between cartridge body and headshell, together made a retest worthwhile. The more revealing measurement and auditioning techniques employed in this edition have resulted in greater discrimination between the fixed and detachable headshell versions, and also examined the effects of damping; the last issue recommended the model as a whole, albeit with some reservations concerning sound quality.

Engineering and finish were exemplary on this model, although some oddities were present, notably the excessive biasing and damping. This design uses a precision ball race for horizontal movement, with knife edges used in the vertical plane. The design was engineered for low mass, especially in the case of the non-detachable version. Full height, overhang and tilt facilities were present, and comprehensive instructions were provided.

Lab performance

Friction was excellent and downforce calibration accurate, with cueing satisfactory on drift and exhibiting sensible rates. The bias compensation introduced negligible extra friction thanks to the pulley, although the values were nearly double that required, and while the damping if arranged as instructed proved excessive, almost any degree could be attained by diluting the fluid, (special accessory) or using the different paddle sizes. Effective mass was low at 6g for the fixed shell and medium (9g) for the detachable — the latter still a pretty low result. The arm resonances were notably different for the two models, with the non-detachable showing a superior result up to 3 or 4kHz, having better 'Q' control, together with a more evenly distributed high frequency range.

Sound quality

In the context of this report, both the Mark II fixed and detachable arms were rated as only 'average'. The general characterisations included the presence of a brashness, a lack of bass definition, with impaired stereo image depth and precision plus a slightly 'loud' quality. However, the non-detachable version was definitely superior to the detachable, especially using the cartridge fixing mastic. The *FD200* damper provided a significant improvement, the stereo image now better stabilised, with more bass depth and precision apparent, this final combination being 'classed as 'good'.

Conclusion

Of the *3009 II* versions tried, on grounds of engineering and sound quality, low effective mass and optional versatile damping, the non-detachable version would appear to offer the best value and be worth considering, though the cost of the damper takes the total price close to the *IIIS*.

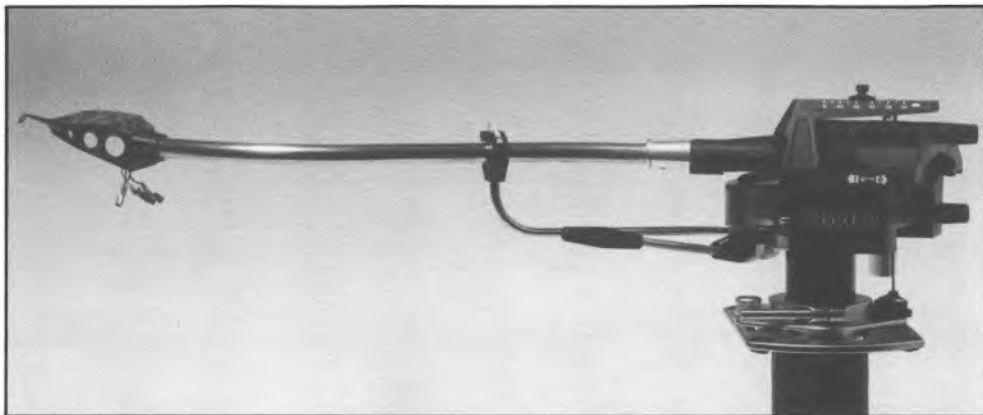
GENERAL DATA

Approximate effective moving mass (excl cart, inc screws)	9g (D)/6g (ND)	Tonearm
Type of headshell	Universal detachable (or ND)	
Headshell mass (inc screws)	6g	
Geometric accuracy	very good	
Facilities for adjustment	tilt, height, overhang	
Finish and engineering	excellent	
Ease of assembly/setting up	good	
Ease of use	very good	
Friction lateral/vertical (typical)	< 10mg/<10mg	
Bias comp: type/force rim/centre (1.5g ell set)	280mg/300mg	
Cueing: drift/8mm ascent/8mm descent	satisfactory/1sec/4secs	
Downforce calibration error 1g/2g	-0.075g/0g	
Amount of damping	none/variable (FD200)	
Arm resonances	see text	
Subjective sound quality	good (ND & FD200)/satisfactory (D)	
Motor recommended	TD160 etc	
Estimated typical purchase price	£75 (damper £20)	

RECOMMENDED

SME 3009 Series 111(S) (re-assessed)

SME Ltd., Steyning, Sussex BN4 3GY. Tel (0903) 814321



Features and design

This review covers the two models in the SME Series 111 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.

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 as recommended, stereo image stability suffered

due to excess forces being applied to the stylus on mild low frequency record warps in the 0.5 to 4Hz range; minimum damping thinned by 30% of diluent stabilised the most severe resonance combinations successfully. In fact many cartridges worked well without damping.

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

Sound quality

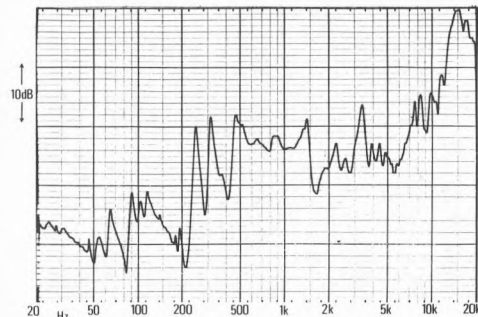
This arm was characterised by a 'soft' balance, with a subjectively subdued treble. Coloration was comparatively low and the overall sound pleasantly relaxed. Stereo imaging was to a good standard and the bass register reasonably detailed and extended. Low compliance moving-coils gave quite good results 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.

Conclusion

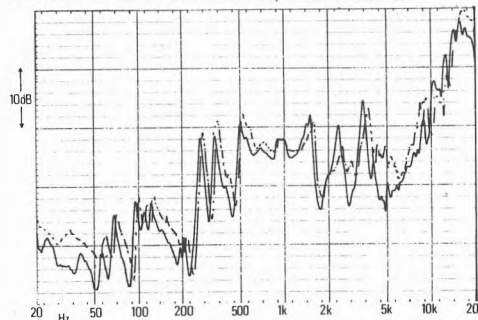
Despite the higher effective mass option, this finely made and exceedingly versatile arm is not really suited to top moving-coil cartridges possessing lowish compliances. However, it remains one of the best low mass tonearms at its price, and may be aligned to a high state of precision; the optional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

GENERAL DATA

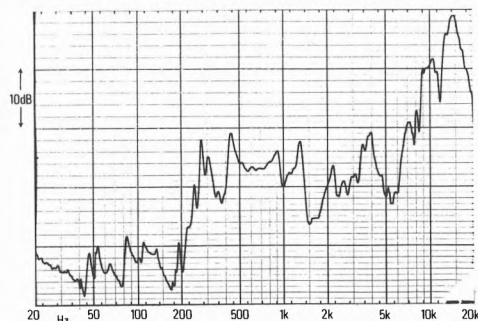
Approximate effective mass inc screws, excl cartridge	5.0g	Tonearm
Type/mass of headshell	plug in arm tube/N/A	
Geometric accuracy	..... excellent	
Adjustments provided	..... overhang, tilt, arm height	
Finish and engineering	..... excellent/very good	
Ease of assembly/setting up/use	..... good/good/very 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 (not 'S')	
Estimated typical purchase price	..... £120 (£90 'S')	



Structural arm resonances, audio band.



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



Arm resonances with headshell mass loading.

Sony PSX 600

Sony UK Ltd., Consumer Showroom, 134 Regent Street, London W1. Tel 01-439 3874



Features and design

The only new model available in time for this issue, the *PSX600* can be regarded as a downmarket version of the unusually elaborate and costly *PSB80*, which we examined in the last edition. This was the first model to incorporate the much publicised '*Biotracer*' electronically controlled tonearm, and the new '600' incorporates a version of this arm design, though in this case the player costs less than £200.

Sony have demonstrated occasional intermittent strength in turntable design, and the new *PSX600* has quite a lot going for it. The *Biotracer* facilitates automatic operation, including record size detection via a fixed optical turret, and power traverse is provided and controlled by DC force motors built into the arm and under servo-control. These also apply downforce and biasing, and a measure of electronic damping of the arm/cartridge subsonic resonance is automatically provided.

A substantial plinth is fitted with viscous core vibration-absorbing feet, though the lid is a shade resonant, and as usual is joined directly to the plinth, which is no help so far as acoustic isolation is concerned. A Sony quartz-locked direct drive motor is fitted, possessing sufficient torque for instant start cueing; speeds are fixed at 33 and 45rpm.

The 1.6kg platter is equipped with a sensibly flat rubber mat, and by employing a special Sony detachable headshell of reduced weight, a total effective mass of 11g has been achieved. This is nominally suitable for medium compliance

cartridges of 12–25cu, but the inbuilt damping permits a more extended 10–35cu range.

As measured, however, the damping level was high, which resulted in a visible and hence significant stylus deflection of medium compliance cartridges when tracking a 'swinger' or similar warp. Theoretically this could impair the stereo image stability, due to the exaggerated low frequency modulation of the mean cartridge generator geometry (the absence of damping for a serious arm/cartridge resonance naturally results in a similar modulation). As with all engineering problems in audio, the answer lies in an optimum balance rather than an extreme solution to a particular problem.

Lab results

While Sony claim –78dB DIN rumble, our measurement could not better –74dB. We did not suspect that the excellent motor was at fault, but rather that noise generated in the arm servo electronics was responsible, as a similar effect had been recorded earlier with the *PSB80*. Nonetheless the rumble spectrogram illustrated was more than satisfactory, and turned out to be that of the arm alone; surprisingly the graph taken with the platter rotating was no different! State of the art speed accuracy was demonstrated, with excellent wow and flutter results and a rapid 0.8 second start up; no dynamic wow effects were present.

The arm was generally well engineered and showed good alignment, but bearing play was nonetheless present. It was difficult to measure because of the inbuilt electronics, but bearing friction was low, the bias compensator quite accurate, and the downforce calibration particularly so.

When running the audio response curve, the subsonic resonance of our test cartridge showed a well-controlled response, the peak reduced to +4.5dB, 12.5Hz (from +9.5dB, 11 Hz undamped). A reduction to +6dB would have been sufficient, but the supplied degree of damping did endow the turntable with exceptional impact shock resistance. Possessing a fairly even trend, the resonance curve above 20Hz was dissected by flexural modes from a low 120Hz upwards. X10 scaling was just possible for the disc impulse, showing good mid and treble damping, but also platter rocking at 30Hz. Acoustic breakthrough was also quite good and the vibration resistance better than expected.

Sound quality

The sound quality was appropriate for the type and price, demonstrating good low frequency

feedback immunity, though the bass was 'light' in character with 'softened' definition. In tonal balance the treble range was 'dulled', and some loss of image depth was also noted in the midrange, but overall the stereo performance was quite respectable.

Conclusion

Easily bettered in sound quality by a manually operated 'audiophile' unit, the PSX600 nonetheless has certain features which on balance qualify it for a reserved recommendation. It is a fairly neutral sounding, well made product with exceptional shock resistance, which could prove important to some purchasers. In addition it 'handles' well, with excellent automatics giving quiet and smooth operation.

GENERAL DATA

Integrated Turntable

Motor Section

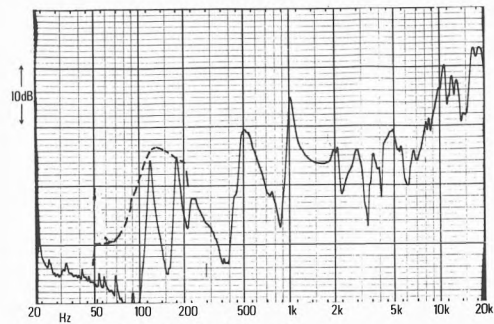
Type quartz, direct drive, fully automatic
 Platter mass/damping 1.6kg/good
 Finish and engineering very good/very good
 Type of mains lead/connecting leads 2 core/phonos + earth
 Speed options 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) <0.05%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) <0.1%/<0.06%
 Absolute speed error <0.01%
 Speed drift 1 hour/load variation <0.01%/<0.01%
 Start up time to audible stabilisation approx 0.8sec
 Rumble: DIN B wtd L/R av (see spectrum) -73/74dB

Arm Section

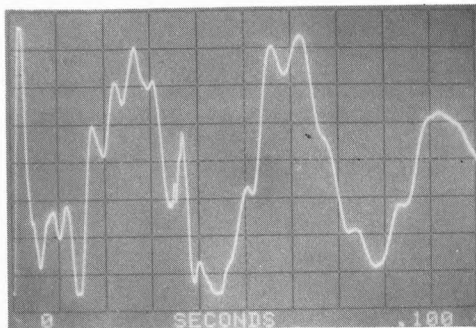
Approximate effective mass incl screws, excl cartridge 11g
 Type/mass of headshell incl screws special detachable/6g
 Geometric accuracy very good (see text)
 Adjustments provided overhang, lateral angle
 Finish and engineering very good/good
 Ease of assembly/setting up/use very good/very good/very good
 Friction: typical lateral/vertical less than 20mg/less than 20mg
 Bias compensation method electronic
 Bias force: rim/centre (set to 1.5g elliptical) 160mg/190mg
 Downforce calibration error 1g/2g +0.04g/±0.00g
 Cue drift/8mm ascent/descent negligible/0.5sec/0.5sec
 Arm resonances fairly good
 Subjective sound quality above average
 Lead capacitance/damping method 100pF/electronic servo damping

System as a whole

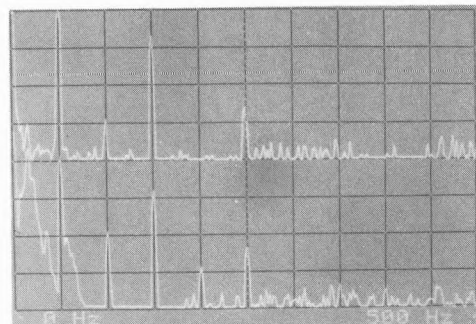
Size/clearance for lid rear 43.0(w) x 37.5(d) x 12.5(h)/4.5cm
 Ease of use very good
 Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system above average
 Hum level/acoustic feedback good/good
 Vibration sensitivity/shock resistance fairly good/exceptionally good
 Estimated typical purchase price £160



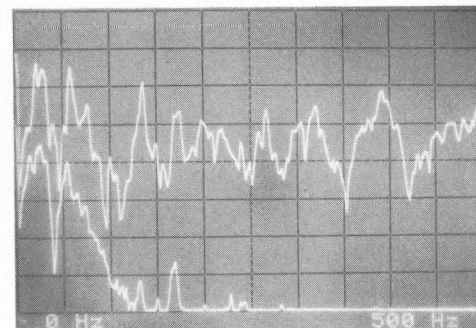
Arm resonances and damping.



Disc impulse transmission, magnified X10.



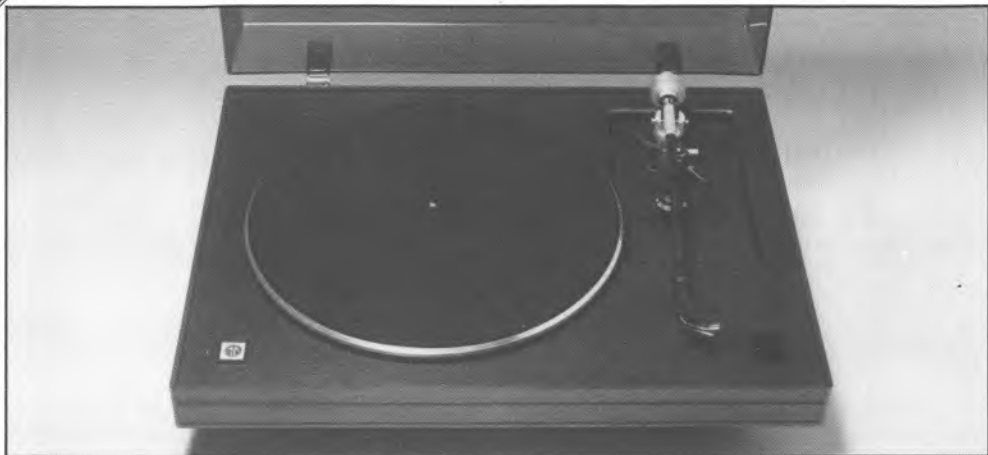
'Rumble' (0-500Hz lin): above, electrical alone; below, electrical plus arm (see text).



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

STD 305S(M)

Stratclyde 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

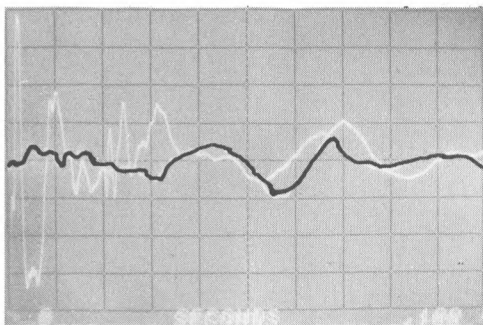
In its price class the S was undoubtedly capable of a high sound quality. The benefits of negligible motor imperfections, good resistance to feedback, and the isolated nature of the disc platform were reflected in the precision of the stereo staging, good detail and depth rendition, an extended and fairly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

Conclusion

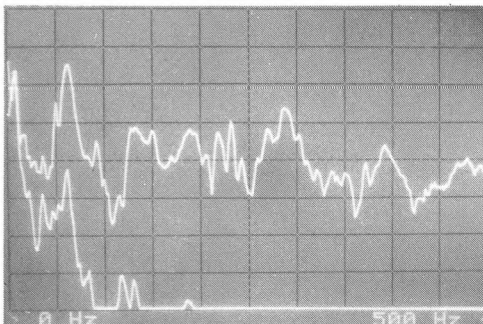
While the M remains worth considering, the S can be confidently recommended as providing good value for money. The shock resistance achieved by some foam damping in the springs, is a little better than for other competing sub-chassis models, and this might be a particular factor in its favour under certain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

GENERAL DATA

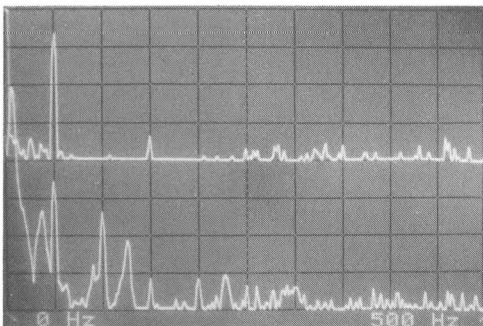
Type	Motor Unit
Platter mass/damping	bell drive
Finish and engineering	2kg/good
Type of mains lead/connecting leads	good/good
Speed options	2 core/-
Wow and flutter (DIN peak wtd sigma 2)	33/45rpm
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.07%
Absolute speed error	0.11% < 0.06%
Speed drift 1 hour/load variation	+0.25%
Start up time to audible stabilisation	-0.35%
Rumble: DIN B wtd L/R av (see spectrum)	synchronous
Size/clearance for lid rear	3.5secs
Ease of use	-75/-76dB
Typical acoustic breakthrough and resonances	47.5(w) x 36.5(d) x 15.5(h)/5.5cm
Subjective sound quality of complete system	fairly good
Hum level/acoustic feedback	very good
Vibration sensitivity/shock resistance	very good/very good
Estimated typical purchase price	very good/fairly good
	£170



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

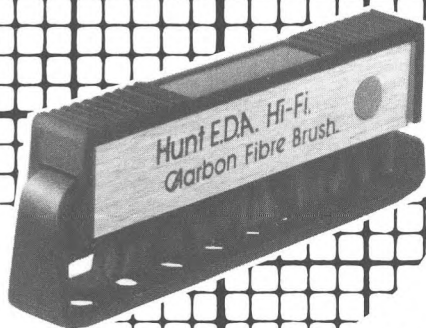


Rumble (0-500Hz lin): above, electrical only; below, total.



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

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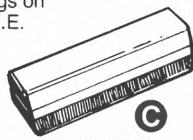
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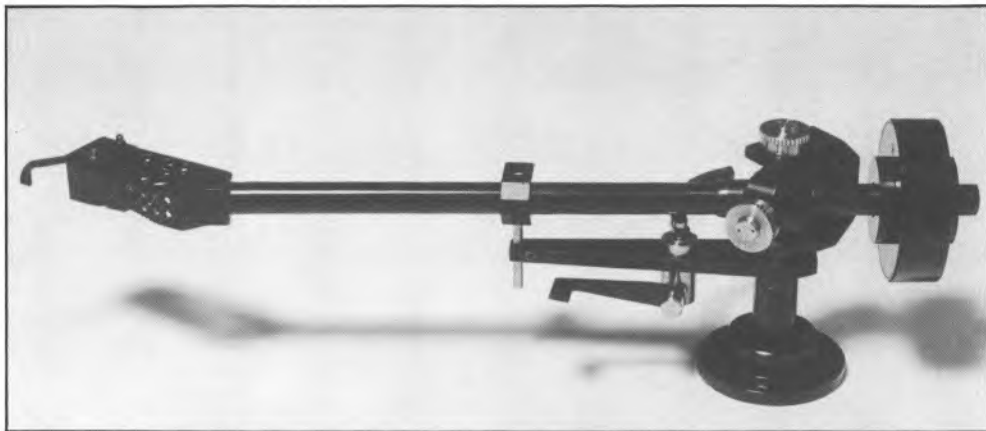
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Features and design

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 loose lead shot filling for energy absorption. The *Ittok* controls are calibrated *a la* Japanese, but not so the Sumiko (*a la* Breuer), which also demonstrated a rather low level of bias correction, the designer's philosophy 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 too 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.

