

HI-FI CHOICE

TURNTABLES AND CARTRIDGES

The most comprehensive guide to buying turntables, pick-up arms and cartridges ever published.



£1.50

Best Buys Recommended
100 Models Tested



The new
ADC Headshell.
Something free
that's well worth
having.

We built our reputation on ADC cartridges with their unique induced magnet system. They perform far better than most other cartridges.

Now we hope to build another great reputation for the ADC Headshell. When you compare it to other headshells it has so many advantages.

For a start, it's precision engineered in magnesium. So its total weight is just 7.83 grams.

In fact, an aluminium headshell of the same thickness (3mm) would weigh 13 grams!

The beauty of making it in magnesium is also that it eliminates any twisting or resonance experienced with other types of headshell.

So the ADC Headshell has the perfect mass and rigidity for high compliance cartridges.

Naturally, it's particularly suited to ADC cartridges, perfect contact being ensured by 24 carat gold plated connections.

If you buy the ADC Super XLM Mk2, the XLM Mk 2 or the VLM Mk2, we'll make you a present of our new headshell.

You'll find it plugs in easily to most top quality pickup arms, and comes in a specially designed cabinet for three cartridges.



Distributed by BSR Ltd., Powke Lane,
Cradley Heath, Warley, W. Midlands B64 5QH.

Hi-Fi Choice No.5: Turntables and Cartridges by Martin Colloms

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Turntables and Cartridges

Consumers' introduction written by Adrian Hope

Test measurements, technical reports and conclusions written by Martin Colloms

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WHY GUILDFORD HI-FI HAS A NUMBER OF PROBLEMS

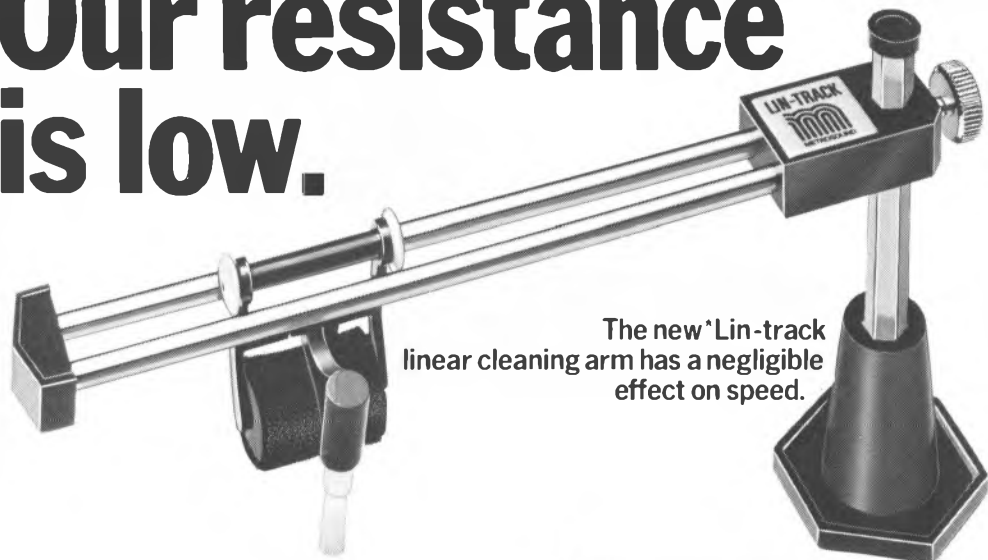
- SALESMEN** Sales personnel at this establishment have a disconcerting habit of treating the customer as though they were human-beings and capable of rational actions. On occasion they have recommended equipment when it was not in stock and have even recommended that customers listen to the equipment in their own homes prior to purchase.
- LOCATION** This shop is unwisely located more than twenty miles from Tottenham Court Road out in the wilds of Surrey. Customers are even allowed to park within walking distance which is unfortunate since the customer is not completely exhausted upon entering the shop and might not purchase the first item that is thrust at him.
- PRICES** Prices at this shop tend to be higher than those of well-known discounters. They try to justify this devious practice by offering generous trade-in allowances, hire-purchase facilities, delivery, installation, home-demonstrations and an extravagant guarantee.
- BRAND-NAMES** There is a genuine dearth of reassuring, well-known, household brand names at this establishment. Instead they make the iconoclastic and highly improbable claim that many other smaller, less touted manufacturers make equipment that actually sounds better, costs less, lasts longer and represents better value for money than the well known brands.
- TECHNOLOGY** This is going to be hard to believe but this shop actually stocks valve equipment. Everyone knows that valves have been dead for the past ten years, and no wonder! They are bulky, noisy, hot and they wear out. Their specifications are inferior to solid-state designs and to top it all they cost more than transistors. But these guys say that although this is true, Valve equipment still sounds superior and they intend to cater to people who care about listening to accurate music reproduction rather than those who are interested in mere technological innovations. To show that they mean business they now stock such outlandish brands as dB Systems, Paragon, Futtermans and Lux valve equipment and they threaten to bring in even more esoteric gear in the future.



GUILDFORD HI-FI

270 HIGH ST, GUILDFORD, SURREY Tel. 71534

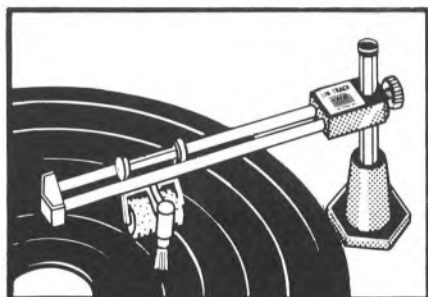
Our resistance is low.



The new *Lin-track linear cleaning arm has a negligible effect on speed.

It's a new concept, but so simple you'll wonder why no-one thought of it before.

It's compact, has low mass (below 0.5 grams) and will not affect the playing speed.



The independently pivoted brush tracks in the record groove at precisely the correct angle, while the velvet pad picks up surface grime.

With minimum height and overhang it will fit most turntables.

At £2.98 inc. VAT it's a small price to pay for really clean records.

Metrocare. More good sound ideas.

*Patent applied for.



Thorens Metrocare Accessories
Metrosound Audio Products Ltd., 4/10 North Road,
Islington, London N7 9HN. Tel : 01-609 0087

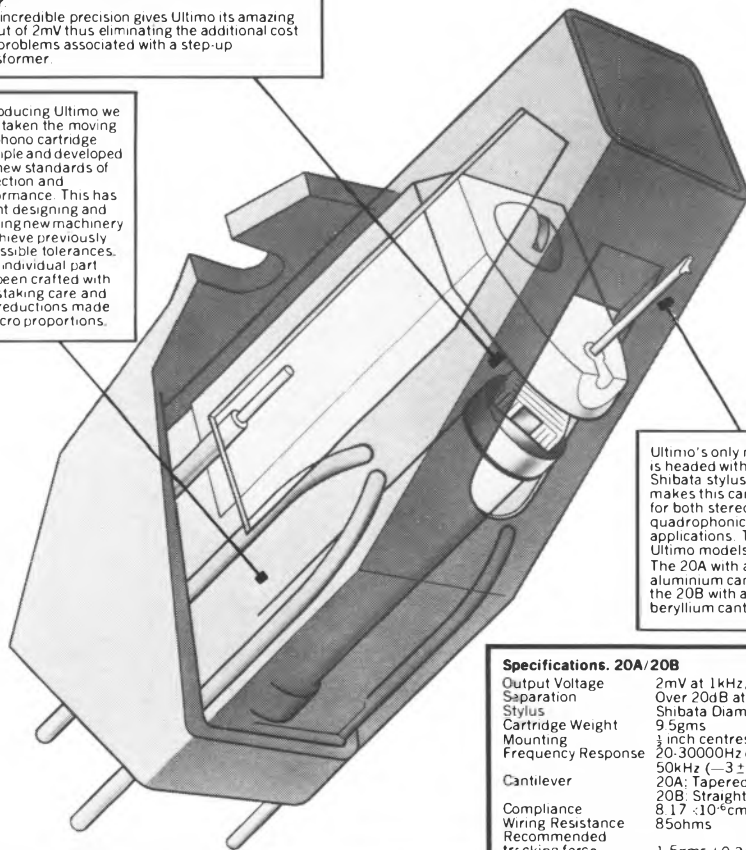
Ultimo

The beginning of your love affair with moving coils!

On a coil former this size (■) we have wound two separate coils over 200 times, at a 90° angle to each other.

This incredible precision gives Ultimo its amazing output of 2mV thus eliminating the additional cost and problems associated with a step-up transformer.