Sound quality

This tonearm offered a uniquely relaxed sound

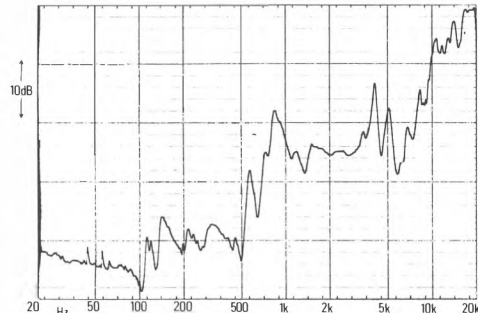
with very low coloration, and a tonal balance distinguished by a degree of smoothness and integration that we have rarely encountered. If anything the balance tended to 'richness' with an apparently subdued treble register, and as such the more lively and 'forward' cartridges suited it well: in particular the *Koetsu*, and I suspect the *Supex SDX 1000*. By contrast the *Asak* demonstrated an almost 'withdrawn' effect in the upper midrange. The stereo image showed great detail, ambience and depth, and secure tracking was apparent with all the cartridges we tried. Perhaps we are being hypercritical, but a slight loss of transient sharpness was noted in the bass, plus the mildest 'defocusing' in areas of the midrange.

Conclusion

The lack of proper calibration was a significant nuisance, and I feel that more should be done for the user in this respect. As supplied and considering the elevated price, it is not possible to offer the *Sumiko* a value for money endorsement. Having said that, it must be admitted that it achieves an exceptional standard of sound quality and is suited to some of the world's finest cartridges. For example, there is no doubt that a *Sumiko*, *Oracle*, and *Koetsu* system is entirely viable soundwise, all from the same UK supplier, but at a combined cost of around £2000!

GENERAL DATA

Approximate effective mass inc screws, excl cartridge	..... 13g	Tonearm
Type/mass of headshell	..... fixed/N/A	
Geometric accuracy	..... excellent	
Adjustments provided	..... overhang, lateral angle, height	
Finish and engineering	..... very good/very good	
Ease of assembly/setting up/use	..... very good/fair/good	
Friction: typical lateral/vertical	..... less than 20mg/less than 20mg	
Bias compensation method	..... coil spring	
Bias force: rim/centre (set to 1.5g elliptical)	..... 180mg/210mg*	
Downforce calibration error: 1g/2g	..... N/A/ N/A	
Cue drift/8mm ascent/descent	..... negligible/0.5sec/4.5secs	
Arm resonances	..... very good	
Subjective sound quality	..... very good	
Lead capacitance/damping method	..... 85pF/absorbent counterweight	
Estimated typical purchase price £750	
*after re-setting		



Structural arm resonances, audio band.

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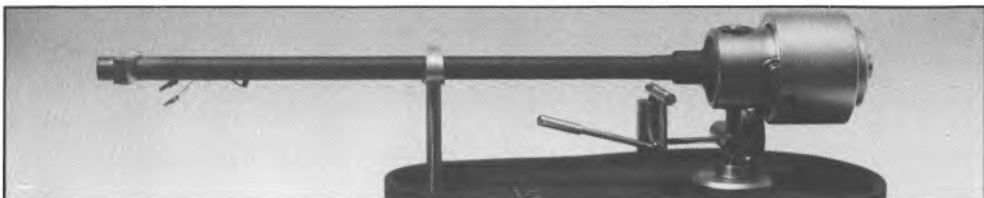
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Features and design

An unusual arm, the *PU2* was designed by an engineer who made no allowances for either fashion or precedent. Our version came built on a *Systemdek* board for easy installation, but it is also available to suit a *Sondek*, and an SME-compatible base plate can now be purchased which will provide almost universal fitting.

The main aluminium tube has been designed to provide great strength, and is terminated by a stepped taper to the massive gimbal bearing. The designer has however managed to keep the effective mass at a low 9g through the use of a small sliding and rotating block against which the cartridge is firmly bolted and clamped. This does not provide the maximum contact area for the back of the cartridge, and could damage some models, since a small area of the main beam itself is clamped against the cartridge under tension, to give good mechanical coupling. The generous ball races are perhaps the largest fitted to any current tonearm, and are stress relieved on one side of each plane by the use of resilient brushes, to improve bearing stability.

The counterweight is adjustable on a threaded steel rod in a direct line from the front of the arm, and is uncalibrated; once set using an accessory balance, it is locked in position via a socket head screw. No decoupling is provided, which is a deliberate move in order to control the energy flow paths in the arm and reference the high counterweight mass to the main tube, thus reducing the transmission down the pillar. Partly to achieve this end, as well as to generate an asymmetric effective mass in the vertical and lateral planes, an accessory 'mass ring' is available, which fixes on the headshell gimball. A ball race is used for the bias compensator as well; this is also uncalibrated, and possesses an excessive adjustment range.

As noted by the designer, the arm is quite unbalanced dynamically and is thus unduly sensitive to true level as well as to low frequency shock; in fact to produce zero bias it needed to be a touch out of level, and it proved even more sensitive to disturbance with the mass ring fitted. In the main the geometry is very good, but a

weakness is that the stylus tip appears well below the vertical bearing axis, so during play stylus drag develops a significant modulation-dependant upwards force, which offsets the downforce required for secure tracking. Tests have shown that this effect, together with the dynamic balance characteristic, mean that cartridges require 15–20% more downforce to attain their normal tracking margins in the *PU2*, especially if the mass ring is used.

Lab results

An attempt was made to calibrate the bias compensator, which gave a 1.5g downforce equivalent fully screwed up, a 2g equivalent with the weights centred on the threaded shaft, and a 4g equivalent when fully extended. The bias results were in the wrong ratio across the disc, those tabulated being for the median position.

Friction was satisfactorily low at 20mg or less in both planes, with no detectable play. And apart from the relatively awkward setting up procedure, everything worked well once installed. At 9g without the ring, the arm was suited to cartridges in the 12–30cu range, and in particular to the *Karats* with their tolerant tracking margins. Using the ring, models down to 6cu were nominally compatible.

From the graphs the subsonic resonances may be seen for the two conditions, the mass ring providing a separate lateral resonance at f_1 , 9Hz, as distinct from the normal mode at 12Hz. Differences were also apparent in the audio range resonance characteristics. In my view, a preferable result was obtained without the ring, which served to increase the severity of the resonance peaks from 50Hz right up to 2kHz. The main flexural mode lies at 550Hz, so the arm clearly possesses high rigidity.

Sound quality

The Syrinx is known to work well on the Linn and we also found it gave fine subjective results with the *Systemdek*. In terms of absolute quality the *Ittok* is its nearest rival, but the *PU2*'s tonal balance is less 'characterful', implying lower coloration levels. The treble was less prominent,

and the midrange flexure was better disguised. The bass was powerful and deep and the stereo had good detail and depth, conversely tracking was not as secure as usual, and there was a slight loss of stereo precision in terms of 'focus' in the centre stage. With the ring the bass sounded less transparent, and the mid/treble ranges were not as well integrated.

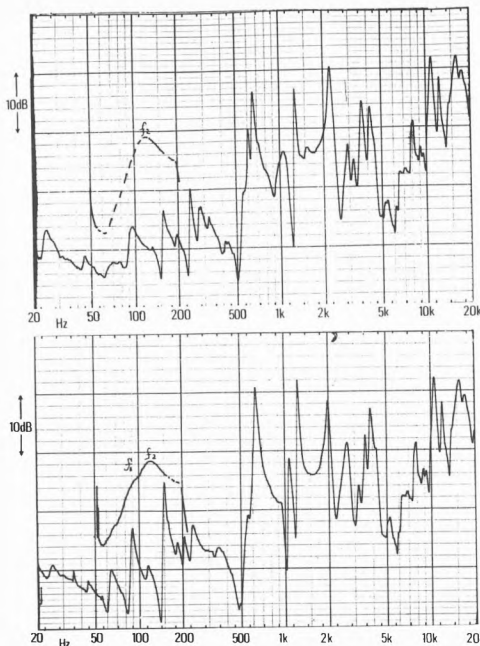
Conclusion

As regards sound quality versus price the *PU2* is competitive, but considering the £200 odd asking price, we were not sufficiently happy to give an unqualified recommendation. Details of finish and set up must be held against it, and while the integrated arm board is a help for the right turntables, the *PU2*'s overall lack of calibration implies that it is best suited to the enthusiast.

GENERAL DATA

Approximate effective mass inc screws, excl cartridge	..... 9g	Tonearm
Type/mass of headshell	..... fixed headshell, detachable block/N/A	
Geometric accuracy	..... very good	
Adjustments provided	..... overhang, height, tilt	
Finish and engineering	..... good/good	
Ease of assembly/setting up/use	..... fair only/good	
Friction: typical lateral/vertical	..... approx 20mg/approx 20mg	
Bias compensation method	..... thread and weighted lever	
Bias force: rim/centre (set to 1.5g elliptical)	..... 250mg/200mg*	
Downforce calibration error: 1g/2g	..... N/A/ N/A	
Cue drift/8mm ascent/descent	..... slight/0.5 sec/2.0secs	
Arm resonances	..... good (see text)/very good (see text)	
Subjective sound quality	..... potentially very good	
Lead capacitance/damping method	.....

Estimated typical purchase price..... £190
 *uncalibrated, medium setting



Audio band arm resonances 'with'/'without' mass ring, showing subsonic resonance (X decade).

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

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

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

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

All the turntables are fully automatic and fitted with protection devices, for example to cue up the arm instantly when the lid is moved or lifted. Small slots in the mat/platter allow the lid-mounted LED lamps to activate sensors underneath, detecting record size and setting speed/cueing position. Manual override is however

possible, for example for a 45rpm 12 inch disc, and a repeat play function is also provided.

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

The cartridges

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

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

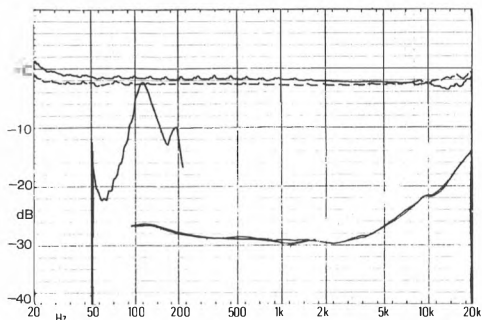
All the cartridge masses are identical, and hence are interchangeable without any necessary readjustment. In addition Ortofon have now built a compatible version of one of their own *30* series, though appropriate electrical loading should be applied here to give the best results.

Lab results

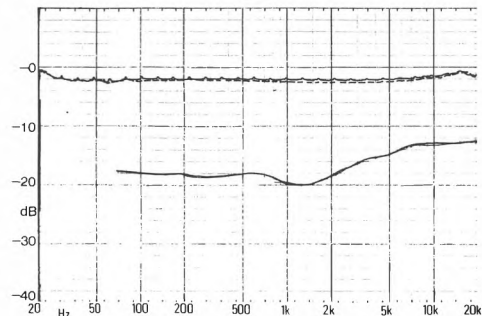
Not every unit in the range has been tested, but key models have been evaluated which are generally representative of the group as a whole.

SLDL1

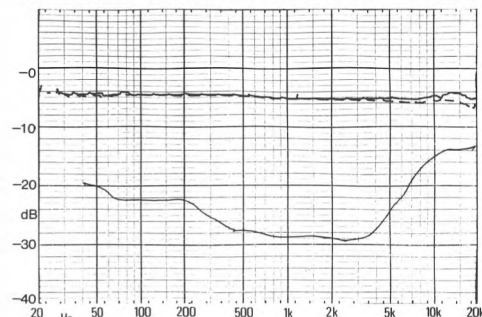
The *SLDL1* delivered an excellent mechanical performance with high torque, overshoot-free, with low drift and negligible wow or rumble. The arm performed well, judged largely by the fine stability and tracking performance of the supplied



Cartridge response/crosstalk/subsonic resonance raised (X decade): *P202ED* (on *SL7*).



Cartridge response/crosstalk: *P202* (on *QL1*).



Cartridge response/crosstalk: *P23E* (on *DL1*).

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

continued overleaf

GENERAL DATA

Integrated Turntable

Motor Section

Type direct drive, parallel tracking, automatic
 Platter mass/damping 1.4kg/good
 Finish and engineering very good/very good
 Type of mains lead/connecting leads ... 2 core/phonos + earth
 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%/<0.06%
 Absolute speed error <0.1%
 Speed drift 1 hour/load variation <0.1%/<0.1%
 Start up time to audible stabilisation approx 1.6secs
 Rumble: DIN B wtd L/R av (see spectrum) -77dB

Arm Section

Approximate effective mass, excl cartridge approx 3g
 Type/mass of headshell plug in cartridge, special type /N/A
 Geometric accuracy excellent
 Adjustments provided downforce
 Finish and engineering both very good
 Ease of assembly/setting up/use excellent/excellent/excellent
 Friction: typical lateral/vertical N/A
 Bias compensation method not required
 Bias force: rim/centre (set to 1.5g elliptical) N/A
 Downforce calibration error 1g/2g N/A
 Cue drift/8mm ascent/descent negligible/0.5sec/1.0sec
 Arm resonances N/A (see SL10)
 Subjective sound quality (complete unit) good
 Lead capacitance/damping method N/A/none

System as a whole

Size/clearance for lid rear 43.0(w) x 35.0(d) x 8 (h)/0cm
 Ease of use excellent
 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 average +/-very good
 Estimated typical purchase price £180

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

SLQL1

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

SL7

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

GENERAL DATA

Integrated Turntable

Motor Section

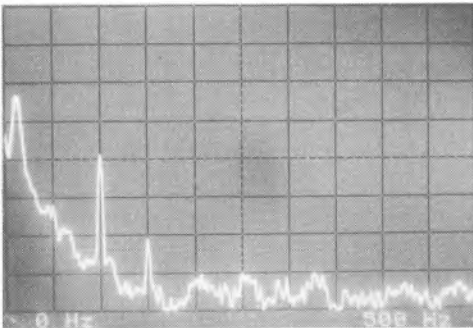
Type direct drive, parallel tracking, automatic
 Platter mass/damping 1.35kg/good
 Finish and engineering very good/very good
 Type of mains lead/connecting leads ... 2 core/phonos + earth
 Speed options 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) <0.06%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ... <0.1%/<0.06%
 Absolute speed error <0.01%
 Speed drift 1 hour/load variation <0.01%/<0.01%
 Start up time to audible stabilisation approx 1.3secs
 Rumble: DIN B wtd L/R av (see spectrum) better than -76dB

Arm Section

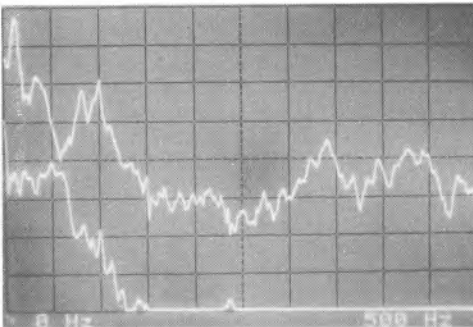
Approximate effective mass inc screws, excl cartridge approx 3g
 Type/mass of headshell plug in cartridge/N/A
 Geometric accuracy excellent
 Adjustments provided downforce
 Finish and engineering very good/very good
 Ease of assembly/setting up/use very good/excellent
 Cue drift/8mm ascent/descent negligible/1.0sec/1.0sec
 Arm resonances see SL10
 Subjective sound quality good
 Damping method none

System as a whole

Size/clearance for lid rear 31.5(w) x 31.5(d) x 6.5(h)/0cm
 Ease of use excellent
 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 average +/-very good
 Estimated typical purchase price £200

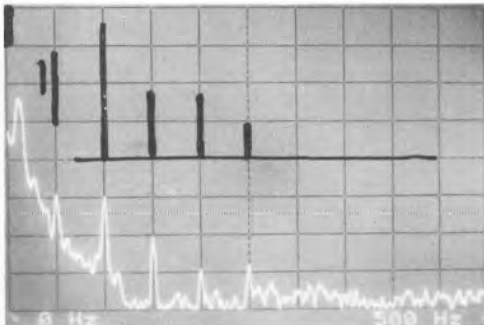


Total rumble via lacquer, SLDL1/SLQL1.

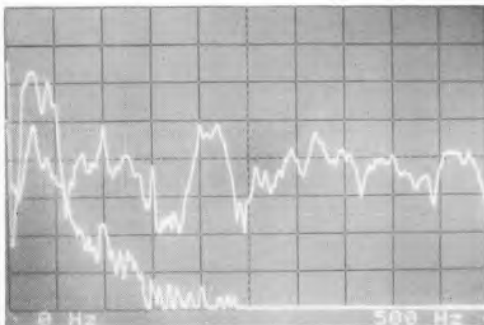


Breakthrough SLDL1/SLQL1: above, acoustic; below, vibration.

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



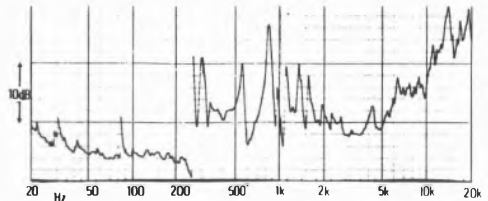
Rumble via lacquer disc (0–500Hz lin).



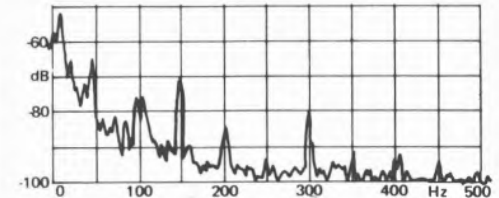
Breakthrough (0–500Hz lin): above, acoustic; below, vibration.

SL10

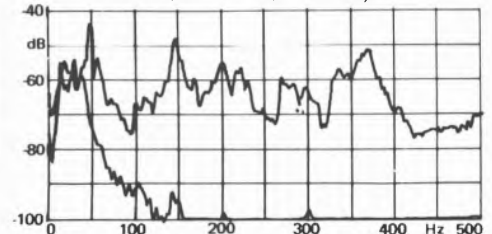
Overall the performance of the SL10 can be seen to be similar to the other models in the group, though one detail difference was noted, in that the power level and speed of the arm tracking servo-motor was higher than for the later turntables in the series. Very critical listening involving relatively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



Structural arm resonances, audio band.



Rumble via lacquer disc (0–500Hz).



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

GENERAL DATA

integrated Turntable

Motor Section

Type direct drive, quartz, parallel tracking
 Platter mass/damping N/A/good
 Finish and engineering both excellent
 Type of mains lead/connecting leads 2 core/phonos + earth
 Speed options 33 $\frac{1}{3}$, 45rpm
 Wow and flutter (DIN peak wtd sigma 2) <0.045%
 Wow and flutter (LIN peak wtd 0.2–6Hz/6–300Hz) <0.16%/<0.048%

Absolute speed error <0.05%
 Speed drift 1 hour/load variation quartz lock/none
 Start up time to audible stabilisation approx 1.2secs
 Rumble: DIN B wtd L/R av (see spectrum) 75dB

Arm Section

Approximate effective mass inc screws, excl cartridge 4g
 Type/mass of headshell none/N/A
 Geometric accuracy excellent
 Adjustments provided downforce
 Finish and engineering both excellent
 Ease of assembly/setting up/use excellent/excellent
 Friction: typical lateral/vertical N/A / N/A
 Bias compensation method not required
 Bias force: rim/centre (set to 1.5g elliptical) N/A / N/A
 Downforce calibration error: 1g/2g N/A / N/A
 Cue drift/8mm ascent/descent good/1.0sec/1.2secs
 Arm resonances good
 Subjective sound quality good
 Lead capacitance/damping method N/A/none

System as a whole

Size/clearance for lid rear 31.5(w) x 31.5(d) x 8.8(h)/none required
 Ease of use excellent
 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 above average/very good
 Estimated typical purchase price £300 (inc cart & head amp)

continued overleaf

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

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

Sound quality

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

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

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

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

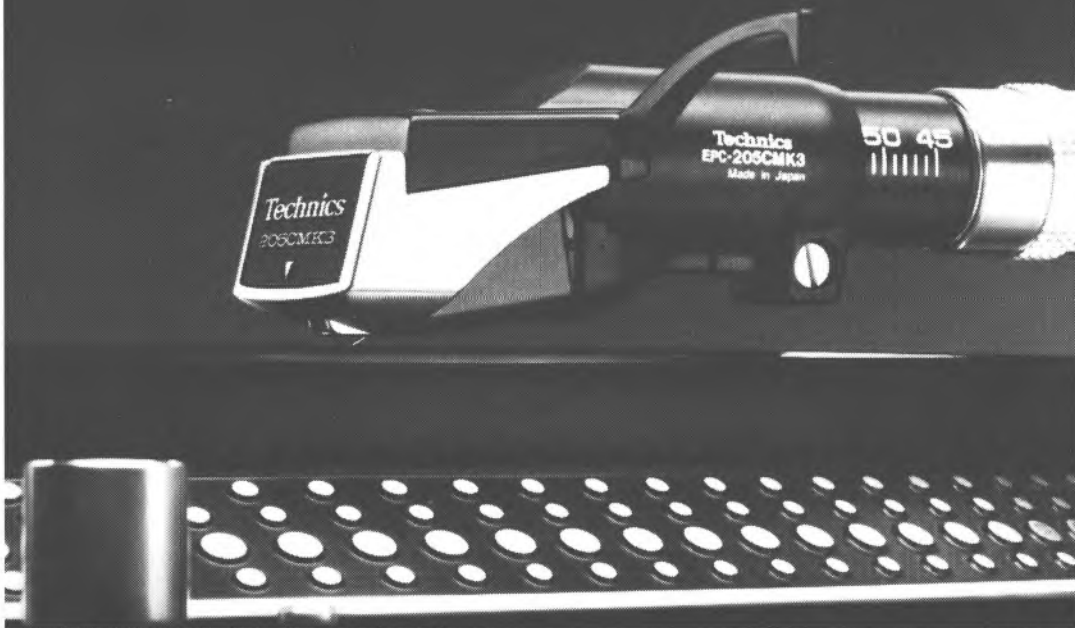
Conclusions

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

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



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If you know anything about cartridges, you'll know that flat frequency response is the holy grail of all hi-fi manufacturers.

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Our EPC-205C Mk3 isn't just a better cartridge. It delivers a total response range of 5-80kHz with no more than ± 0.5 dB deviation.

In plain terms, the flattest response yet.

A RADICAL CONCEPT

Achieving this level of frequency response meant drastically reducing the effective moving mass of the armature and cantilever.

Which in turn meant breaking new ground in audio engineering technology.

The breakthrough was fashioning a hollow tubular cantilever out of pure boron, a material of extraordinary rigidity and lightness.

(On the Mohs scale Boron has a hardness of 9.5 compared with 10 for diamond).

To this we added a tiny 0.1mm square-cut

diamond stylus and a high energy samarium-cobalt magnet.

Net result: a stylus assembly adding up to just 0.149mg.

Or the smallest effective mass ever achieved in a phono cartridge.

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As you'd expect, our EPC-205C Mk3 is designed to fit into a Technics deck.

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But we've also designed a version without an integrated headshell to fit a wide variety of tonearms.

It's called the EPC-U205C Mk3.

Fit one and we can promise you a response that will flatter the humblest of decks.

Technics

EPC-205C Mk3 Stereo Cartridge

300/318 Bath Road, Slough, Berks SL1 6JB. Tel: Slough 34522

Technics SP15 (EPA500)

Panasonic UK Ltd., 107-109 Whitby Road, Slough, Berks. SL1 3DR. Tel (0753) 34522



Features and design

This is a top class system made up from separately available components which are physically difficult to match with any others, and hence were used together to form an integral unit.

Owing a great deal to the popular professional *SP10 II*, the *SP15* has a less costly motor more applicable to domestic situations, but improvements in efficiency which provide a very similar rapid electronic start-stop performance. A quartz-lock direct drive motor is used, offering two speeds with very high torque and excellent dynamic characteristics. The substantial platter is fitted with a fairly hard rubber mat whose flat surface affords favourable disc support and damping. In the Technics tradition the engineering is to an exceptional standard with an accurately machined platter and a strong main bearing possessing low friction and undetectable play. Fine speed control is provided in the form of a synthesiser unit which allows pushbutton selection of 0.1% speed increments up or down, the amount monitored by a LED readout.

As a chassis the motor unit may be mounted in any strong panel, but for our tests we used the matching plinth and cover, which has a very substantial laminated wood base. Visually the plinth is split into two sections with a rosewood upper and a satin black lower portion. The whole assembly is heavy, and is supported on relatively compliant rubber feet which provide quite a low main suspension resonance at 6Hz or so. Due to the high foot damping and the attachment of the large lid to the plinth, the isolation will not match

a good subchassis design, despite the lid being of excellent quality and moulded in a low resonance grade of smoked plastic.

The *EPA500* is a versatile tonearm with a longer than usual stylus tip to pivot distance. Tracing errors are somewhat reduced, and the smaller offset angle consequently reduces bias compensation requirements. The extra length means that very few turntables can accommodate it, and furthermore it employs a very large pillar assembly to make space for the substantial mechanics which provide easily variable height adjustment via a strong helical gear assembly free of play.

A key feature of the design is the interchangeable top sections. The whole cartridge carrier complete with adjusted counterweight may be pre-balanced and rapidly swapped. A thumb-wheel lock firmly fixes the carriers into the precision gimbal bearing assembly, and the lead out wire connections are integral with the join. Increasing its versatility, three types of carrier are available to suit different types of cartridges. The 'H' is a low mass unit with a reinforced plastic headshell suited to high compliance models; the 'M' is somewhat beefed-up, but otherwise similar, and the 'L' is a substantial large diameter tube with a cast metal headshell, giving strength and effective mass suited to the finest low compliance moving-coil cartridges.

The integral seismic counterweights incorporate effective viscous damping for control of the arm/cartridge subsonic resonance. No down-force calibration is provided, so Technics supply

an accurate electronic gauge. A convenient calibrated internal spring provides bias compensation, and the side entry cabling requires considerable below-deck clearance.

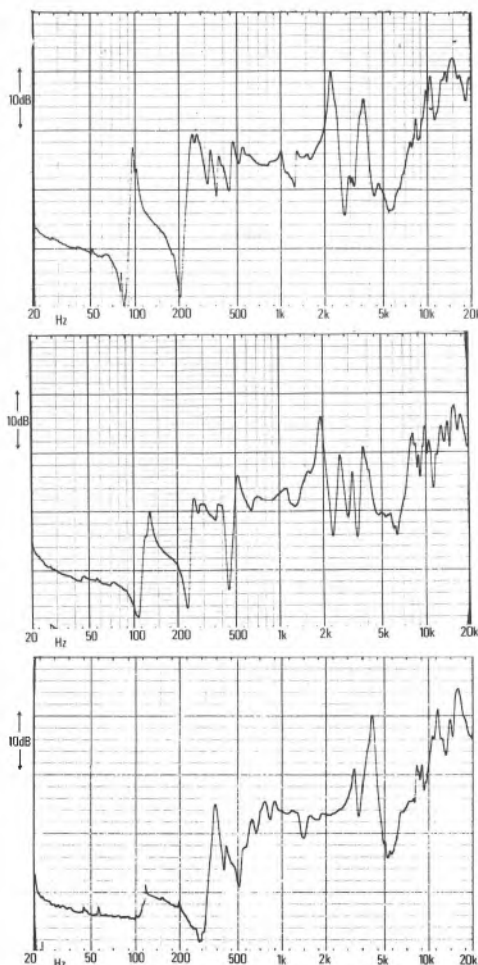
Lab results

Not unexpectedly in terms of lab results the motor performance was exemplary. State of the art rumble figures were in no way compromised by the spectrum analysis reading down to -100dB relative to the test reference level, and no trace of mains-related rumble, motor-pole or bearing noise could be detected. The total rumble accurately mirrored the static electrical performance with the exception of the tiny contribution made by the rumble bridge itself, and wow and flutter was likewise below measurement thresholds, probably better than 0.035% DIN peak weighted. The motor can be expected to maintain this standard of performance for many years, as it has so few moving parts.

Start up time was very fast, approximately 0.3 second to $33\frac{1}{3}\text{rpm}$ and proportionately more for the higher speeds, while electronic braking assured similarly rapid speed change and stop. Vibration isolation was in fact quite good, as indeed was the acoustic breakthrough, the latter showing an even, balanced character. Interestingly the breakthrough was poorer than for the 'miniature' Technics series, due to the larger lid area involved, so as a trial the lid was removed, providing the 10dB or so improvement shown by the dotted line. By implication, if used under high sound level conditions, the subjective quality should also be improved, and this was indeed found to be the case.

Shock resistance was also above average, due partly to the good dynamic balance of the arm, and also to the high mass of the system as a whole. A X10 scaling was possible for the disc impulse transmission response, which showed good control of the initial transient and progressive, even damping at all frequencies; there can be little point in substituting alternative mats in such as case.

While the bearing assembly was common to all three arm carriers, and hence they share the same recorded low friction levels, their other characteristics were distinctly different. Type *H* had an effective mass of 8g, suited to cartridges in the 15 to 30cu range, while *M* possessed a 10.5g mass for 12–25cu matching, and *L* a 14g effective mass suitable for 8–15cu cartridges (many moving-coils). Differences in construction resulted in a range of audio band resonances which are plotted separately, with *H* showing a first break at 90Hz. The cause was not immediately identified, but it was also present at 110Hz on the *M* version. The first flexure on *H* appeared at a fairly low 220Hz and was probably due to the headshell bonding to the tube; this was also a



Arm resonances: top, 'L'; middle, 'M'; bottom, 'H'.

feature of *M* at 230Hz. With *H* a strong step appeared in the energy trend above 230Hz, though the modes were well controlled at higher frequencies; in this respect however *M* was judged superior, with better damping and a more uniform trend.

Of the set the honours go to the *L* tube which avoided significant flexure until 310Hz and further up the range the damping was quite good, with a comparatively smooth energy trend and very few other resonances: a result certainly worthy of high quality moving-coil cartridges.

The arm mechanics worked very well, with biasing of the correct values and in the right ratio, and it also proved easy to use.

continued overleaf

Sound quality

Of the three tonearms *M* was best for low mass, medium compliance cartridges, and performed well with the *EPC 205 III*, for example. The sound was well balanced, demonstrating good stereo and low coloration levels. By comparison *H* was less well integrated and gave a more 'muddled' quality with a slightly reduced stereo depth impression. However the *L* tube was clearly superior overall, offering greater clarity, a firmer low frequency register, and a neutral and unexaggerated treble response.

The complete unit demonstrated a pleasant and secure standard of reproduction, which was not quite as coherent as, say, the complete Linn system, but which was very satisfying nonetheless. At the highest sound levels the stereo depth and clarity benefited from removal of the heavy lid, while the 'vinyl sound' was comparatively clean, confirming the good disc support.

Conclusion

In my view the *SP15* is certainly more than good enough for studio desk use. Its plinth system plus the matching *EPA500* tonearm results in a fine manually operated player, offering three speeds, cartridge matching versatility and interchangeability, and a synthesised variable speed. The unit promises a long and reliable life, and in context is certainly worth consideration, despite the fact that the overall sound could perhaps be matched by other less expensive systems.

GENERAL DATA Integrated Turntable (available as separates)

Motor Section

Type	quartz, direct drive, manual
Platter mass/damping	2.65kg/very good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33/45/78rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	<0.06%/<0.06%
Absolute speed error	<0.01%
Speed drift 1 hour/load variation	<0.01%/<0.01%
Start up time to audible stabilisation	approx 0.3sec
Rumble: DIN B wtd L/R av (see spectrum)	-78/-78dB

Arm Section

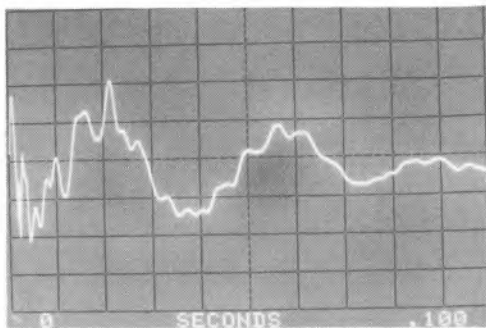
Approximate effective mass inc screws, excl cartridge

	'H' 8.0g, 'M' 10.5g, 'L' 14.0g
Type/mass of headshell	detachable arm tubes, 3 types/N/A
Geometric accuracy	excellent
Adjustments provided	overhang, lateral angle, height
Finish and engineering	excellent/excellent
Ease of assembly/setting up/use	excellent/very good/good
Friction: typical lateral/vertical	20mg/less than 10mg
Bias compensation method	internal spring
Bias force: rim/centre (set to 1.5g elliptical)	150mg/130mg*
Downforce calibration error: 1g/2g	negligible/negligible
Cue drift/8mm ascent/descent	negligible/1.0secs/1.5secs
Arm resonances	see text
Subjective sound quality	see text
Lead capacitance/damping method	85pF/seismic counterweight

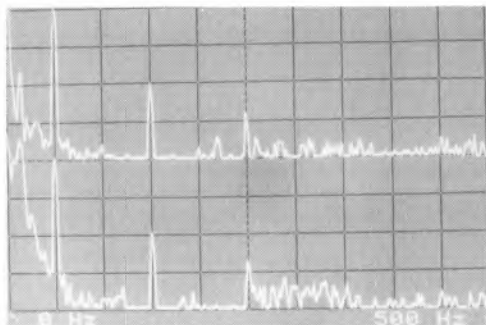
System as a whole

Size/clearance for lid rear	53.0(w) x 42.0(d) x 17.2(h)/7.5cm
Ease of use	very good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good ++
Humi level/acoustic feedback	excellent/very good
Vibration sensitivity/shock resistance	good/good
Estimated typical purchase price	£650 (motor £315, arm £170)

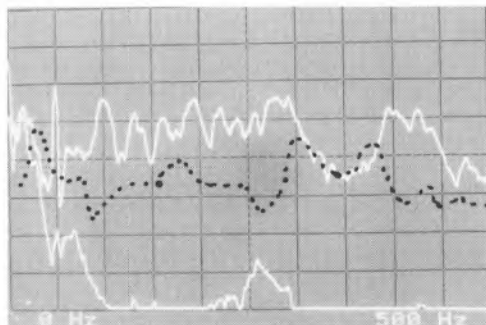
*longer than usual arm



Disc impulse transmission, magnified X10.



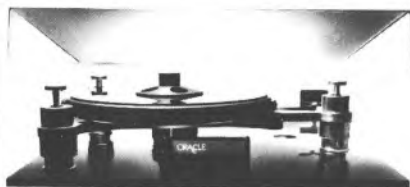
Rumble (0-500Hz lin): above, electrical only; below, total.



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

CHOICE TURNTABLES AT SURREY'S HI-FI AND VIDEO CENTRE

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Oracle

Our suggested system with the Oracle turntable
Meridian M1 Active loudspeakers
Meridian 101 control unit
Linn Ittok pickup arm
Koetsu moving coil cartridge

352-4 LOWER ADDISCOMBE ROAD,

Linn

Our suggested system with the Linn Sondek LP12 turntable

Linn Isobarik loudspeakers
Naim NAP 250 power amplifier
Naim NAC32 pre amplifier
Linn Ittok pickup arm
Koetsu moving coil cartridge



CROYDON SURREY.

Systemdek

Our suggested system with the Systemdek turntable

B&W 802 loudspeakers
Lentek stereo integrated amplifier
Linn Ittok pickup arm
Linn Asak moving coil cartridge



TEL. 01-654 1231 or 01-654 2040

Ariston

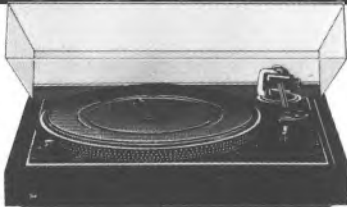


Our suggested system with the Ariston RD80 turntable

B&W DM14 loudspeakers
A&R (Cambridge) A60 integrated stereo amplifier
Linn LV Basik tone arm including cartridge



SURREY'S HI-FI AND VIDEO CENTRE



Dual

Our suggested system with the Dual 505 turntable (mc tonearm)

Mission 700 loudspeakers
NAD 3020 Integrated Stereo Amplifier
A&R C77 cartridge

Akal • AKG • ARC • A&R Cambridge • Ariston • Asak • Audio Philz • Bever • B&W • Celest • DCM Time Windows • Decca • Denon • Dual • Elite • Entre • Exposure • Gale Hi Genesis • Glary • Goldring & Grace • Grado • Hadcock • Harbeth • IMF • Isobarik • Ittok • JBE • JMW • JR • JVC • KEF • Koptus • Koss • Lentek • Linn • Lux • Mayware • Meridian • Mitchell • Mission • Mordant's Short • NAD • Nagaoka • Naim • Nakamichi • National • Nightingale • Nyltech • Oracle • Ortofon • Philips • Pioneer • Profile • QED • Quad • Radford • Reference • Rega • Revox • Rogers • Sansui • Satin • Sennheiser • Shure • SME • Sony • Spandor • STD • Sugden • Syntex • Systemdek • Tandberg • Teal • Technics • Thorens • Threshold • Ullimo • Video

RECOMMENDED

Thorens TD105 II *(re-assessed)*

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



Features and design

Currently the least expensive of the Thorens models, the 104/105 II models are basically the same deck, the difference being the addition of an auto-return facility on the 105. Previously reviewed in *Choice*, they have been re-assessed this time round on the advice of the UK agent, as certain small improvements have been made, notably to the damping of the top deck and by the substitution of a better mat.

This turntable has a low mass tonearm with a detachable carrier tube, but the lead capacitance remains at a rather high 300pF, which rules out a number of the more load conscious cartridges. The only cure would be to rewire the signal leads with low capacitance cable or alternatively, if the set-up permits, shortening of the cable provided.

The light 1.3kg platter has a strobe cut into the rim and illuminated from below, and the unit is belt driven from a small DC motor. This is electronically controlled for good speed stability, the electronics enabling conductive type touch switches for speed select and stop to be used. The main bearing was quite small in diameter but well tolerated and finished, demonstrating negligible play. The deck plate is mounted on springs possessing quite a low resonant frequency, helping to isolate it from the light resonant lid as well as from vibration transmitted to the plinth from below. The power supply comes in a separate box which is moulded onto the mains cable.

Lab results

The motor exhibited sufficient torque to keep the speed variation under load to a moderate 0.3%. Start-up was average at 3.5 seconds, but in its favour, the drive showed a complete lack of

speed overshoot/dynamic wow effects (which is in marked contrast to the more costly '115 series, and indeed the '126).

Wow and flutter measured well, if a shade higher than for the earlier model, but unfortunately rumble was definitely worse, and averaged just 70dB DIN B (previously a 74dB averaged figure was obtained). Spectrum analysis revealed numerous modes around 100Hz plus a spurious 280Hz component.

The acoustic breakthrough results also showed imperfections, being quite good at lower frequencies but demonstrating a serious deterioration above 300Hz. Vibration isolation was good at around 150Hz, but below this frequency it proved less satisfactory as well as non-uniform. It was just possible to present the disc impulse transmission with X10 scaling, the result showing quite poor disc damping and a large low frequency resonance attributable to platter rocking at an estimated 10Hz; this is a rather low frequency and is indicative of poor rigidity.

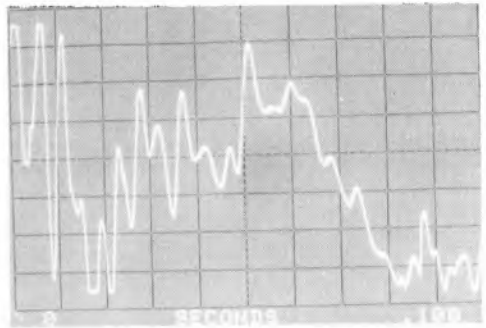
The moderate effective mass of 8g provided by the tonearm is suitable for medium compliance cartridges. A trace of play was evident in the bearings, but friction was low in both planes, bias correction was good, and downforce calibration satisfactory; cue operation was also fine. Audio band resonances were numerous, with evidence of 'chatter' or 'play', but in the main they were quite well controlled, displaying a relatively uniform energy trend. The counterweight resonated at 80Hz, the tube flexed at 200Hz, and a further severe mode is shown at 1.8kHz.

Sound quality

Despite the 'improvements' the 105 did not gain more than an 'average' rating for sound quality. Some midrange coloration was present with a slightly aggressive upper range, for which the new mat was partially responsible. The bass was unexceptional with some 'softening' of impact, and the stereo imaging was neither particularly well-focused nor transparent.

Conclusion

The TD105/104 players are reasonable enough, and sufficiently better than many other similarly priced models to merit recommendation.



Disc impulse transmission, magnified X10.