In producing Ultimo we have taken the moving coil phono cartridge principle and developed it to new standards of perfection and performance. This has meant designing and creating new machinery to achieve previously impossible tolerances. Each individual part has been crafted with painstaking care and size reductions made to micro proportions.



Ultimo's only moving part is headed with the famous Shibata stylus which makes this cartridge ideal for both stereo and quadrophonic applications. There are 2 Ultimo models available. The 20A with a tapered aluminium cantilever or the 20B with an ultrarigid beryllium cantilever.

Specifications. 20A/20B

Output Voltage	2mV at 1kHz, 5cm/sec.
Separation	Over 20dB at 1kHz
Stylus	Shibata Diamond
Cartridge Weight	9.5gms
Mounting	$\frac{1}{2}$ inch centres
Frequency Response	20-30000Hz (± 2dB) 50kHz (-3 ± 2dB)
Cantilever	20A: Tapered Aluminium 20B: Straight Beryllium
Compliance	8-17 · 10 ⁻⁶ cm/dyn
Wiring Resistance	85ohms
Recommended Tracking force	1.5gms ± 0.3gms
R.R.P.	20A £75.95 Inc VAT 20B £99.95 Inc VAT
12 Month Guarantee	
Each Cartridge has its own calibration chart.	

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TYPICAL EXAMPLE

LENCO L90 TURNTABLE

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CARTRIDGE AND ARM MATCHING IS CRITICAL

Whatever turntable you choose there is no doubt that the arm and cartridge combination is the most critical of the record playing system. Because of this we have spent many hours trying the hundreds of arm and cartridge permutations — measuring and listening to find the correct combinations. As a result of this we are able to match cartridges to your arm, or arms to your cartridge to ensure complete compatibility. We can also advise on the correct loadings to obtain the optimum matching between cartridge and amplifier.

Of course we are able to give comparative dems of any cartridges we stock, along with all the best in ancillary equipment — phone for details of hourly appointments.

Agents for: —

ADC, AKG, Ariston, Colton, Connoisseur, Decca, Dual, Empire, Fidelity, Research, Fidelix, Fons, Formula 4, Gale, Goldring, Harmon Kardon J.V.C., KMAL, Lustre, Lux, Micro Acoustics, Micro Seki, Monitor Audio, Nakamichi, Ortofon, Reference, Rotel, Sansui, Satin, Shure, S.M.E., Stanton, Stax, Technics, Thorens, Trio, Ultimo, Yamaha.

Audio T
The Audio Consultants

190 West End Lane
London NW6 1SQ
Tel. 01-794 7848

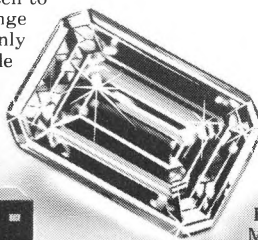
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Technics SL1700



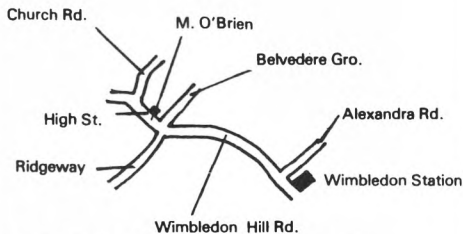
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Cartridges by: Ortofon, Ultimo, Fidelity Research, A.K.G., Pickering, Empire, Goldring, A.D.C., Audio Technica, B&O, Stanton, Shure.

Personal, uninterrupted demonstration facilities available. Please telephone for details.

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By Bus: 93 from Putney Bridge Station.

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Record care

A first class way to remove bothersome dust from hi-fi records is to immerse them in hot, soapy water and scrub them vigorously with a scouring pad. One annoying side effect of this method is that severe tracking problems may be experienced due to the absence of grooves.

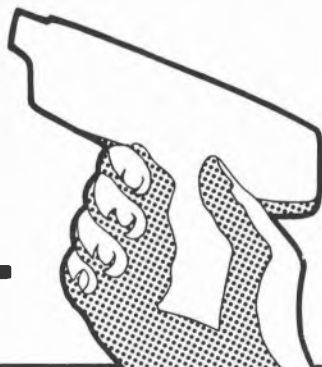
A better procedure is to prevent the dust getting on to the disc in the first place. Dust is attracted by static. The Zerostat anti-static pistol neutralises static, without contact, in seconds.