GENERAL DATA

Integrated Turntable

Motor Section

Type belt drive, auto return
 Platter mass/damping 1.3kg/fairly good
 Finish and engineering very good/good
 Type of mains lead/connecting leads
 2 core, sep AC adaptor/phonos + earth
 Speed options 33/45rpm (variable)
 Wow and flutter (DIN peak wtd sigma 2) 0.07%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) 0.1%/0.07%
 Absolute speed error variable
 Speed drift 1 hour/load variation -0.2%/-0.3%
 Start up time to audible stabilisation 3.5secs
 Rumble: DIN B wtd L/R av (see spectrum) -72/-68dB

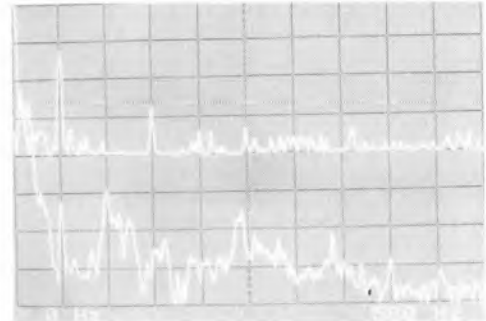
Arm Section

Approximate effective mass inc screws, excl cartridge 9g
 Type/mass of headshell fixed/plug in arm/N/A
 Geometric accuracy very good
 Adjustments provided overhang, lateral angle, tilt
 Finish and engineering good/good
 Ease of assembly/setting up/use good/fairly good/very good
 Friction: typical lateral/vertical less than 20mg/less than 20mg
 Bias compensation method spring
 Bias force: rim/centre (set to 1.5g elliptical) 160mg/180mg
 Downforce calibration error 1g/2g -0.09g/-0.1g
 Cue drift/8mm ascent/descent negligible/1.0sec/1.5secs
 Arm resonances fairly good
 Subjective sound quality average
 Lead capacitance/damping method

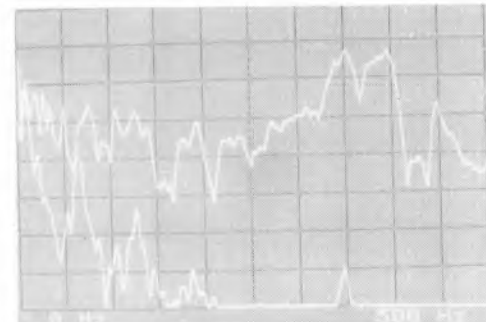
300pF/decoupled counterweight

System as a whole

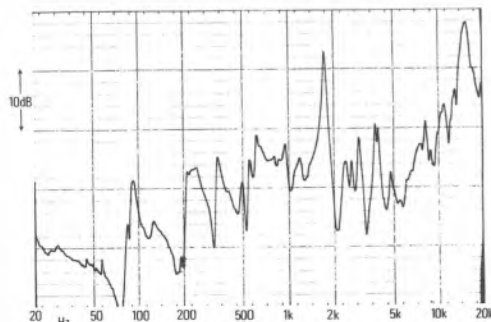
Size/clearance for lid rear 43.0(w) x 35.0(d) x 13.2(h)/4.5cm
 Ease of use good
 Typical acoustic breakthrough and resonances above average
 Subjective sound quality of complete system average
 Hum level/acoustic feedback good/above average
 Vibration sensitivity/shock resistance average/good
 Estimated typical purchase price £104 (104 II £87)



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



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



Structural arm resonances, audio band.

Thorens TD115 II *(re-assessed)*

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



Features and design

Reviewed in the previous edition, the *115 II* is completely reassessed here to determine the worth of certain minor improvements. (I seem to recall the same reason being given for reassessment last time around, so in fact this is an assessment of improvements to improvements!)

I have consistently criticised this model for an unfortunate motor drive characteristic, the use of an underdamped first-order servo system having hitherto resulted in a degree of dynamic wow. This effect is caused by a significant speed overshoot appearing after a small load change such as a transient increase in stylus drag over a high modulation passage. I have to report that this is still uncorrected, and that an estimated $\pm 0.3\%$ peak wow occurred during peak signal levels when using a low compliance 2g downforce cartridge, the light platter (1.3kg) possessing insufficient inertia to iron out such variations.

This belt driven unit uses a pressed steel damped deck plate mounted on four special springs of 'double' construction. Lid and plinth decoupling is thus provided, although the vertical mode resonance was too high for safety at some 18Hz. A version of the *Isotrack* tonearm is fitted, a low mass fixed headshell tube provided with a detachable socket near the arm pillar giving an interchangeable plug-in carrier system.

Lab results

As before good weighted wow and flutter was obtained for a steady low level test tone, but wow alone was poorer than average at 0.15% and again the start up time was slow at 4.5 seconds.

Both drift and load variations were well controlled in the long term, while rumble was very good indeed, and in this respect at least the deck was better than its predecessor. Spectrum analysis however revealed a 100Hz component at -75dB with some spurious noise in the 50Hz region. X10 scaling of the disc impulse transmission response was just possible, and showed poor control over many frequencies, with a 10Hz fundamental platter flexure (also evident with the *105*). Vibration isolation was just average, with visible breakthrough extending up to 200Hz. Above 100Hz the acoustic isolation was quite good, and certainly better than average.

The arm set up well and provided low friction together with sensible effective bias compensation. Downforce calibration was satisfactory but the cue descent was a trifle slow at 3 seconds (one second is the preferred figure for a damage-free descent rate over 8mm drop). Rated fairly good on audio band arm resonances, the graph showed a consistently even energy trend from 20Hz upwards; however the resonant modes were rather numerous, and those at 160Hz and 320Hz were severe in magnitude.

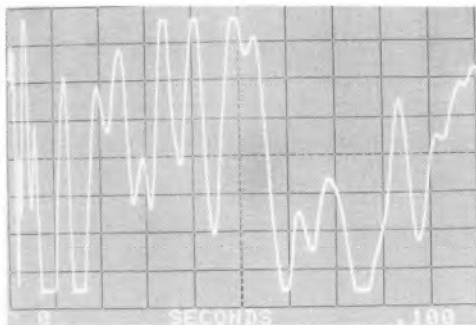
Sound quality

Rated slightly above average for sound quality, spectral balance was a little smoother than for the *105*. Mid and bass clarity were superior, though a significant loss of stereo depth was apparent for critical listeners. Detail was well presented, with quite good image stability and precision. This player could sound a trifle 'forward' and 'hard' in the upper midrange, partly

the fault of the mat, so it favoured a cartridge tending to a 'sweet' balance such as an ADC or B&O moving magnet type, and benefitted from the substitution of a softer sounding absorptive mat. A trace of dynamic wow could occasionally be heard with 'difficult' program.

Conclusion

On balance the 115 and related 110 models are worthy of consideration, and their choice might depend on just how sensitive a particular user is to wow. However in context the 160C III is far superior, and the 115 does not merit full recommendation.



Disc impulse transmission, magnified X10.

GENERAL DATA

Integrated Turntable

Motor Section

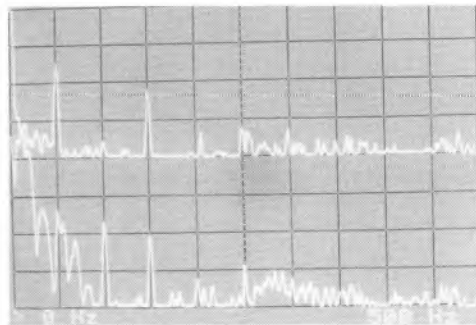
Type	belt drive, auto return
Platter mass/damping	1.3kg/fairly good
Finish and engineering	good/good
Type of mains lead/connecting leads	2 core/phonos + earth
Speed options	33/45/78rpm
Wow and flutter (DIN peak wtd sigma 2)	<0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.14%/0.06%
Absolute speed error	variable speed
Speed drift 1 hour/load variation	+0.25%/<0.05%
Start up time to audible stabilisation	4.5secs
Rumble: DIN B wtd L/R av (see spectrum)	-79/-78dB

Arm Section

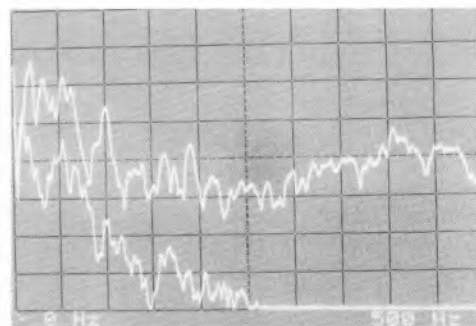
Approximate effective mass inc screws, excl cartridge	8g
Type/mass of headshell	detachable arm tube/N/A
Geometric accuracy	very good
Adjustments provided	tilt, overhang, lateral angle
Finish and engineering	good/fairly good
Ease of assembly/setting up/use	fairly good/fair/good
Friction: typical lateral/vertical	less than 20mg/less than 20mg
Bias compensation method	magnetic
Bias force: rim/centre (set to 1.5g elliptical)	180mg/180mg
Downforce calibration error: 1g/2g	<0.05g/<0.1g
Cue drift/8mm ascent/descent	some/2.0secs/3.0secs
Arm resonances	fairly good
Subjective sound quality	average +
Lead capacitance/damping method	230pF/decoupled counterweight

System as a whole

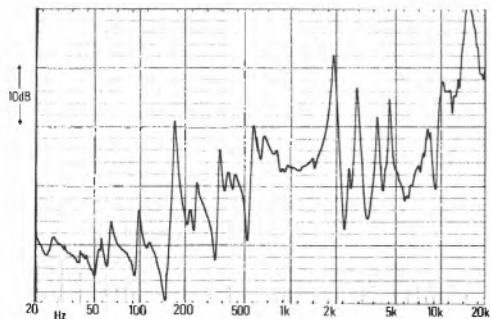
Size/clearance for lid rear	44.4(w) x 35.8(d) x 13.4(h)/0cm
Ease of use	very good
Typical acoustic breakthrough and resonances	good +
Subjective sound quality of complete system	average +
Hum level/acoustic feedback	very good/-
Vibration sensitivity/shock resistance	fair/good
Estimated typical purchase price	£174



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



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



Structural arm resonances, audio band.

Thorens TD160C 111 (re-assessed)

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



Features and design

This integrated model was already well established when it was reviewed in the first *Choice* edition to cover turntables and tonearms. It was subsequently withdrawn, but popular demand in the UK led to its reintroduction, and it now comes with an improved mat, whose flat areas offer some extra disc contact. For many years a leading low-cost integrated deck based on subchassis construction, the previous model was one of the earliest exponents of the low mass arm with detachable carrier, that now fitted is to the latest Thorens design.

The main bearing is substantial, with a 10mm shaft and a conical point contact on the hardened steel thrust washer. A die-cast double platter is used, belt driven from a two speed synchronous motor. The speed change and arm cueing are accomplished via convenient front-mounted controls which do not disturb the subchassis. Although levelling and set-up is not simple due to the concealed nuts, this model should have been pre-aligned at the factory in view of its integrated arm.

The arm itself is a quality model with a tight low-friction gimbal bearing array, and incorporates subtleties such as spring operated downforce and magnetic bias compensation. In addition to the usual lateral alignments, it is also adjustable for height and tilt, and has a bearing axis close to the stylus tip height for maximum tracking stability under heavy programme modulation, further assisted by the arm's dynamic balance. It proved to be a stable tracker in general, extracting a fine mechanical performance from most cartridges. The effective mass of 6g means that it is a genuinely low mass model suited to compliances in the 15-35cu range, which includes the more delicate moving-coils as well as the majority of high performance moving magnet types.

Lab results

The combined wow and flutter result was excellent at 0.06%, though the wow alone was a little higher than average at 0.15%. The fairly heavy 2.5kg platter came to speed in a slow 4 seconds, despite the motor clutch which was supposed to accelerate matters (in the past this has never worked particularly well either). Speed was a trifle fast, and a moderate 0.3% slowing under load was encountered. The DIN B weighted rumble was very good, averaging -76.5dB; spectrum analysis showed little difference between the total rumble noise and that for electrical breakthrough alone, although the latter was higher than usual. X10 disc impulse scaling was just possible, but the new mat can be seen to possess rather poor absorption properties.

Well-adjusted, the arm returned very low friction levels, with the tabulated readings in fact dominated by a trace of residual bias compensation. The biasing force was slightly low, but worked well due to its negligible added friction, while the downforce calibration was accurate. The resonance graph showed a promisingly even energy trend, but with rather numerous and only partially controlled modes; the fine detail suggests some 'play' in either the counterweight or perhaps the carrier socket fixture.

The acoustic and vibration performances were well above average, but not quite on a par with more modern designs due to excess foam in the springs.

Sound quality

We were struck by the generally complete and well ordered sound quality of this model, which was well ahead of other similarly priced commercial integrated players (barring perhaps the untested Rega combination). Bass was noticeably 'quick' and 'clean', with good definition and evenness; detail was well represented with

promising stereo depth, ambience, and image stability. The supplied mat emphasised the mild treble 'hardness' in the tonearm, which could also sound a little 'grainy' in the treble region, and substitution of an *Audio Ref* mat resulted in a notable smoothing as well as 'softening' here – a good match.

Conclusion

We can congratulate Thorens and their importers on the reintroduction of this model, which is as good a purchase now as it ever was. At the price it is highly competitive in terms of sound quality, is foolproof to use, and relatively easy to set up. A strong recommendation is appropriate, particularly if used with a better mat.

GENERAL DATA

Integrated Turntable

Motor Section

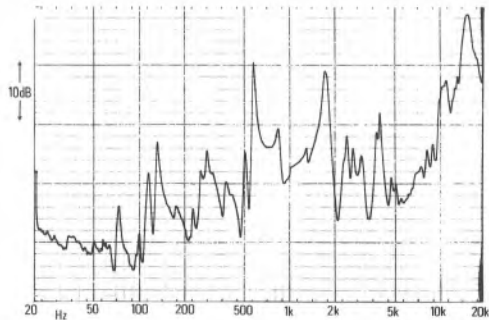
Type..... belt drive, manual
 Platter mass/damping..... 2.5kg/good
 Finish and engineering..... very good/very good
 Type of mains lead/connecting leads... 2 core/phonos + earth
 Speed options..... 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2)..... 0.06%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) ... 0.15%/0.09%
 Absolute speed error..... +0.6%
 Speed drift 1 hour/load variation..... synchronous/-0.3%
 Start up time to audible stabilisation..... approx 4secs
 Rumble: DIN B wtd L/R av (see spectrum)..... -77/-76dB

Arm Section

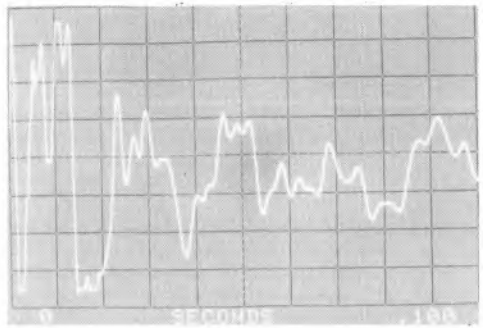
Approximate effective mass inc screws, excl cartridge..... 6.0g
 Type/mass of headshell..... plug in arm tube/N/A
 Geometric accuracy..... very good
 Adjustments provided..... overhang, lateral angle, height, tilt
 Finish and engineering..... very good/very good
 Ease of assembly/setting up/use..... good/fair/very good
 Friction: typical lateral/vertical..... 25mg/25mg
 Bias compensation method..... magnetic
 Bias force: rim/centre (set to 1.5g elliptical)..... 140mg/140mg
 Downforce calibration error: 1g/2g..... +0.1g/0.00g
 Cue drift/8mm ascent/descent..... slight/0.6sec/2.5secs
 Arm resonances..... average +
 Subjective sound quality..... average +
 Lead capacitance/damping method..... 180pF/none

System as a whole

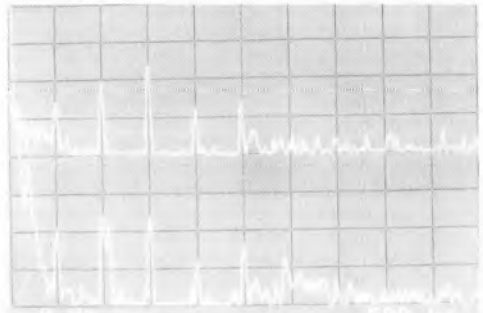
Size/clearance for lid rear..... 43.0(w) x 34.0(d) x 15.0(h)/8cm
 Ease of use..... very good
 Typical acoustic breakthrough and resonances..... good
 Subjective sound quality of complete system..... good
 Hum level/acoustic feedback..... very good/very good
 Vibration sensitivity/shock resistance..... good +/-fairly good
 Estimated typical purchase price..... £161



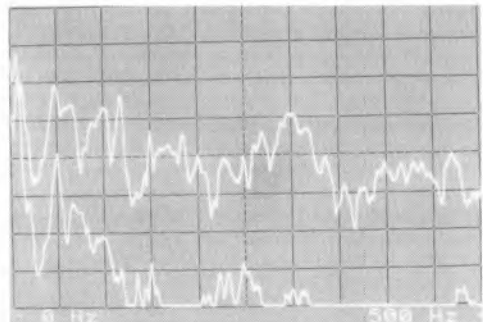
Structural arm resonances, audio band.



Disc impulse transmission, magnified X10.



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



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

Thorens TD160BC (revised and reprinted)

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141

RECOMMENDED



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

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

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

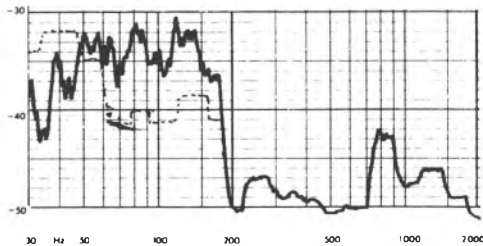
Rated as good for the standard Thorens version and as very good with the ATR style modifications, the subjective performance attracted very little criticism. The mat change resulted in a significant

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

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

GENERAL DATA

	Motor Unit
Type	belt drive
Platter mass/damping	2.5kg/good
Finish and engineering	very good
Type of mains leads	2 core
Speed options/variable?	33 $\frac{1}{3}$; 45rpm/no
Wow and flutter (DIN pk wtd σ_2)	0.06%
Wow/Flutter (lin pk wtd 0.2-6Hz/6-300Hz)	0.11%/0.08%
Speed accuracy/drift/variation under load	+0.6%/none/-0.4%
Start up time to audible stabilisation	3.5secs
Rumble (av DIN B wtd L/R)	73/74dB
Size/rear clearance for lid	43(w) x 34(d) x 15(h)/9.5cm
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level/Acoustic feedback	very good/very good
Vibration of shock sensitivity	very good
Ease of use	straight forward
Estimated typical purchase price	£120



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

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141

**Features, facilities, setting up and use**

Following the interest in the *ATR* version of the '160, as well as in other modifications both official and unofficial, an importer guaranteed version of the existing *TD160BC* has now been released. For those familiar with the existing standard '160, the improvements made for the *S* version were as follows. The platter balance and centration were to a closer tolerance, both components in die-cast zinc alloy, while the main bearing was of selected quality. The subchassis was acoustically damped by a bituminous laminate, the spring isolation efficiency was increased by removal of the foam cores, while a reinforced arm mount was also supplied. The plinth was much heavier in construction, manufactured from a wood composition with a massive bottom cover, and the lid was fitted with friction stop hinges. A flat rubber mat offering improved disc and platter damping was supplied, but in all other respects the two decks were identical, and comprised two speed synchronous motor designs, driven via a flat belt.

The measured performance showed a distinct improvement over the previously reviewed standard *160BC*, and strong gains were also apparent in acoustic terms. Wow and flutter were very good – particularly flutter (actually this was one of the best results for a quality belt drive motor that we measured). It ran slightly fast at a moderate +0.3%, but showed little slowing under load, while the fairly heavy 2.5kg platter reached speed in 3.5 seconds, and the rumble reading was also excellent at 78/79dB. The spectrogram was one of the cleanest in the report, particularly when the electrical nature of the 50 and 100Hz lines is taken into account. The mechanical resonance was satisfactorily low at 3.1Hz lateral and 6.3Hz vertical, although it was not very well balanced and

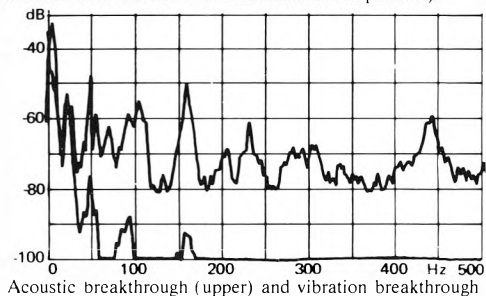
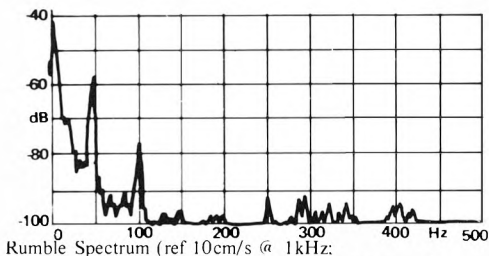
on our sample required careful adjustment. Despite a small peak at 160Hz, the acoustic breakthrough was very good, and vibration isolation was similarly rated, while feedback and hum were very good and shock resistance reasonably good.

Clearly in the top turntable group on our tests, we could make few criticisms of this model's sound quality.

Although it was not as well finished or as substantially engineered, the *TD160S* delivered comparable quality to the highly rated models up to £250 in my estimation. A recommendation is thus mandatory. The *160S* is clearly good value for money at its typical purchase price of around £170.