Don't get into a lather over record care, get yourself a Zerostat from your local hi-fi dealer, or, write to,

Department HFC, Zerostat Ltd.,
Edison Road Industrial Estate,
St Ives, Huntingdon, Cambs.
(telephone St Ives 62225)

Yes, the Zerostat pistol costs only
£6.99 (including VAT)

ZEROSTAT



WHY BUY BLIND?

To be honest, few people understand hi-fi. The jargon alone is another language. Squarewave response, pink noise, intermodulation distortion. The expressions are endless. And all seem designed to confuse the unwary. Because with hi-fi, a little knowledge is not only dangerous but expensive. Mistakes cost money. And getting it wrong is all too easy. Just to read a few reviews, a couple of brochures, and to talk to friends is not enough. Friends have prejudices. Manufacturers are certain to praise their own products. And a review in one magazine can often reach a different conclusion to a review of the same product in another. Fortunately, there is a better way. And Hi-Fi Choice can help you. Each issue exhaustively tests, reviews and compares at least fifty models in any one product category. By using exactly identical test methods, we are

able to select a number of units as 'Best Buys'. Models representing outstanding value for money. One of which will almost certainly meet your requirements.

To date there are Hi-Fi Choices on loudspeakers, receivers and cassette decks. And, included in the cassette decks issue is a survey of over fifty types of cassette tape. An edition on amplifiers will be published in September. Each will tell you everything you need to know exactly what to do when buying hi-fi. Ask your newsagent or hi-fi dealer for a copy today, or order direct from the publishers. It will cost you £1.00 or £1.50. Not a lot to pay to see what you're doing.

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Please send me the following copies of Hi-Fi Choice:

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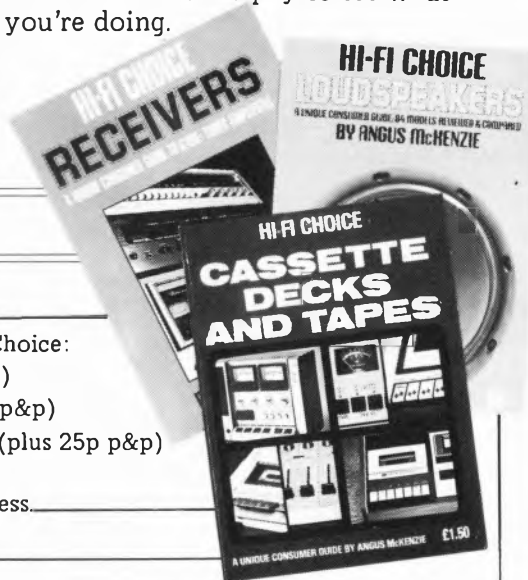
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Tenorel T2001ED R.R.P. £10.50 Excl. VAT.

Tenorel T2001SD R.R.P. £19.50 Excl. VAT.

Ask your local dealer for more details.

Distributed by:- **Condor Electronics Ltd.,
100 Coombe Lane, London SW20 0AY. Tel: 01-946 0033**

VAC-O-REC

The clean machine



Next time you play your favourite music, listen very carefully. You'll hear some very unpleasant sounds. Because, hidden inside every record there are microscopic dust particles. Like scouring powder they will grind into the grooves, wear away your sensitive stylus and gradually ruin your enjoyment. And, up 'til now, there's been very little you could do about it . . . most liquid cleaners and cloths only scratch the surface, they don't get deep down to the problem.

But, where conventional cleaners fail, Vac o Rec succeeds. Vac o Rec is an entirely new concept in record care. We call it our 'album saver'. Here's how it works . . . Take any record - EP, LP or 78 - and slot it into your Vac o Rec. Very gently the record will start to revolve as three separate cleaning operations go to work on the micro-grooves. Soft mohair brushes will reach deep down to dislodge and lift the dirt particles. This grime is then sucked

well away from the record surface by a powerful built-in vacuum cleaner. And, whilst Vac o Rec is cleaning up, special 'mylar strips' sweep the record surface to reduce static electricity and so prevent further build-up of fluff.

No other cleaner takes such care of your record collection. And you don't have to take our word for it - listen for yourself. Only Vac o Rec can give you back the sounds you love.

Available now from all good record and music stores.

vac o rec

YOU CAN HEAR THE DIFFERENCE

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Your best buy . . .