GENERAL DATA

	Motor unit
Type	manual belt drive
Platter mass/damping	2.5 kg/very good
Finish and engineering	good/very good
Type of mains lead/connecting leads	2 core/N/A
Speed options	33 $\frac{1}{3}$, 45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.065%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.11%/<0.05%
Absolute speed error	+0.3%
Speed drift 1 hour/load variation	synchronous/-0.25%
Start up time to audible stabilisation	3.5secs
Rumble: DIN B wtd L/R av (see spectrum)	78/79dB
Size/clearance for lid rear	43.7(w) x 36.0(d) x 16.5(h)/7.5cm
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/very good
Vibration sensitivity/shock resistance	very good/good
Estimated typical purchase price	£170



Thorens TD126/SME (re-assessed)

Cambrasound, 4-10 North Road, Islington, London N7. Tel 01-607 8141



Supplied over the years in various forms, this latest version has 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 are necessarily for the better: for example, the main bearing shaft is now smaller, measuring just 6.5mm in diameter. The same servo-controlled motor is fitted as before, but the servo time constants have been altered and the dynamic wow is still present, estimated at $\pm 0.3\%$, 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

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 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

A generally good performance was achieved in the listening tests, well ahead of the non-subchassis competition at this price, but the frequency balance was not as even as normal, the mat providing some extra 'bite' and mid 'hardness'. The bass range was quite even and well extended, with the stereo imaging to a good standard, but a trace of pitch uncertainty was occasionally noted on heavy programme transients when using low compliance moving coil cartridges.

Conclusion

This turntable still exhibited dynamic wow and this sample (ex dem) was not perhaps as 'clean' as it should have been. The standard is satisfactory, but is not really good enough to merit recommendation.

GENERAL DATA Motor Section

Motor Unit - integrated with SME III

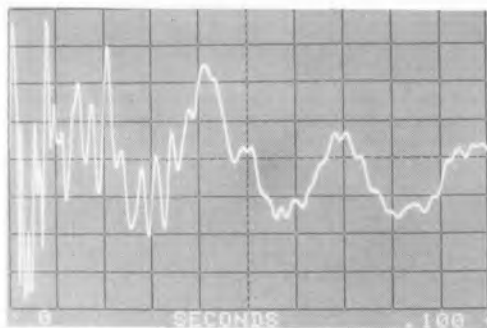
Type	..... belt drive
Platter mass/damping	..... 2.5kg/good
Finish and engineering	..... very good/very good
Type of mains lead/connecting leads	..... 2 core/phonos + earth
Speed options	..... 33/45/78rpm (variable)
Wow and flutter (DIN peak wtd sigma 2)	..... <0.05%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	..... <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

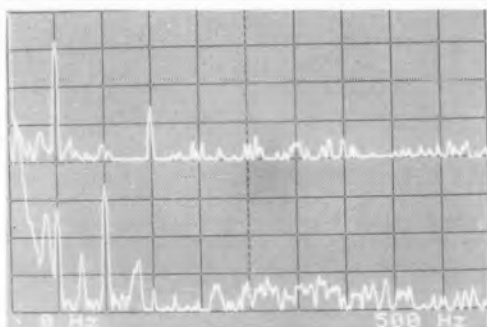
Approximate effective mass inc screws, excl cartridge	..... 5.0g
Type/mass of headshell	..... plug in arm tube/N/A
Geometric accuracy	..... excellent
Adjustments provided	..... overhang, tilt, arm height
Finish and engineering	..... excellent/very good
Ease of assembly/setting up/use	..... good/good/very good
Friction: typical/lateral/vertical	..... less than 10mg/less than 10mg
Bias compensation method	..... suspended weight (pulley)
Bias force: nm/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

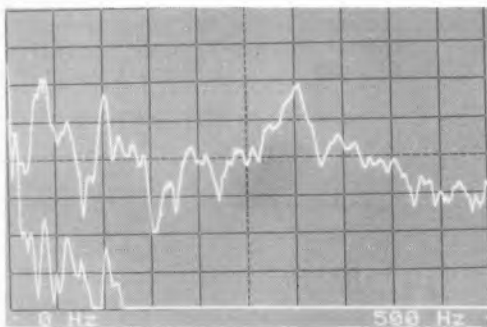
Size/clearance for lid rear	..... 50.3(w) x 38.8(d) x 17.0(h)/0cm
Ease of use	..... very good
Typical acoustic breakthrough and resonances	..... good +
Subjective sound quality of complete system	..... good +
Hum level/acoustic feedback	..... very good/very good
Vibration sensitivity/shock resistance	..... good/very good
Estimated typical purchase price	..... £400



Disc impulse transmission, magnified X10.



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



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

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Toshiba SRQ660

Toshiba House, Frimley Road, Frimley, Camberley, Surrey. Tel (0276) 62222



Features and design

Although classified as a Toshiba model, the 660 is in fact designed along similar lines to the Aurex SR-Q770. The major external difference lies in the tonearm, the '660 carrying a medium/heavy 'S' shaped model with a metal universal detachable headshell (whereas the Aurex has a low mass, straight arm).

At an estimated effective mass of 16g the unit is suited to low compliance cartridges in the 7-14cu range. A 'starter' cartridge was supplied, designated a C-290M moving magnet. Of moderate quality, the spec described a 1.75g downforce model with better than 25dB midband channel separation, a shank-mounted spherical diamond stylus, and a compliance of 8cu, compatible with the arm mass.

A direct drive two speed quartz locked motor is used, which Toshiba describe as a coreless slotless design with a -75dB DIN B rumble performance, the latter confirmed on test. The automatic mechanism has auto start and arm return, and it may also be set for speed/record size, and will cue accordingly; a repeat-play button is also provided. As with the other Toshibas, construction was rather lightweight; despite the use of a precision aluminium die-cast platter, the latter's total mass including a substantial mat was only 0.7kg. The plastic plinth was supported on relatively ineffective soft rubber feet, with the resulting resonances in the 10-16Hz range overlapping that of the arm/cartridge; this will be detrimental to the tracking

stability under conditions of excessive shock or vibration. The lightweight plastic lid was of a highly resonant type, and the unwanted vibrations are coupled straight into the arm due to the design of the plinth.

Lab results

Measuring -76dB DIN B weighted overall, the rumble spectrogram revealed a trace of motor noise, but at a level where this must be of little consequence. The motor started well, with satisfactory torque and no dynamic wow. Under all conditions of measurement wow and flutter was well controlled, with speed accuracy and stability virtually beyond criticism (this was true of quartz referenced machines in general). X1 scaling was essential to represent the impulse transmission response, which was barely muted in its passage across the record to the stylus position and was also accompanied by severe platter resonances. Vibration isolation was poor, 25dB worse than average at 100Hz, and the acoustic breakthrough was no better.

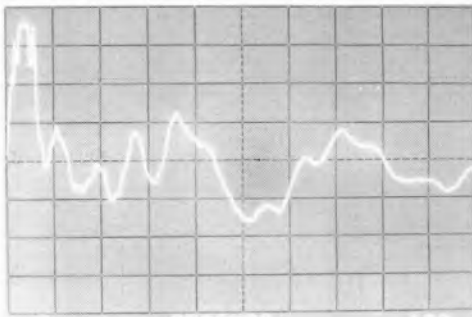
The arm geometry was also well below par, preventing accurate two point alignment. Though of correct magnitude, the biasing was in the wrong ratio from rim to centre. The bearings were slack although they offered low friction levels. The arm resonance graph was unpromising, with the counterweight mode at 40Hz, the headshell socket flexing at a low 160Hz (with a bearing chatter), and further severe modes present at 450Hz, 900Hz, 3kHz and 4kHz.

Sound quality

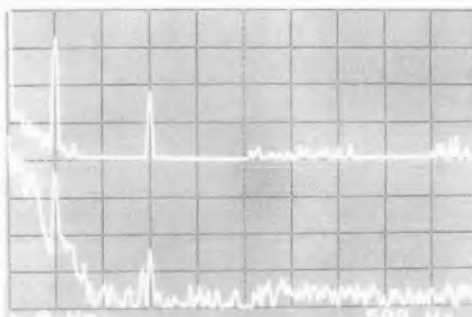
As this turntable proved to be feedback prone, careful control of siting and some restriction of maximum sound levels were essential to get reasonable subjective results. The general quality was somewhat coloured with a significant veiling of musical detail and a loss of stereo depth. Bass notes were uneven, with a noted loss of power at the lowest frequencies. The cartridge showed some sibilance and aggression in the treble register.

Conclusion

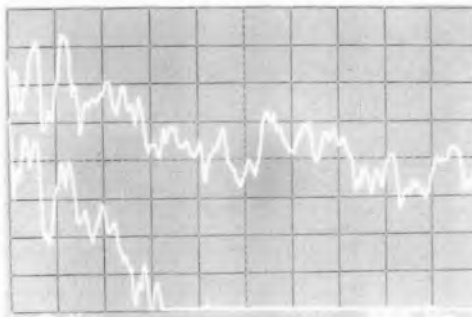
This is undoubtedly the best Aurex/Toshiba model assessed in mechanical terms, but unfortunately on grounds of sound quality it still does not merit recommendation.



Disc impulse transmission, standard X1.



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



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

GENERAL DATA

Integrated Turntable

Motor Section

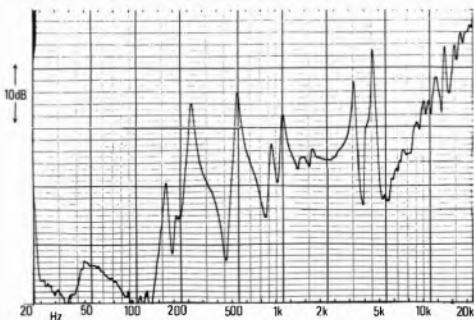
Type quartz, direct drive, automatic lock
 Platter mass/damping 0.7 kg/fairly good
 Finish and engineering good/fairly good
 Type of mains lead/connecting leads ... 2 core/phonos + earth
 Speed options 33/45rpm
 Wow and flutter (DIN peak wtd sigma 2) 0.07%
 Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz) 0.1%/0.1%
 Absolute speed error <0.01%
 Speed drift 1 hour/load variation <0.01%/<0.01%
 Start up time to audible stabilisation approx 2secs
 Rumble: DIN B wtd L/R av (see spectrum) -76dB

Arm Section

Approximate effective mass inc screws, excl cartridge 16g
 Type/mass of headshell universal detachable/8.5g
 Geometric accuracy fair only
 Adjustments provided overhang, lateral angle
 Finish and engineering very good/good
 Ease of assembly/setting up/use very good/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 0.00g/+0.1g
 Cue drift/8mm ascent/descent negligible/0.5sec/1.5sec
 Arm resonances average -
 Subjective sound quality average -
 Lead capacitance/damping method 170pF/decoupled counterweight

System as a whole

Size/clearance for lid rear 42.0(w) x 38.2(d) x 12.5(h)/6cm
 Ease of use very good
 Typical acoustic breakthrough and resonances average -
 Subjective sound quality of complete system average -
 Hum level/acoustic feedback good/fair
 Vibration sensitivity/shock resistance poor/fair
 Estimated typical purchase price £130



Structural arm resonances, audio band.

Trio LO7D

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



Unquestionably a Trio 'flagship', designed to partner their costly range of LO amplifiers, the LO7D comprises a complete manual player fitted with an elaborate tonearm, and able to accommodate a second arm if so desired. Fundamentally it subscribed to the 'high mass and rigidity in the chassis/plinth' philosophy; in Trio's own words 'designing the entire signal conversion system into an ultra-rigid closed loop'. To achieve this end, a composite plinth consisting of an aluminium frame casting, to which is bonded a resin matrix weighing 22lbs is used; the whole is firmly attached to a mahogany multi-ply base (15lbs). *In toto*, the unit weighs a massive 68lbs, and carrying handles are (fortunately) provided.

A direct drive motor is fitted, employing a separate power unit in a steel clad box. The design is of the coreless/slotless type, with quartz locking offering just 33 $\frac{1}{3}$ and 45rpm, but no variable speed control. Electric and mechanical braking produce rapid stop and speed change of

the heavy 5.5kg platter, the latter weight including a substantial plate of non-magnetic brushed stainless steel 'mat'. The platter is itself laminated from two component parts, and is constructed from both cast alloy and duraluminium plate to provide high self-damping. A well-publicised accessory namely the 'rim clamp' was unfortunately unavailable for this review; this comprises a weighted ring which fits over the record edge, clamping it and flattening it onto the platter.

Trio claim a -94dB DIN B rumble measurement, which we were unable to verify since our test limit was -78dB. I can only imagine that some spectrum analysis method was used by the manufacturers, summing the readings and weighting them in accordance with the DIN B requirements. Unlike the Marantz 'super-rigid' deck, which possesses a degree of absorbent isolation in the feet, the Trio has none as standard; in fact the feet are quite rigid, and Trio

clearly expect that the 'closed-loop high-mass' theory will prevent vibration being detected by the stylus. Hard rubber pads are supplied for cases of severe feedback, and these may be stuck to the under surface of the existing feet.

The arm is distinguished by a complex height adjuster, which employs a miniature handwheel operating on a vertical rack, rather like a microscope. A massive lever-operated collet type bush clamps the arm pillar in the correct height position; for what it is worth, the height may be adjusted over a 1/4" range (7mm), in microscopic steps of 0.1mm.

The tough headshell weighs 12.5g including screws, and is a universal detachable type. Quite firm in its fitting, it is built of a plastic compression moulding loaded with layers of carbon and boron fibre reinforcement. Inside the arm is a special Litz wiring, simply arranged to lie in the centre of the tube to produce minimum capacitance.

Equally complex is the tube itself, which uses a collet type entry for the headshell socket to improve the clamping. A partially tapered construction used for the rear section of the arm tube is for resonance control. The tube itself is a triple laminate of aluminium, plus carbon and boron fibre. Bias compensation was *via* a thread and weight system, with an interesting double pulley arrangement to take the thread round two crossed right angles. The large rotating-scale type counterweight runs on a concealed threaded stem, and no damping or decoupling was in evidence. The bearings were well adjusted and virtually free of play.

Lab results

It seems almost too easy for today's good direct drive motors to achieve a textbook performance on speed and wow and flutter, and the LO7 was no exception. Start up time was approximately 1.8 seconds, indicating high torque in view of the heavy platter, and although the fine figures are hardly worth discussing, a trace of mains frequency related 200Hz noise was present on the rumble spectrogram at -87dB, with nothing else of significance present.

The disc termination was sufficient to allow an expanded X10 presentation of the rim impulse transmission response. The higher frequency start point was small enough to miss the recorder trigger setting, leaving this to the later and longer wavelength platter rock at about 22Hz, which was quickly damped in 80ms. Other vibration frequencies were well suppressed, and the performance with the big ring clamp should be even better.

It was the breakthrough performance of the LO7 which gave rise to some concern. The acoustic response was decidedly uneven, peaking at 40, 180, and 400Hz and attaining just average levels. This is the result of the disc

support system as a whole, as well as the transmission of vibration *via* the feet, from the excitation of the test table on which the measurements were taken; a paving stone would help matters here. As standard the vibration isolation was poor (the upper of the two lower curves), thereby disproving the closed-loop high mass theory at least as far as the 50 to 500Hz range is concerned. Adding the thin rubber pads to the feet undoubtedly helped, improving the 100Hz to 500Hz isolation by a typical 10-15dB, and from these results I can only conclude that Trio have not themselves submitted this model to vibration isolation tests, or do not consider this aspect of performance important.

The arm effective mass was established at a high 17g, suited to reasonably well-damped cartridges in the 7-13cu range, typical of moving-coil models. Bearing friction was low, bias levels appropriate and in the correct ratio, and the counterweight assembly provided downforce with good calibration accuracy.

Judged just 'fairly good' on audio range resonances, despite the obvious care taken in its construction, the arm showed a first resonance at a low 170Hz, which in all probability is the counterweight. The headshell mode was probably the one at 280Hz (better than average), and this was followed by the main beam flexure at 500Hz, again quite a good result. Beyond this point the graph was relatively tidy, indicating good damping of upper range resonances. But if comparisons are made, this is not quite up to the standard set by similarly priced 'superfi' arms.

Sound quality

This turntable proved to be something of an enigma, which, frankly, we did not fully resolve. The absence of the usual lid assembly clearly removed influences from that quarter, which were obvious complications in the case of the comparable Lux PD555 or Technics SP15 models, for example. However the player proved very sensitive to its siting, either requiring a fairly flexible support to offer some elastic decoupling to the chassis, or alternatively a very rigid and massive shelf of the paving stone variety, augmenting the already high mass. The worst situation was the strong wooden shelf, which seemed to maximise the coupling of vibration to the unit, with a resultant clouding of lower midrange depth and ambience, a loss of stereo focus, and an undeniable reduction in bass transient precision.

The arm was subjectively inoffensive and only exhibited mild coloration, with the overall tonal balance quite neutral, and demonstrating a distinct lack of midband coloration.

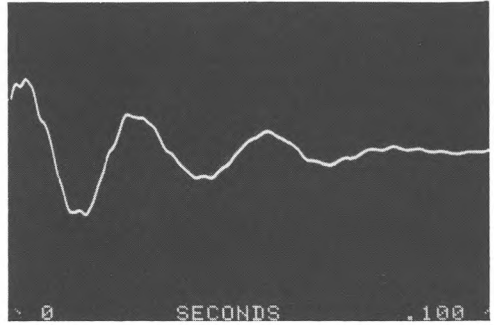
Despite experiments with various cartridges and different sitings, we were unable to obtain

continued overleaf

the very high sound quality which other commentators have indicated this deck is capable of producing. The standard is good, as well as appealing in some respects. But it is significantly limited by the detachable head and by the lack of elementary isolation provision.

Conclusion

As shown by the Marantz TT1000, the closed-loop high-mass/rigidity theory still needs some degree of isolation, and only in exceptional circumstances will the LO7 begin to deliver the sonic performance that Trio promise. At the price level involved, the high engineering content is of little consequence without a sound quality to match, so this model cannot be recommended.



Disc impulse transmission, magnified X10.

GENERAL DATA

Motor Section

Type	quartz, direct drive
Platter mass/damping	5.5kg/very good
Finish and engineering	excellent/very good
Type of mains lead/connecting leads	power unit 2 core/phonos
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)	<0.08%/<0.06%
Absolute speed error	<0.01%
Speed drift 1 hour/load variation	<0.01%/<0.01%
Start up time to audible stabilisation	approx 1.8secs
Rumble: DIN B wtd L/R av (see spectrum)	< -78dB

Integrated Turntable

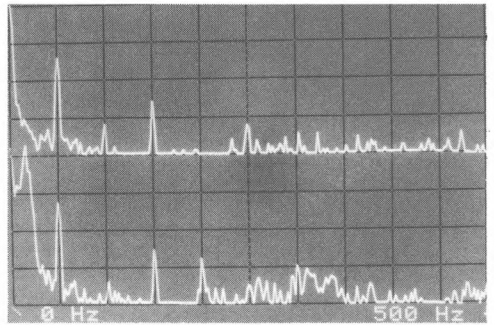
Arm Section

Approximate effective mass inc screws, excl cartridge	17.0g
Type/mass of headshell	universal detachable/12.5g
Geometric accuracy	very good
Adjustments provided	height, overhang
Finish and engineering	both excellent
Ease of assembly/setting up/use	very good/good
Friction: typical lateral/vertical	less than 20mg/less than 20mg
Bias compensation method	thread and lever
Bias force: rim/centre (set to 1.5g elliptical)	175mg/225mg
Downforce calibration error: 1g/2g	<0.1g/<0.1g
Cue drift/8mm ascent/descent	negligible/0.5sec/2.5secs
Arm resonances	good
Subjective sound quality	fairly good
Lead capacitance/damping method	estimated 90pF/none

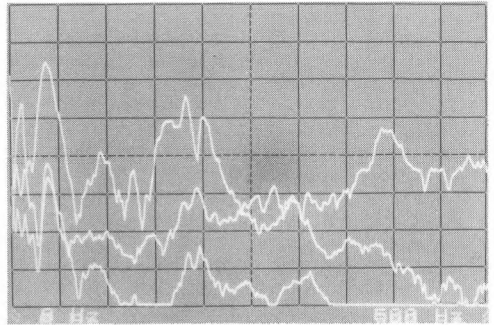
System as a whole

Size/clearance for lid rear	55.5(w) x 47.0(d) x 16.0(h)/no lid
Ease of use	good
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good*
Hum level/acoustic feedback	very good/good*
Vibration sensitivity/shock resistance	fair/very good
Estimated typical purchase price	£1100

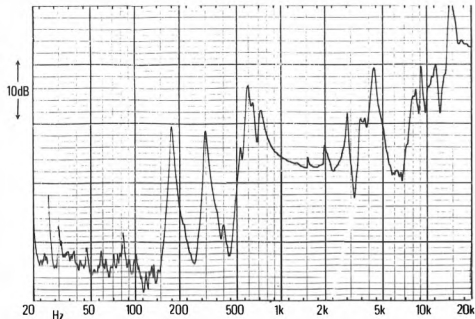
*depends on siting



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



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



Structural arm resonances, audio band.

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



Features, facilities, setting up and use

More or less a successor to the more costly *KD750*, the *600* motor unit is also available with a Trio arm, and is known as the *KD650*. The design was founded on a massive plinth moulded in Trio's mineral loaded resin - A.R.C.B. A thick and relatively dead lid was provided, but the usual ineffective rubber feet were used for isolation, the overdamped plinth resonances appearing at 8.1Hz lateral and 16.2Hz vertical and able adversely to affect a cartridge's tracking ability at its subsonic resonance. The powerful direct drive motor was quartz speed referenced, and the substantial 2.7kg platter was well damped by an effective mat. Two fixed speeds were provided (33 $\frac{1}{3}$ and 45rpm) but the lack of metalwork on the plinth may have been responsible for the less than ideal level of acoustic breakthrough.

Wow and flutter was excellent with no wow overshoot. Interestingly the speed was 0.1% fast - a negligible error, but one which is unheard of in the case of an inbuilt quartz referenced oscillator whose spec accuracy should have been of the order of 0.002%! Stability and drift were excellent, start up was fairly quick and exactly to specification at 1.9 seconds, while rumble was very good at 75/72dB, if not quite to spec. Analysis of the spectrogram revealed the presence of some mild motor noise plus some mains related breakthrough, believed to be due to an inadequately decoupled power transformer. Rated as good on acoustic breakthrough peaks were nevertheless present at 55, 140 and 330Hz, while vibration isolation was merely average. Feedback was poorer than that, appearing first in the bass, though as is so often the case, shock was well resisted.

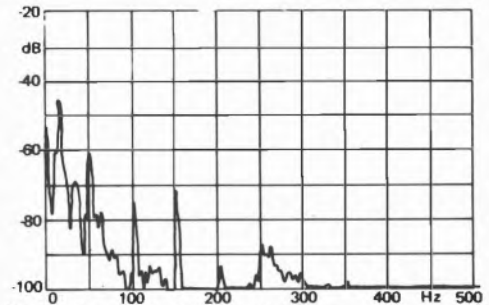
Rated just average on sound quality using a good quality tonearm (SME III), the low frequencies

were not reproduced clearly enough, with a loss of extension and transient clarity. But matters did improve when the deck was moved to a substantial shelf location. The midrange however was pleasant and detailed.

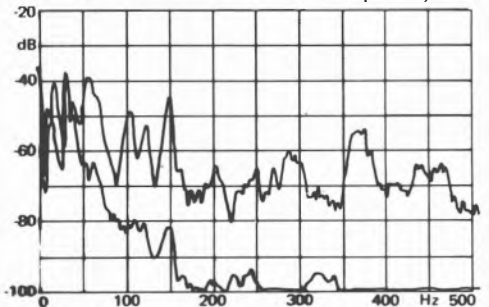
Good isolation is a key factor as regards the more costly turntables, for without it they rarely make the grade. Offering good performance in the right location, the *KD600* was however too costly for recommendation in view of its overall performance.

GENERAL DATA

Type	quartz direct drive	Motor Unit (650 with arm)
Platter mass/damping	2.7kg/very good	
Finish and engineering	excellent/very good	
Type of mains lead/connecting leads	2 core/N/A	
Speed options	33 $\frac{1}{3}$, 45rpm	
Wow and flutter (DIN peak wid sigma 2)	<0.05%	
Wow and flutter (LIN peak wid U 2-6Hz/6-300Hz)	<0.05%/<0.05 5%	
Absolute speed error	+0.1%	
Speed drift 1 hour/load variation	quartz/<0.05%	
Start up time to audible stabilisation	1.8secs	
Rumble: DIN B wid L/R av (see spectrum)	75/72dB	
Size/clearance for lid rear	49(w) x 40.5(d) x 16.7(h)/5.3cm	
Ease of use	good	
Typical acoustic breakthrough and resonances	good	
Subjective sound quality of complete system	average	
Hum level/acoustic feedback	very good/below average	
Vibration sensitivity/shock resistance	average/good	
Estimated typical purchase price	£240	



Rumble Spectrum (ref 10cm/s @ 1kHz;
includes both electrical and mechanical components).



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We couldn't have put it better ourselves.

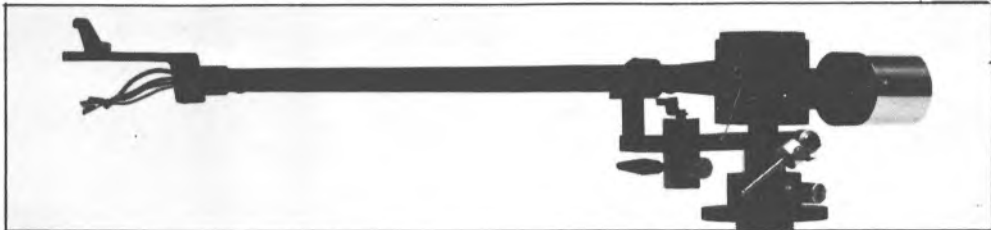
OSAWA

For full details of the excellent new Ultracraft AC30 tone arm and a list of stockists, contact Osawa.
J. Osawa & Co. (UK) Limited, 10 Forge Court, Reading Road, Yateley, Camberley, Surrey, GU17 7RX. Telephone: Yateley (0252) 875919.

Ultracraft AC30 (revised and reprinted)

J. Osawa & Co. Ltd., 10 Forge Court, Reading Road, Yateley, Camberley, Surrey GU17 7RX

RECOMMENDED



Features, facilities, setting up and use

At a price reduction of some 30%, Ultracraft have ingeniously produced the new AC-30 arm, which embodies the best of the '300 series while adding further improvements. Treading a middle path between the very low and very high mass '300 versions, the '30 was a rigid structure with the tube/stem and headshell properly and permanently fixed, offering a modest 9g effective mass. The arm is finished entirely in black, though the same pillar unit as on the '300 was used, including the variable damping unipivot. A rotating type calibrated counterweight was employed, and the arm was fitted with a good quality low capacitance cable measuring a total of 95pF. As with the '300, the same 15mm overhang geometry measurement was recommended instead of a sensible card protractor.

In general well engineered, we were slightly concerned over the lack of complete rigidity at the pivot, due to spring loading of the jewelled pin, presumably to prevent damage by shock; that on the AC-300 appeared firmer by comparison.

Lab performance

This arm performed very well in the lab with fine geometrical accuracy and very low pivot frictions, offering effective damping as and when required. Effective mass was moderate at 9g – at the low end of the medium mass category – and in conjunction with damping was suitable for cartridge compliances in the 10–25cu range. Bias compensation was fine though the cue drifted a little on descent. A good rating was achieved for resonances, the arm exhibiting generally good control and a well maintained energy trend. The counterweight was apparent at 100Hz, but the break at 250Hz was not felt to be a true resonance – possibly it was movement at the pivot. The first flexural mode of the tube was masked, but probably lay at 500Hz.

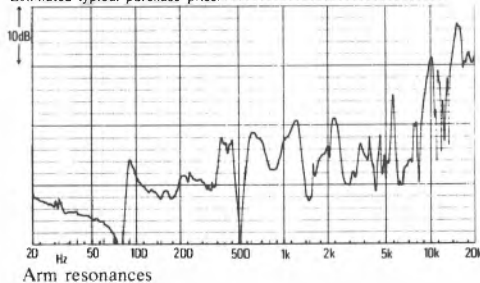
Sound quality

Felt to be of 'SME III' character, the AC30 sound was well balanced and neutral, showing a distinct lack of coloration and offering no emphasis of any spectral region. The sound was quite detailed and showed promising stereo depth and ambience, but the final degree of transient clarity and resolution of detail shown by the best arms was felt to be muted.

Conclusion

Ultracraft have, in the AC30, produced a superior tonearm capable of almost universal application, especially in terms of its sensible effective mass and the variable damping facility. The value and the sound quality was good, and merits recommendation at the new reduced price.

GENERAL DATA		Tonearm
Approximate effective mass inc screws, excl cartridge	.....	9.0g
Type/mass of headshell	.....	fixed/N/A
Geometric accuracy	.....	very good
Adjustments provided	.....	tilt, overhang, lateral angle, height
Finish and engineering	.....	excellent
Ease of assembly/setting up/use	.....	good/good
Friction typical lateral/vertical	.....	<15mg/<10mg
Bias compensation method	.....	thread and lever
Bias force: nm/centre (set to 1.5g elliptical)	.....	140mg/220mg
Downforce calibration error: 1g/2g	.....	+0.05g/+0.07g
Cue drift/8mm ascent/descent	.....	fairly good/1.5secs/2.5secs
Arm resonances	.....	good
Subjective sound quality	.....	good
Lead capacitance/damping method	95pF/variable via fluid well
Estimated typical purchase price	£99





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Turntables of this calibre require suitable arms and those we can recommend include the **Mission 774**, **Syrinx PU2**, **Hadcock GH220**, also **Fidelity Research FR64**, **Signet XK50**, **ADC ALT-1** and **Mayware F4**.



Cartridges from: **Mission** – **Nagaoka** – **Glanz** – **Ortofon** – **Dynavector** – **Denon** – **AKG** – **Audio Technica** – **Signet** – **Goldring** and **Elite** complete the important combination.

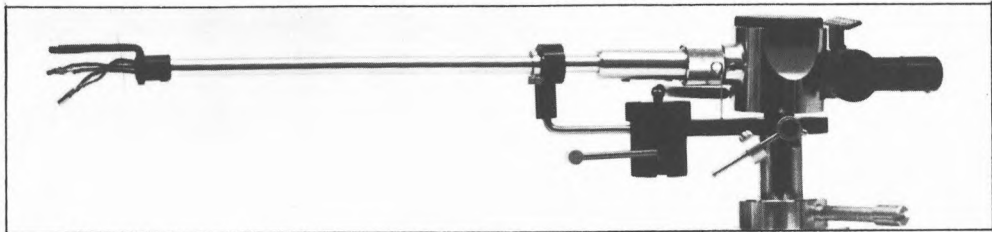


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Features, facilities, setting up and use

A well established tonearm, the *AC300MkII* comprised a family of models based on the same pillar, counterweight and bearing structure. The pillar was built with a well engineered interchangeable arm tube facility, the range developing via a variety of tube/shell types. That reviewed was the low mass *AC300MkII* with straight arm stem and fixed headshell, but as an accessory a higher mass version with an 'S' shaped tonearm and a more conventional detachable headshell was also available. The *400II* additional series represents essentially the same arm, but with the effective tube length increased from 237mm to 283mm. The supplied manual was both well written and helpful, and listed more accessories.

A unipivot design, the arm incorporated variable damping using a viscous fluid well. The bias compensator was a thread and lever type, with no pulley to relieve the sharp bend the nylon thread has to undergo, and despite the arm's obvious sophistication, the clumsy overhang method for cartridge alignment was suggested. Though well engineered, the headshell section was not as well secured to the tube as we would have liked. Effective mass was very low at 3.75g – suited to delicate high compliance cartridges – and the capacitance was also low at 100pF.

Lab performance

Using a protractor to set it up, the geometry was excellent and no problems were encountered; the end result was good for a unipivot. Some drift was apparent on the cue but the bearing friction was below sensible measurement levels. The biasing was close to the correct value and in fact added negligible additional friction. Downforce calibration was on the high side, but not unduly so.

Rated as above average rather than good on the arm resonance characteristics, the counterweight mode was apparent at 85Hz and numerous well damped breaks also occurred, suggesting inferior

rigidity; in fact no really clean area existed. Conversely the overall energy trend was well reflected, implying a good frequency balance.

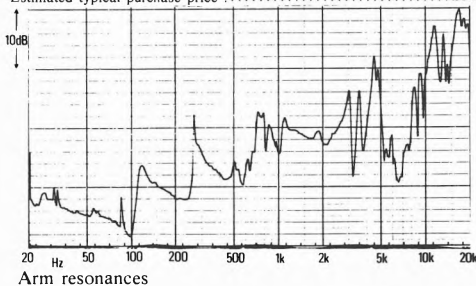
Sound quality

Rated as good, the character was pleasant enough with a smooth balance, quite good bass, plus promising stereo imaging and depth. Superficially it appeared similar to the *SME III*, but lacked some of the latter's precision and detail.

Conclusion

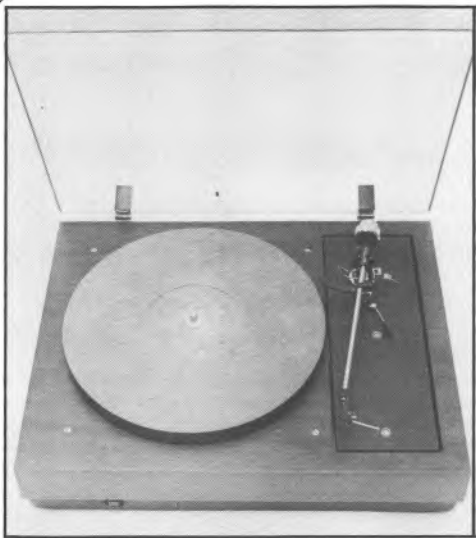
This versatile and interesting arm has not done badly and in the main was well engineered. High compliance cartridges are its *forte*, and with these the structural resonances will be less relevant. Despite the recent price reduction, this version is still too expensive to merit recommendation in the context of this report.

GENERAL DATA	Tonearm
Approximate effective mass inc screws, excl cartridge	4g
Type/mass of headshell	detachable arm tube/N/A
Geometric accuracy	excellent
Adjustments provided	tilt, height, overhang, slight lateral angle
Finish and engineering	very good/very good
Ease of assembly/setting up/use	fairly good/fairly good/good
Friction: typical lateral/vertical	<15mg/<10mg
Bias compensation method	thread and lever
Bias force: rim/centre (set to 1.5g elliptical)	200mg/225mg
Downforce calibration error: 1g/2g	+0.06g/+0.08g
Cue drift/8mm ascent/descent	fair/1sec/2secs
Arm resonances	above average
Subjective sound quality	good
Lead capacitance/damping method	100pF/vari. fld. unipivot+dcpld c/wt
Estimated typical purchase price	£145



Walker CJ55

CW & J Walker Ltd., Brentwood, Red Lane, Frodsham, Warrington WA6 6RA. Tel (0928) 33326



Design and features

Supplied at the last minute in pre-production form to meet *Choice's* deadlines, the *CJ55* is the latest and least expensive of the many UK-designed subchassis turntables, and is intended to sell for less than £140. Designer Colin Walker is well known in the hi-fi industry, and 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 point-less 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 isolation 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

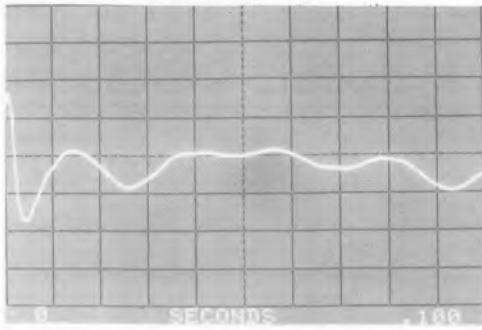
Acquitting itself well, the sound quality was above average for the price. In tonal terms it tended to a rich 'musical' balance, favouring orchestral programme, particularly with arms such as the *FR64FX*. The disc support was considered good, while image stability and stereo depth both received favourable comment.

Conclusion

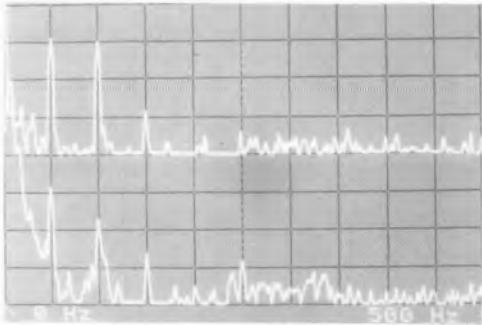
If this motor unit maintains its promise in production, it will clearly represent good value for money. It would appear best suited to an arm with a 'tight' bass sound, such as a *Mission 774* or perhaps the *Helius*. At a lower price level the *Linn Basik* would also make a satisfactory match, with perhaps the *GH220* falling somewhere in between. A recommendation is deserved by the newcomer, though with the provision that our review sample was too early to be guaranteed representative of production.

GENERAL DATA

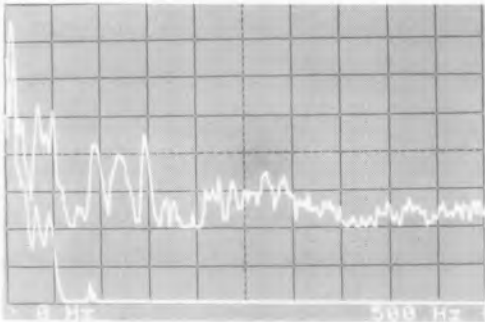
	Motor Unit.
Type	belt drive, subchassis
Platter damping	good
Finish and engineering	good
Type of mains lead/connecting leads	3 core/-
Speed options	manual change 33/45rpm
Wow and flutter (DIN peak wtd sigma 2)	0.06%
Wow and flutter (LIN peak wtd 0.2-6Hz/6-300Hz)	0.11%/<0.05%
Absolute speed error	+0.2%
Speed drift 1 hour/load variation	-0.2%
Start up time to audible stabilisation	4.5secs
Rumble: DIN B wtd L/R av (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 sensitivity/shock resistance	very good/fairly good
Estimated typical purchase price	£135



Disc impulse transmission, standard X1.



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



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

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SUMMARY REVIEWS

These summary reviews are included to give basic information on models which we have evaluated at some stage. The products concerned may not be widely available now, and the information may not be entirely representative of samples currently on sale, but the information does serve to increase comprehensiveness.

Akai AP-B10C

Offering reasonable value at a modest £55, this player has an acceptable arm of moderate mass, suited to the rather basic fitted cartridge or alternatives in the 12–20cu range. Rumble and breakthrough performances were however poor.

Decca International

This unipivot design has a moderate 12g effective mass, and gives a generally above average sound quality, characterised by a rather 'rich' balance, with some bass muddling and mid-forwardness; a good match for Decca's individual-sounding cartridges. Construction quality was a little disappointing.

Dynavector DV505

This extraordinary arm itself weighs no less than 1.8kg, and has a correspondingly high effective mass, particularly laterally. Despite the very high price, our listening tests placed this model at only average, with a similar rating for arm resonances. Friction was on the high side horizontally, and no cueing system was fitted.

Eagle 7500

Although quite modestly priced, this player gave poor results on the arm resonance, breakthrough and listening tests, which prevents any recommendation. The arm effective mass of 14g suits medium/low compliance cartridges.

Infinity Black Widow

This arm had an exceptionally low effective mass, suiting it to high compliance cartridges, but at a heavy cost in terms of structural rigidity, reflected in the poor audio band resonance results. Generally good engineering in other respects resulted in above average sound quality, though the high price makes this model uncompetitive.

JBE Series IV

We have deleted this model from the report, as despite the passing of several months, JBE did not come back to us with a flat slate platter to replace the wobbly one fitted to our pre-production review sample, and which resulted in poor wow and flutter results. We were in any case unimpressed by the Matsushita *DFX* motor, which measured 10dB worse on rumble than the older *MKL* fitted to the *JBE Series 111*. But, for the record, the new model with its softly sprung

feet did provide a good vibration resistance, although the acoustic isolation was just average. The results of any listening tests could not have been sensible with this sample.

JVC LA11

Typical of many modestly priced Japanese players, this belt-drive model was fitted with a cartridge which was not ideally suited to the heavy 18g effective arm mass, and showed poor resistance to breakthrough. Rumble and arm bearing friction were also in evidence, and the package rated below average on sound quality.

JVC QLA5

This model showed many of the same weaknesses as the above mentioned *LA11*, despite its much higher price tag. Motor performance was better, but not as good as others of a similar price.

Marantz TT2000

Quite a reasonable turntable at £85, the low mass (6.5g) arm will accommodate most cartridges, and performed acceptably except on audio band resonances. The motor was also adequate, if not particularly 'clean', while listening tests rated below average with some treble coloration and bass 'softening'.

Marantz TT4000

Although the quartz lock ensures excellent speed stability, in other respects our samples of this player performed rather less well than our *TT2000*, to which it is very similar.

Monitor Audio ET500

This motor unit required careful siting to give good results, and showed a degree of the dynamic wow problem associated with this particular Matsushita direct drive motor.

Optonica RP5100

An attractive deck of medium arm mass, the performance was reasonable for the price, though marred somewhat by a slight tendency to bass feedback and poor arm friction on our sample.

Pioneer PL200X

A recommended model in our last edition, this player had a generally good balance, but would benefit from careful siting. The 17g arm mass is only really suited to the less compliant cartridges.

Pioneer PL400X

Offering little if any advantage over the recommended *200X*, the *400* costs some 50% more, and is consequently less competitive.

Revox B790

Predecessor to the reviewed *795*, the only difference between the two models appears to be the inclusion of variable speed at a price penalty of over £100. To some extent our findings on the *Revox* models have been compromised by

the included cartridges.