The great majority of shops buy turntables to meet popular demand resulting from magazine articles and also those turntables that are easy and simple to set up where such a service is offered. We, at Hampshire Audio, have not been influenced by magazine reviews for previously advertised reasons, nor are we concerned if the equipment is difficult to set up. However, it would appear that the Linn Sondeck LP12 has, as a result of magazine articles, acquired a certain mystique and we do know from extensive experience that the Linn Sondeck LP12 is one of the most time-consuming turntables to set up for maximum performance. Mystique or not, the Linn Sondeck offers the listener more detail than any other turntable we have come across and because of our enthusiasm for the LP12, we often suggest using one in systems that our customers say do not justify such a

fine piece of equipment. This initially blindered attitude of the customer is unfortunate but we are most willing to discuss with visitors to our demonstration studios why the LP12 can be used successfully with lesser equipment. However, such quality does demand a generous budget allowance for a turntable and as often this is not possible we are not at a loss to demonstrate an alternative unit at a lower price. All items are backed by our normal two-year labour and parts guarantee with, of course, our pre-sales check which we insist on even for turntables. Outside the guarantee period servicing on items supplied is charged out at no more than actual cost. Finally, being small, dedicated and knowledgeable, we are one of those few remaining shops where *real* personal satisfaction can still be found when buying hi-fi equipment.

. . .at Hampshire Audio Ltd

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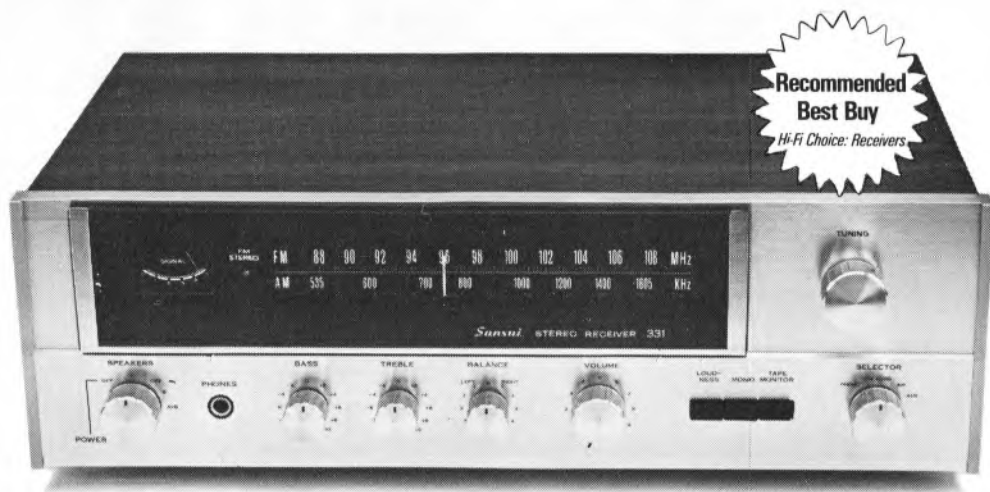
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Beneath its simple design, are sophisticated electronics. They guarantee the famous Sansui sound.

The 331 receiver offers excellent FM/AM reception with high stability and low distortion. Connected to a turntable and a pair of speakers, it allows you to sit back and enjoy the music you like. If you're in the London area, drop into our Showroom for a

full demonstration. It's just next to the G.P.O. tower. Or if you're out of town, see a qualified Sansui dealer.



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Continuous power into 8 Ω	
1000 Hz, each channel driven	15 W x 2
Continuous power at 1000 Hz	
into 8 Ω, both channels driven	13 W x 2
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both channels driven	12 W x 2
Total harmonic distortion	1.0%
Power bandwidth	20-40 000 Hz
Hum and noise (IHF)	80 dB
FM Sensitivity	1.3 μV (DIN)
FM stereo total harmonic distortion	1.0%
Controls	Bass, Treble, Loudness

Sansui

Thank you for listening

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BD2/A - The Connoisseur's First Choice

Based on the popular BD2, the BD2/A offers the hi-fi enthusiast all the features usually associated with Connoisseur turntables, such as low rumble, wow and flutter, plus the addition of an automatic pick-up arm lift off at the end of the record. This is achieved by an ingenious, though simple, electro-magnetic system which avoids having any physical contact with the pick-up arm. It is possible, therefore, to use top quality cartridges, tracking at less than one gram, without putting any extra side pressure on the stylus. The BD2/A comes either as a chassis model, or mounted on a slimline plinth, standing on rubber anti-vibration feet and fitted with a hinged dust cover. For those with restricted space, a compact plinth measuring only $13\frac{3}{4}$ " x $15\frac{3}{8}$ " x $5\frac{1}{8}$ " is still available.