Sansui SR222 II

Undoubtedly THE budget £70 player until Dual's 505 offered a challenge, this model is sadly no longer available, but might be worth watching for on the secondhand market. The 11g arm mass suits medium or low compliance cartridges best.

Sony PSX60/70

These turntables possess excellent motors but were fitted with a rather indifferent arm. This had a bias friction and calibration problem and an effective mass of 25g, which is hardly well suited to any available cartridges.

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 SLB2/B3

Reasonable though not exceptional for the price, these models are quite well balanced, but our sample had poor arm friction. Arm mass of 13g suits low/medium compliance cartridges, and careful siting is worthwhile.

Technics SLQ2/Q3

A splendid motor was to some extent compromised by a rather average arm and breakthrough per-

formance. The arm is suited to cartridges in the 10-17cu range. Sound quality was above average, pleasantly detailed and neutral, but lacking some stereo depth and bass definition.

Technics SL1700 II (1600 II/1800 II)

One of the few integrated models to rate 'good' on sound quality in the context of our last issue, this range of players was generally well balanced, the superb motor being to some extent compromised by only average ratings on audio band arm resonances and vibration susceptibility. Recommended overall, these players are best suited to cartridges in the 10-17cu range.

Toshiba SRF225

Below average sound quality due to motor effects preclude any recommendation of this modestly priced belt-drive automatic, which is suited to low/medium compliance cartridges tracking at a 2g minimum downforce.

Toshiba SRF325

Very similar to the '225, this slightly more expensive model did fare a little better in the listening tests, and was pleasant though unexceptional.

Trio 1033B

This well established belt-drive model budget did not particularly impress us when we examined a sample some time ago, though we understand that improvements may have been carried out since. Our findings indicated problems of arm friction and motor noise breakthrough.

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PLATTERMATS

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.

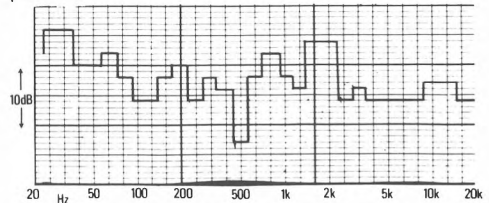
The reference curve (1) is that of the disc unsupported – that is lifted some 5mm clear of a metal platter by a thick washer at the spindle. The record was then tried on a number of available mat types, ranging from untreated plain metal to plate glass, felt, suede, and finally both hard and soft rubber. The effect of a typical label clamp was also checked.

We found that the differences 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.

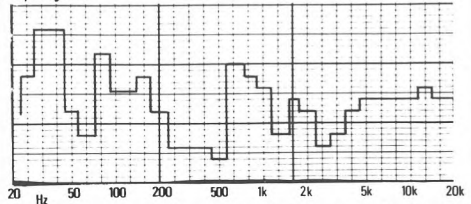
Take the case of the Sondek and its well known felt mat. Suppose a system had been constructed around it whereby the mat, player, arm, cartridge, amplifier and speaker were all complementary and produced a satisfying sound balance. The substitution of the soft composition 'Dumpa' mat would produce a 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 30-45 Hz, 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.

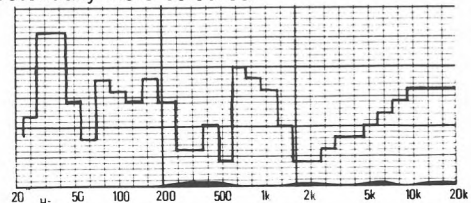
Perhaps dealers who stock and sell the more expensive 'special' mats (one glass mat currently costs around £50) could keep a loan stock and allow customers to try several at home before purchase?



1) The reference trace for the 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 $\frac{1}{3}$ -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

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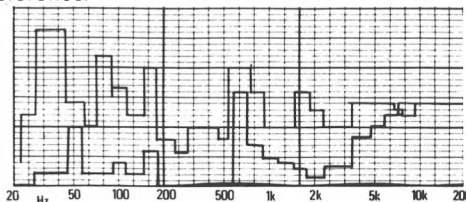
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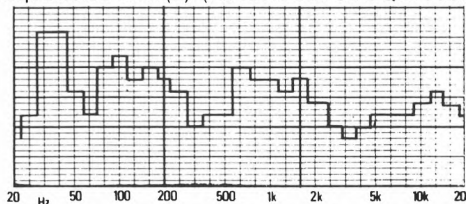
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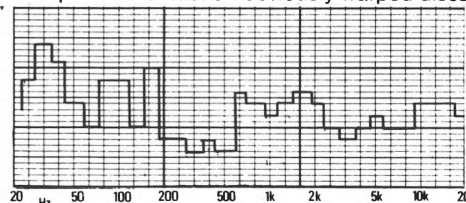
further accentuated the 30-40Hz lift, while the overall noise level was 9.5dB down on the reference.



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*.)

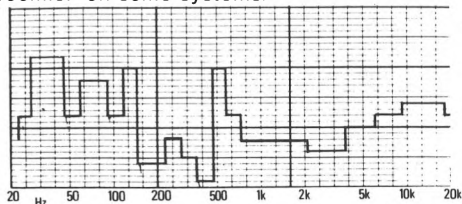


5) This strikingly good absorption result was achieved using a nominal glass mat, in this case a 10mm thick Rega platter, which approximates to the glass mats currently available. A reduction of 12dB was attained, with the 'A' weighting clearly not showing the full benefit at low frequencies. Compared with the rubber mat (4) the following improvements in 1/2-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.



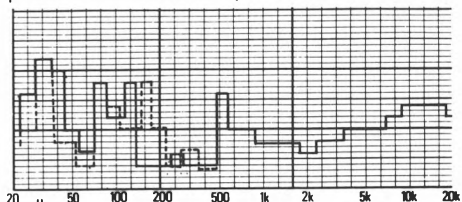
6) A Linn felt mat showed a fairly even 'neutral' character but with less effective absorption at 5.7dB.

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

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good deal of the mat termination and absorption 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 absorption 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 absorptive 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 'openness' 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 exorbitant. 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.

CUNARD COMPETITION

At the Cunard Show 1981, the *Hi-Fi Choice* stand held a competition entitled 'Let us pick your brains'. It may be a cliché, but it is also a truism to say that the entries were of a sufficiently high standard to make judgement painful. In the end the following winners were selected:

- 1st Prize (Linn *Sondek LP12* turntable)
Mr A. Lockwood, Luton, Bedfordshire
- 2nd Prize (Mission 774 tonearm)
Mr K. D. Connelly, Forest Row, Sussex
- 3rd Prize (ADC *XLM III Imp* cartridge)
Mr I. M. B. Erskine, London W11

Our thanks to all those who took part. Your suggestions will be taken seriously, particularly the widespread request for more combination/interaction information. We agree with you about a number of areas where the magazine could be improved, though a number of 'ideals' cannot be pursued for practical reasons.

The Editor.

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wide range of products, and serve to illustrate the importance of certain aspects of design.

Design

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 continuing 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 have 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 rotational 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

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Upon reflection this has been the most difficult turntable issue to produce so far. Our increased attention at the 'audiophile' end of the market resulted in a move away from the mass market models where we have plenty of experience, and where cause and effect are usually clear enough. It became obvious that comparatively subtle interactions between high quality components could 'make' or 'break' the performance of a 'superfi' turntable combination. Perhaps this issue should have been retitled 'Disc Playing Systems', since we feel most confident in our assessments of complete systems amongst 'superfi' components.

The Linn proved to be the classic audiophile turntable available at anything like a sensible price. It was used exactly as the manufacturer's recommend, with the felt mat, full and detailed alignment, and the latest *Ittok* and *Asak* components (not however the 'special' versions of these). It did not offer perfection – no hi-fi ever can – but in our opinion this disc player fended off all the opposition until a doubling of system price level was reached.

Our findings reinforce the view that single motor units, arms etc, cannot attain their full potential until a compatible match has been identified, enabling a set of balanced disc player components to be assembled. The separate component goal of high neutrality and universality, permitting easy interchangeability would therefore appear to be inappropriate at the high quality end of the market. Furthermore individual changes made to a balanced system which can theoretically be shown to improve matters, can actually detract from the subjective performance of the whole.

Take the case of the Pink Triangle. Its particular character was such that we felt the *Asak* cartridge was unsuitable even if used in an *Ittok*. The almost bland, neutral and comparatively recessed midrange sound needed a more 'forward' sounding cartridge; the *Koetsu* proved to give the best results. Each platter and mat combination lends its own peculiarities, and wherever possible audition of a complete and set-up system is advisable before purchase.

Leaving behind the audiophile stratosphere, several models at more modest price levels also demonstrated the benefits of system design, and in so doing provide the consumer with foolproof, consistent and value-for-money performance. Noteworthy are the Technics parallel tracking group, with their low mass integrated cartridge/arm; these had above average structural integrity

and mass, and came fitted with fine quality highly compatible cartridges.

Choice has never had much sympathy with those silver-plated plastic creations sporting innumerable gadgets of dubious value (such as auto track selection and quartz readouts), so it was gratifying to find that an old stalwart, the Thorens *TD160CIII* has returned to these shores. The Swiss parent company tried to withdraw this straightforward model a year or so back, but with its new mat and despite its age, it immediately merits recommendation, showing clear advantages over younger and flashier competitors.

A similar pattern is also demonstrated by the German Dual range, where the old style sprung-chassis 505 is far more competitive than more recent orientally styled stablemates, the 741Q and 508.

This rise and fall in product quality from various manufacturers is a continuing curiosity. For example, this time it is Sansui's misfortune to come up with product of little interest; likewise the Toshiba/Aurex range is less interesting than before. These two manufacturers appear to be in competition to use the lowest quantity of material for their turntable construction; I have seen more substantial saucepan lids than certain of the frail but highly polished platters fitted to some of these models!

Other Japanese manufacturers have had some success using the subchassis principle, notably Technics, Akai and Pioneer. But the most refined example is undoubtedly the Lux *PD300*. Strong in many respects, this design seems to have undergone revision at the last moment in order to cope with an unwarranted (?) fear of subchassis instability, resulting in the addition of excess damping to the suspension (see review). With further attention paid to spring rate and damping, however, the '300 could well become one of the world's leading analogue turntables, and even as it stands it remains a fine performer.

Conversely, experiments in the direction of extreme mass and strength are typified by the Marantz and Trio top line models. These aim to lock the arm and platter together *via* massive inertia and rigidity in the plinth. In theory vibration will be suppressed and isolated from the playing section by this closed loop, but in practice the stylus remains excited by numerous resonances throughout the frequency range, due to imperfect dynamic balance and finite plinth chassis rigidity.

Fashion clearly plays a part in turntable design, but trends are nonetheless discernible from this

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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.

Tonearm factors

The tonearm is also a critical component, in that both its electrical and physical characteristics – lead capacitance, structural weaknesses and resonances, effective mass and geometric properties – all influence the sound quality. An aspect which has been looked at concerns the long established but little discussed relationship between the vertical pivot plane and the stylus. As noted in the *AT1100* review, a pivot position significantly above the stylus results in an upward directed force component which counteracts tracking downforce, particularly when the stylus undergoes increasing frictional drag from strong music modulations. Thus a momentary downforce reduction occurs, just when the maximum downforce may be required for optimum tracking, thereby reducing tracking stability. The majority of the arms examined suffered from this defect to a greater or lesser degree, and these included the Syrinx *PU2*, plus most of the unipivot types including those from Ultracraft, Mayware, Hadcock, Decca and Connoisseur, as well as the ADC *LMF* series, to name but a few. To our knowledge there are several tonearms which have been specifically optimised, including the unipivot Michell *Focus*, the Audio Technica *AT1100*, Helius and *SME III* models. By placing the vertical pivot plane at the stylus the downforce does not vary with drag. Placing the pivot below the stylus produces an overpressure on loud sections momentarily aiding tracking, though the overpressure does not develop at a faster rate than the subsonic resonance risetime will allow, and tends to appear after some 100ms or so delay. Specifically the *AT1100* places the plane a little below the stylus for most cartridges. Warp wow is of course at a minimum at the 'mean warp height' position, though this effect is rarely of a worrying magnitude with most designs.

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 spined collet type fixing (eg *F.R.*). Mismatch and flexure 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 (eg *Infinity Black Widow*, *Micro MA707*). 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 *Hadcock GH228*); less desirable behaviour produces severe jumps in the energy trend, implying that the effective mass is discontinuous with frequency (eg *BIC 75*).

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*, *Ultracraft AC30* or *Technics SL10*), while others clearly show a different and less uniform trend as regards both balance and resonance distribution (eg *Thorens 115* and *105*, *Fidelity Research FR12*, and *Michell Focus*).

Lead capacitance

While of negligible importance where moving-coil models are concerned, lead capacitance is

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vital with many moving magnet models. Taking as an example a 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 instructions for cartridge fixing, and the manufacturers generally not supplying any form of protractor. Several accessories for correct alignment are available: for example, a recent introduction from Elite Electronics proved useful, as did our own two point gauge from *Cartridges and Headphones* (see p. 38). Models with supplied cartridges all too frequently arrive 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 over and beyond the usual 'align it by the instructions' 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 range is 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 lower mass cartridges with compliances of up to 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 suspension 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!

It remains a matter of concern that despite our present well developed understanding of good turntable design, so many basic mistakes are evident in the isolation techniques employed by manufacturers.

Quality and consistency

Quite a number of turntables (including some of the most expensive) required retesting due to the faults evident on the first review sample supplied. About 20% overall were substandard: for example, direct drive motors where unexpectedly high wow and flutter and/or rumble was generated. One deck did not work at all!

Several showed incorrect arm geometry. This was rarely a design fault, but was usually caused by incorrect instructions, while several ready fitted cartridges were in fact incorrectly aligned.

Far too many tonearms possessed frail, poorly adjusted bearings with excessive slop and rattle. Play or looseness in the arm system adds a random indecisiveness to the effective cartridge position, which clouds detail and gives an almost 'fuzzy' effect to the reproduction. High lateral friction values of the order of 60–100mg were often recorded, and these are barely satisfactory.

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Bias compensation continues to be frequently a 'hit or miss' affair, with similar arms demonstrating rather different readings, while the compensators were poorly calibrated with a typical 50% error, and in many cases they added lateral friction due to poor design.

The worrying thought is that if these problems were present on 'official' review stock, how severe is the quality variation in the shops? One might well feel happier if the dealer were to check out your turntable before purchase, and any dealer who is appropriately equipped and prepared to carry out effective pre-sales service is clearly likely to be more than worth a full retail price.

In the last issue it was commented that turntables seemed rather primitive in engineering terms considering their cost, particularly so when compared with a good SLR (single lens reflex) camera, for example. For £150.00 or so, an SLR offers an array of high precision bearings in a fine state of adjustment, as well as complex and delicate mechanisms and gears. Sophisticated multi-element optics made to extraordinarily close tolerances are part of the package, which also includes an electronics content comprising LED displays, light metering and timing circuits, many of these on microchip processors. By comparison, most £150.00 integrated turntables appear to offer little for the money.

To meet the digital audio player challenge in the coming years, the conventional turntable will have to be more competitively priced and engineered, in order to offer a viable and less expensive alternative to the digital player. Inevitably the latter will be initially rather expensive during the early years of its manufacture, and will thus be inappropriate for many budget and medium priced hi-fi systems.

The digital future

In the previous issue I speculated somewhat prematurely on the availability of the 'compact disc' digital player. Our latest information now suggests the latter part of 1982 as the probable UK release date. A basic player is expected to sell for between £150 and £300, being self-contained and only requiring an auxiliary lead connection to an amplifier. The standard now adopted is a full 16-bit (rather than the 14-bit I noted previously), with a 44.1 kHz sample rate. Quoted parameters so far include signal-to-noise ratios and channel separation of better than 90dB, and a 10Hz to 20kHz ± 0.5 dB frequency response, with peak level total harmonic distortion below 0.05% and a speed stability

(wow, flutter and pitch) of close to quartz-oscillator precision (*ie* better than 0.01%). Tracked by a laser cartridge' only the light beam contacts the disc, and the 120mm diameter discs will play for an uninterrupted hour. An inbuilt error correction system should nullify scratches, resulting in very durable recordings. Major manufacturers at present publicly committed to this system include Philips, Sony, Technics, Grundig, Revox, Sanyo, Pioneer, Toshiba, to name but some.

On paper digital sounds almost too good to be true, but the quality of the above specification can be readily perceived in audible terms. Anyone keen on piano or church organ music, for example, and with a good ear for pitch, would discover a solidity and stability of tone and pitch with digital replay which provides a much more immediate impression of the live instrument. By comparison, analogue disc replay of such programme offers barely acceptable wow levels on most pressings. Transients are also reproduced with an almost electric sharpness and clarity on digital, with uncanny precision of stereo localisation detail, providing information right back to the recording microphone technique. The distortion at high levels normally associated with stylus mistracking or tape compression is entirely absent, and the system is likewise immune to acoustic feedback or vibration coupling. (Prototype player mechanisms have been shown to absorb up to 5g of shock before the laser head loses its optical grip on the impressed information spiral.) Background noise is also inaudible.

Despite these positive attributes, there are however certain mild reservations concerning earlier and some current digital recording systems. If significant, these worries may form the basis of a continuing if misplaced affection for conventional analogue systems, which may then enjoy prolonged life despite numerous and readily appreciated imperfections.

I recently had an opportunity to assess digital versus analogue under true 'double blind' conditions via the Nimbus *Hammerklavier* demonstration set, specifically mastered for this purpose. One unexpected result was my ability to discriminate between the three mastering systems employed via the resulting analogue discs. The techniques represented were direct cut, Dolby A analogue tape master, and a 16-bit Sony *PCM 1600* digital system. The analogue tape process involved extra processing on the ambisonic mike system, and theoretically this might be expected to impair the stereo image. In practice this was found to be the main point of difference when compared with the other two. Digital and direct

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cut programmes gave a similar image stability, the latter very slightly duller in the treble (the PCM 1600 has marginal high frequency shelf loss). Direct cut and master tape provided comparable ambience and low level detail, but I was surprised by a mild but detectable loss of low level ambience and detail on the digital: I had expected it to be indistinguishable from the direct cut, and ended up placing it a close third (analogue tape in second place).

If valid – and similar results have been reported by other critical listeners – how then do we value digital? Are we going to have to trade a degree of subtle ambience on some recordings for the acknowledged high level signal virtues offered by digital? In fact, the answers lie partly in the original specification quoted for the digital system, where all is not quite what it seems, and partly with the early Sony PCM1600 used for the *Hammerklavier* sessions.

The quoted 90dB dynamic range/signal-to-noise ratio for digital is not in fact comparable with a similar figure derived for an analogue system. Exceeding peak level on digital has a hard limiting effect with an ensuing rattle, unlike the more forgiving 'soft' progressive compression on analogue tape. Recording engineers have thus tended to under-record with digital, and often 10dB of the available peak level is lost.

At the digital noise floor there is an effect akin to a coarse photographic emulsion 'grain', where the low level signals may be broken up and lost, since no more 'bits' are left on which to code them. The noise floor on analogue tape, however, is similar to a slightly ruffled pool: the surface disturbance veils but does not obliterate the detail beneath. We can hear information 10dB or more into an analogue noise floor. Moreover, though loud music is more disturbed on analogue, we seem to tolerate happily short term peak distortion.

At low levels, digital distortion is higher than analogue, and increases as levels are reduced, whereas analogue gets cleaner and clearer due to improving linearity. Psychoacoustically, a Dolby mastertape gives some 85dB perceived dynamic range (*ie* the ratio between signal peak and extinction), while for superior quality current digital systems appear to offer about the same 85dB (where 16-bit has an S/N ratio of -95dB). Perhaps this is the reason why faults can be heard, and why the low level information is the first area to suffer on digital recordings. At low levels, digital inharmonic modulation products become increasingly important, and those who

have claimed some unsettling aural effects may be hearing these.

Accepting that a theoretically 'perfect' 16-bit digital recording does in fact have an identifiable if highly subtle imperfection (heard *via* high level replay on electrostatic headphones), this is not the end of the matter. We now know that the early PCM1600 unit used by Nimbus suffered from audible imperfections which have since been rectified. In addition the introduction of very low level noise ('dither') to the input has been found to improve the low level sound quality markedly, even to the extent of reintroducing a natural-sounding decay of ambience and reverberation into the noise floor. This, plus greater skill in recording, including fuller modulation, can allow the psychoacoustic digital dynamic range essentially to equal the analogue master tape, without conceding any of the other digital virtues. I can confirm this from recent trials using a digital system in wire link bypass A/B comparisons.

The proper exploitation of digital recording requires digital home replay, and many major record producers have inadvicably promoted early and in some respects imperfect digital recordings in analogue issues. This has not entirely been to their advantage; nor has it done much for the reputation of digital systems.

On balance there is little doubt however that compact digital discs will revolutionise the middle market, offering a much improved sound quality quite independent of matching problems like lead capacitance, effective mass, feedback, and other related ills. I expect that even top quality analogue players will eventually succumb.

Audiophiles are likely to continue their pursuit of excellence for a while at least, *via* improved analogue equipment, but they will soon be frustrated by the almost wholesale use of digital mastering by the studios. Once a session has been digitally mastered, there is no point whatsoever in cutting an analogue disc which will only make matters worse. There is no doubt that in the long run digital recording and replay is the only way to go.

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BEST BUYS AND RECOMMENDATIONS

As in previous editions of *Turntables and Tonearms*, there is no Best Buy category as such, and we have restricted ourselves to 'Recommended' and 'Worth Considering' differentiation. This is largely because even the best products fall somewhat short of the ideal despite being very expensive, while even the best of the cheaper models show manifest flaws to mute our enthusiasm.

This listing should only be taken as a guide, particularly where separate components are concerned, as their performance may well be determined by the quality of set-up or combination. Note also that the value judgements are based upon the prices quoted, that prices do fluctuate significantly, so some re-interpretation may be necessary.

RECOMMENDATIONS INTEGRATED TURNTABLES

Technics SP15

(inc EPA500 and plinth system, £650.00)

More competitively priced than some of its obvious rivals, if care is taken in siting, this no-nonsense unit can provide a high standard of reproduction, offering very good versatility in arm mass/cartridge compatibility and motor speeds, and giving fast start-up.

Linn Sondek + Ittok (£580.00)

Forming a finely matched combination of exceptional subjective performance, they are complemented by the recommended Asak (£180) moving-coil cartridge to give a top class disc playing system, of fine overall balance.

Linn Sondek + Basik (£385.00)

This offers a worthwhile introduction to the Linn 'system' via a fine but inexpensive tonearm. This comes fitted with a 'starter' cartridge, but will benefit from better alternatives; the final upgrade involves the substitution of an *Ittok* tonearm with *Asak* cartridge.

Technics SL Series (from £180.00)

The best all round member of this group is the *SL-7* (£200.00), a disc sleeve sized automatic giving a good performance, factory fitted with a fine compatible cartridge which is uncritical of loading. We preferred this to the physically larger but otherwise similar *SL-QL1* (£220.00), which is also good value. But the better of the larger models is the *SL-DL1* (£180.00). Although not quartz-locked, it does offer variable speeds, and the sound, complete with its own matched cartridge, was also well liked. At higher prices, offering alternative presentation and facilities, the *SL10* and *SL15* also merit consideration.

Michel Focus with Basik

(factory fitted) (£170.00)

Conveniently fitted with a Linn *Basik* tonearm, this forms an interesting and well matched combination at a modest price. The motor alone is also worthy of recommendation.

Thorens TD160C Mk III (£160.00)

Reissued in its latest form, this traditional manual turntable system comfortably merits recommendation, offering a good performance with a precise low mass arm.

Rega Planar 2 (£115.00)

Omitted from the reviews at the manufacturer's request, this well-balanced player is manually operated and provides a well above average standard of sound quality. Due to limited isolation at low frequencies, some care is needed with siting. The *Planar 3* (£148.00) is similar, but has greater mass and tighter tolerancing.

Dual 606 (£95.00)

The 606 represents a highly competent direct drive deck with good facilities and a quality low mass arm giving an above average sound quality. The new pricing enhances its competitiveness.

Dual 506.1 (£85.00)

Similar to the 505 and 506, this restyled deck includes a cartridge, and if deemed suitable, this recommended combination could make a good choice.

Thorens TD104 (TD105) (£87.00/£104.00)

Gaining recommendation by virtue of their new competitive pricing, these models offer low mass arms, with useful operational features and a good performance for the price.

B&O 1700 (£90.00)

A superbly styled automatic player, with minimal complication and no spurious controls, this turntable offers a low mass tonearm with integrated cartridge, and provides stable results under difficult shock and feedback situations.

Dual 505 (£70.00)

One of the least expensive models to gain recommendation, the 505 has a low mass arm, and provides an above average, well balanced performance for the price.

RECOMMENDED MOTOR UNITS

Lux PD300 (£500.00)

This comprehensively designed and well isolated unit was found to justify its high price by offering very low coloration via its suction platter, and was able to accept many models of tonearms.

Linn Sondek LP12 (£348.00)

Having stood the test of time, and showing continued subtle refinements, the *LP12* works

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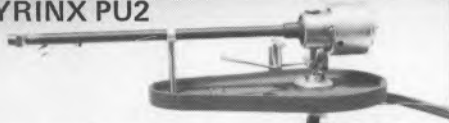
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BEST BUYS AND RECOMMENDATIONS

best with the *Ittok*, but nonetheless remains a fine motor unit in its own right.

Dunlop Systemdek (£300.00)

This is a high quality motor unit offering fine sound quality, excellent isolation, and easier setting up than usual.

Pink Triangle (£300.00)

This unit was easy to align, and offers very low levels of coloration, plus fine sound quality and excellent isolation.

Thorens TD160S (£170.00)

The sound quality offered by this well established subchassis deck is high considering its price level.

Ariston RD80 (£160.00)

Though occasionally tricky in set-up, this deck provides very good sound quality for the price.

STD 305S (£150.00)

This is a good value subchassis deck, relatively uncritical of alignment.

Walker CJ55 (£135.00)

This is another low priced subchassis turntable. If production models are to the same standard as the one we tested, they should offer good value, a promising sound quality, and be easy to set up.

Michell Focus (£130.00)

See integrated players.

Thorens TD160 A/B (£120.00)

This is the basic version of the *160S*, and continues to offer fine value for money.

RECOMMENDED TONEARMS

Linn Ittok LV11 (£230.00)

Nothing can ever be perfect, and the *Ittok* does suffer a little in the upper midrange. But in all other respects it is one of the finest arms available. Offering a medium/heavy effective mass, it is also fully calibrated.

Mission 774 (£160.00)

Still occasionally flawed on quality control, this low mass arm is nonetheless highly versatile and offers a fine sound quality.

Helius (£150.00)

A finely engineered product, this arm gave a confident performance on all our tests.

Grace G707 (£144.00)

Though long established, this tonearm still sets a respectable standard in terms of its sound quality and engineering.

Audio Technica AT1100 (£100.00)

This low mass arm offers adjustable subsonic damping, rigid arm carriers, superb finish, and good tracking, as well as a fine sound.

Ultracraft AC30 (£100.00)

Now more competitively priced, this superior unipivot design is highly versatile and offers a

good sound quality for the price.

SME IIS (£85.00)

A well equipped arm of low mass and generally good performance, it offers the unique SME detachable carrier system for cartridge interchangeability.

ADC LMF1 (£65.00)

This low mass fixed headshell arm is well made and finished, and provides a relaxed sound. (Note that a large rear clearance is required.)

Mayware Mk III (£57.50)

This well engineered arm of excellent finish, uses a unipivot with fluid damping; its low mass suits many cartridges.

Linn Basik (£45.00)

This medium/heavy mass arm comes complete with a starter cartridge. It is unusually well made, offering good sound and meriting a clear recommendation.

WORTH CONSIDERING: PRODUCTS OF ABOVE AVERAGE MERIT

INTEGRATED TURNTABLES

Akai APQ70 (£170.00)

Akai's best model to date, the *APQ70* is above average in many respects, and also has automatic facilities; it offers a factory fitted compatible Ortofon cartridge.

Philips AF829 (£165)

The arm and cartridge were not entirely compatible, and there may be some complications in fitting a substitute, but this player gave a generally competent all-round performance.

Mitsubishi DPEC7 (£160.00)

An honest medium priced direct drive, this turntable is well engineered and offers fairly good value.

Sony PSX600 (£180.00)

This comprises a well made turntable with auto facilities, subsonic damping, and excellent impact shock immunity.

Denon DP30L (£130.00)

This inexpensive direct drive turntable offers good quality construction and finish.

ADC 1700DD (£105)

Although there are reservations, this model has a high quality compatible cartridge fitted, which ensures reasonable value for money. The **ADC 1600** is very similar, with a lower quality cartridge and no quartz lock, at a commensurately lower price.

ADC 1500FG (£70)

Although somewhat flawed by rumble, the performance was respectable for the price, the high mass arm suiting the (Recommended) *QLM34*.



WHO DO WE THINK WE ARE, ROYALTY?

No, but we suspect some of our customers are. Especially when you consider the quality of equipment they buy. And the inevitable prices they pay (even though we keep them as low as possible). But then, in terms of gear, we're talking about the aristocracy. To mention a few names - Linn Sondek turntables, Meridian amps and Quad Electrostatic speakers. Like our customers, this kind of equipment expects to be treated with a bit more respect than the average. Which is why our Demonstration Room is rated among the best in the country. With a near perfect domestic listening environment. So it's natural that we should treat all our customers like royalty. And insist on providing them with Demos by appointment only. Taking the pressure out of Demos is one way we ensure a visit to Audio T won't lead to disappointment. Telephone for your appointment now on **01-794 7848**.

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BEST BUYS AND RECOMMENDATIONS

MOTOR UNITS

Lux PD555 (£1,700.00)

This big Lux with its massive suction platter achieves much in terms of sound quality, but the price places it beyond any value recommendation. Care with siting is still required.

Marantz Esotec TT1000 (£1,000.00)

Similar to the above Lux model in some respects, the Marantz also succeeds on the basis of its high standard of sound quality.

Oracle Delphi (£680.00)

Despite its high price, the Oracle deserves listing here on the basis of its performance on many parameters, particularly its fine sound and good engineering.

Image (£500.00)

This unusually styled product has the potential of a very fine turntable: only time will tell whether it makes the grade or not.

Technics SP15 (£315.00)

As a chassis unit this requires careful siting, but it remains a superb semi-professional motor offering great reliability and state of the art performance.

Logic (£300.00)

This turntable demonstrates great potential, the realisation of which is now in the hands of its designers, and depends on their success in finalising the suspension.

Ariston RD110/RD11 S (circa £250.00)

These turntables can be a trifle awkward to set up, but can achieve sufficiently good sound quality to merit inclusion here.

STD 305M (£200.00)

A good quality subchassis unit.

Thorens TD126 III (from £230.00)

Despite certain reservations, this deck offers a good sound quality in all versions (*ie* with SME or Thorens arms fitted, in addition to the motor unit).

Audio Linear TD4001 (£200.00)

Achieving a good standard in its latest form the higher price precludes full recommendation.

TONEARMS

Sumiko (£800.00)

Despite certain reservations (not the least of which is the price!), this arm deserves inclusion due to its very good sound quality.

Fidelity Research FR64S (£300.00)

A very high mass arm, it offers fine sound quality with particular low compliance cartridges.

Fidelity Research FR64FX (£270.00)

This comprises an improved reduced mass version of the '64S, and is therefore suited to a wider range of cartridges.

Syrinx PU2 (£190.00)

This arm has some drawbacks, but provides very good sound for the price.

Audio Technica AT1010 (£120.00)

A good quality medium/high mass tonearm, which possesses a detachable headshell.

Hadcock GH220 (£100.00)

This model is listed here rather than gaining an outright recommendation due to continuing quality control problems. It possesses fine strong rigid bearings, with good sound quality for the price.

Michell Focus (£85.00)

This versatile low mass unipivot, the Focus offers very good geometric accuracy, but with some minor weaknesses such as the insecure counterweight fixing.

Hadcock GH228 (£70.00)

Constituting good sound quality value in a low mass unipivot design, marginal quality control problems again cause this model to be listed in this section.

SME 3009II N/D (£70.00)

This long established arm is well made and finished, and continues to offer above average sonic and engineering value.

ADC LMF2 (£70.00) and **ADC ALT1** (£35.00)

Both these models are well calibrated and offer quite good value at their respective prices, the ALT clearly representing the better buy.

SUGGESTED COMBINATIONS

Prices are approximate, and this is not a comprehensive list.

Ariston *RD80* + *Basik* (£205.00) or SME *III S* (£250.00) or Mayware (£220.00).

Dunlop *Systemdek* + *Ittok* (£530.00) or Helius (£430.00) or Mission 774 (£450.00) or Syrinx (£500.00).

Pink Triangle + *Ittok* (£530.00).

Lux *PD300* + *Ittok* (£730.00) or Sumiko (£1,300.00) or *FR64FX* (£770.00).

STD *305S* + Mayware (£220.00).

Thorens *TD160S* + Mission 774 (£340.00) or Helius (£320.00) or *AT1100* (£270.00) or Ultracraft (£270.00).

Thorens *TD160BC* + SME *III S* (£205.00) or Mayware (£160.00).

Walker *CJ55* + Hadcock 220 (£230.00) or *Basik* (£180.00) or Helius (£285.00).

Type	Technical Motor Performance		Arm (g) (damping)		Arm Resonances		Arm Bias and Friction		Arm Lead Cap		General Engineering Quality		General Acoustic Isolation		Vibration and Acoustic		Typical Price £		
ADC B3001	motor d.d.	good	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	170	
ADC 1500FG	auto ret b.d.	average—	21	average+	average	220	average	average	average	average	average	average	average	average	average	average	average	70 (c)	
ADC 1700DD	auto ret q.d.d.	average—	6	average+	average	200	average	average	average	average	average	average	average	average	average	average	average	105 (c)	
ADC ALT-1	arm	—	8.5	average+	good	180	good	average+	—	—	—	—	—	—	—	—	—	35	
ADC LMF-1 (2)	arm	—	6.5	good	good	185	v. good	good+	—	—	—	—	—	—	—	—	—	65	
Aiwa LP3000	auto q.d.d.	v. good	25	average—	excellent	250	v. good	average	average—	average	average	average	average	average	average	average	average	375	
Akai AP-Q70C	auto ret q.d.d.	v. good	13.5	average+	good	105	good	average+	good	average+	good	average+	good	average+	good	average+	good	170 (c)	
Ariston RD80	motor b.d.	v. good	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	170	
Ariston RD110	motor b.d.	good	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	250	
Ariston RD11S	motor b.d.	v. good	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	250	
Audio Linear TD4001	motor b.d.	excellent	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	200	
Audio Technica AT1010	arm	—	16	average+	average+	95	v. good	good	—	—	—	—	—	—	—	—	—	150	
Audio Technica AT1100	arm (straight)	—	6 (d)	good	good	95	v. good	good+	—	—	—	—	—	—	—	—	—	100	
Audio Technica AT1100S	arm (S tube)	—	12.5 (d)	average+	good	95	v. good	good	—	—	—	—	—	—	—	—	—	120	
Audio Technica AT1005	arm	—	19	average—	good	75	v. good	average	—	—	—	—	—	—	—	—	—	35	
Aurex SR-M70	auto b.d.	average—	20	—	good	—	—	—	—	—	—	—	—	—	—	—	—	121 (c)	
Aurex SR-Q770	auto q.d.d.	good	8.5	average—	average	175	good	average—	average	average—	average	average—	average	average—	average	average—	good	140	
Beogram 1700	auto b.d.	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	95 (c)	
Beogram 8000	auto d.d.	v. good	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	360 (c)	
Denon DP30LS	manual + lift d.d.	v. good	17.5	average—	good	80	v. good	average+	v. good	average+	v. good	average+	v. good	average+	v. good	average+	good	130 (c)	
Denon DP33F	auto q.d.d.	good	18	average	good	80	v. good	average	—	—	—	—	—	—	—	—	—	190 (c)	
Denon DP90L	manual q.d.d.	excellent	15.5 or 8	average	v. good	75	v. good	average+	average+	average+	average	average+	average	average	average	average	good	250	
Dual CS605	auto stop b.d.	average+	6 (d)	average	good	150	good	average+	average+	average+	average+	average+	average+	average+	average+	average+	average+	v. good	75
Dual CS608	auto-lift b.d.	good	6 (d)	average	average+	150	good	average	average+	average+	average+	average+	average+	average+	average+	average+	average+	v. good	80 (c)
Dual CS606	auto stop d.d.	good	6 (d)	average+	good	150	v. good	average	average+	average+	average+	average+	average+	average+	average+	average+	average+	v. good	95
Dual CS741 Q	auto q.d.d.	excellent	6 (d)	average+	good	150	v. good	average+	average+	average+	average+	average+	average+	average+	average+	average+	average+	v. good	220 (c)
Dunlop Sys4mdek	motor b.d.	excellent	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	300	
Fidelity Research FR64S	arm	—	35	good	v. good	80	excellent	good+	—	—	—	—	—	—	—	—	—	300	
Fidelity Research FR64FX	arm	—	20	good	good	80	excellent	good+	—	—	—	—	—	—	—	—	—	270	
Grace G707	arm	—	7	average+	good	—	v. good	v. good	—	—	—	—	—	—	—	—	—	144	
Hadcock GH228 Export	arm	—	7.5	good	good	140	average—	good+	—	—	—	—	—	—	—	—	—	75	
Hadcock GH220 (S/S)	arm	—	8 or 11.5	good+	v. good	275	average	good+	—	—	—	—	—	—	—	—	—	100	
Heliuss	arm	—	12	good+	v. good	95	v. good	v. good	—	—	—	—	—	—	—	—	—	150	
Hitachi HT660	auto q.d.d.	v. good	18	average	average—	155	good	average	average	average	average	average	average	average	average	average	average	v. good	180
Image	motor b.d.	v. good	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	500	
JVC QLY5F	auto q.d.d.	excellent	17 (d)	average+	good	95	v. good	average	average	average	average	average	average	average	average	average	average	v. good	200
JVC QLF6	auto q.d.d.	excellent	15	average	good	80	v. good	average	average	average	average	average	average	average	average	average	average	v. good	230

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GLOSSARY

Acoustic breakthrough: Sound that gets into the turntable and hence the cartridge from the air and thereby creates a risk of acoustic feedback (see separate entry).

Acoustic feedback: If any sound in the room can find its way through the body of the record deck to the cartridge stylus, then that sound will be reproduced from the loudspeakers, along with the wanted programme material. If too much of this sound from the loudspeakers is picked up by the cartridge in this way then a vicious circle of acoustic feedback will be created.

Arm mass: More accurately called *effective* arm mass, because it is *not* the weight of the arm on a pair of scales. It is the mass of the arm and cartridge combination that appears to be concentrated at, and thus felt by, the stylus tip which is tracking a record groove. There is nothing inherently good or bad about arms with light or heavy effective mass; what matters is the manner and choice of their combination with cartridges of different compliance and the low frequency resonance produced by such combination. See 'resonance'.

Belt drive: The motor has its rotational speed geared down to the required platter speed (33 $\frac{1}{3}$ rpm for LP discs) by a rubber or similar resilient belt which runs round a small pulley on the motor shaft and a large pulley attached to or part of the platter.

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 resilience. 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 the results on paper into better correlation with what the human ear actually hears. This is necessary because the ear hears various frequencies differently according to their volume level.

DIN, peak weighted: Wow and flutter measurements are measured by their peaks, and these doctored according to another correlation curve.

Direct drive: This type of motor has one moving part, the platter/centre spindle. The other part of the motor is fixed to the chassis or plinth.

Downforce calibration: Equivalent to tracking weight calibration, and related to any controls provided to adjust the force with which the stylus acts down on the record groove.

Gimbal: A pair of concentric bearings used in pick-up arms to give freedom of movement in the vertical and horizontal planes.

Headshell: On some arms the cartridge is securely mounted in a light casing or headshell, which is itself mounted at the end of a pick-up arm, and is generally detachable.

Hertz (Hz): Also kiloHertz (kHz) — The modern manner of denoting cycles-per-second. 1 Hz = 1 cycle-per-second, and 1kHz = 1000 cycles-per-second.

Lateral friction: The resistance to movement of an arm and cartridge combination in the horizontal plane (ie across a record), caused by friction in its bearings.

Overhang: The extent to which the cartridge stylus extends beyond the centre of the platter is critical, and controlled by fore and aft adjustment of the cartridge on the arm. Usually, such adjustment is provided for in a headshell (see separate entry). Overhang adjustment effectively controls the lateral angle at which the stylus tracks the groove.

Resonance: Any article 'rings' or 'sounds' at a natural resonant frequency when vibrated. So, all parts of a record

GLOSSARY

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. 33 $\frac{1}{3}$ rpm for LP disc). Error is expressed in percentage. The ear is relatively insensitive to absolute speed errors, as long as they are constant.

Speed drift: Any temporary variation up and down from the required rotation speed of the platter will create wow and flutter in the reproduced programme (depending on the frequency of the up and down variation). The ear is very sensitive to such changes.

S-type arm: A pick-up arm which is bent into a loose S-shape to minimise tracking error. (Alternatively the arm is straight and the cartridge or headshell is attached to its end at an angle).

Template: A plan or pattern to assist in correctly locating the pivot of a pick-up arm with respect to the platter centre.

Tracking error: The discrepancy between the truly tangential angle at which a record is cut and the slightly off-tangential angle at which it is tracked by a stylus on a pivoted arm during some parts of the arm's travel.

Vibration/Shock sensitivity: A purely *ad hoc* assessment of the susceptibility of the system to disturbance at very low frequencies; ie. jolting, springy floorboards etc.

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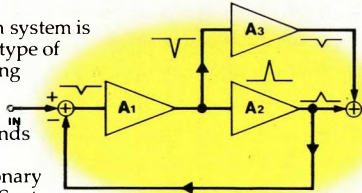
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the beginning!

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