Specification details

Rumble - 65dB when measured in accordance with DIN 45539 using weighting network, referred to 7cm/sec. at 330Hz.

Wow and flutter Less than 0.1%

Hum level - 80dB

The BD2/A Ask your local hi-fi dealer, or write to the factory for further details.



BD2/A Fitted
with the SAU2
Pick-up Arm.

Connoisseur

Write for further details to:

A. R. Sugden & Co. (Engineers) Ltd.
Manufacturers of Connoisseur Sound Equipment, Connoisseur Works, Atlas Mill Road,
Brighouse, West Yorkshire HD6 1ES
Telephone: Brighouse (0484) 712 142, Telex: 517144 Sugden G,
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**OUR REFERENCE SYSTEM COMPRISES
LINN SONDECK LP12, G707ARM AND
SUPEX 900E CARTRIDGE.
DEMONSTRATIONS AVAILABLE ON REQUEST.**

Other TURNTABLES we recommend as good value in their price range are: Rega, A.R., Connoisseur, Thorens, Pioneer, Trio and if you really need three arms, the DDX1000.



CARTRIDGES really need to suit the remainder of the system but as offering a good overall performance for the outlay we recommend models from Ortofon, Fidelity Research, Stanton, Pickering, Empire, Goldring, Sonus and Ultimo.

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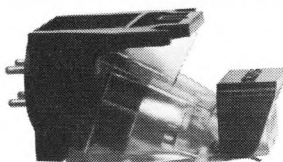
Access

Better Equipment



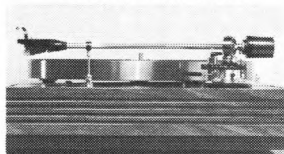
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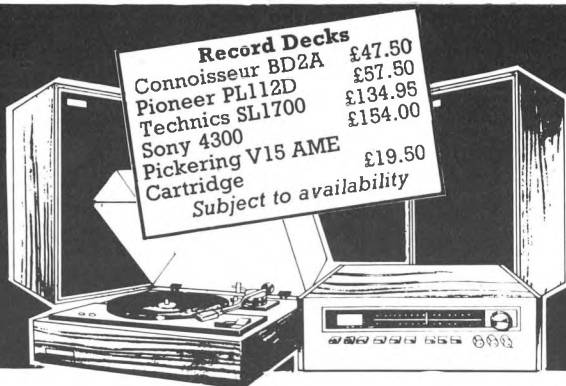
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Each edition of Hi-Fi Choice is intended to be the most comprehensive guide available to a particular part of the hi-fi chain, whether it be cassette decks, receivers, loudspeakers or in this instance, turntables and cartridges. For anybody, from the first time buyer to the professional user of audio, Hi-Fi Choice is invaluable. It can serve as anything from a buyers guide to a survey of the current state of the art. It fulfills whatever purpose you require.

Should you wish to know which of all the turntables and cartridges reviewed are the models we can confidently recommend, you need do no more than read the chapters entitled 'best buys and conclusions'. However, nobody need have any difficulty in discovering how such decisions have been reached. Although the reviews are written in a technical manner, a little time spent reading the non-technical introduction that follows will not only explain the meaning and significance of the language used, but also the importance of each parameter that has been measured and discussed. So for those of you who are new to hi-fi technology just turn the page and read on. In addition, a more technical introduction written by the reviewer, explains the test methods employed and how they were carried out. This edition is concerned with the evaluation of 55 integrated turntables, 5 record decks supplied without pick-up arms and 6 separate pick-up arms. However, some integrated turntables can be purchased as record decks, without pick-up arms fitted. These are the Ariston RD11E, Thorens TD 145 mk II (marketed as the TD 160 without arm), the Connoisseur BD2A (marketed as the BD1 without arm) and the Trio KD-550 (marketed as the KD-500 without arm). Also, the Technics SP10 deck and the Technics EPA100 arm are available separately. In addition, 40 cartridges have been reviewed and compared, and compatibility recommendations made. In order to discover which turntable or pick-up arm is suitable for which cartridge, simply match up the letters for resonance and damping ratings in the compatibility section of each review.

At the last minute, Dual, Monitor Audio and Strathearn were able to submit their turntables for review, and those reports appear in our 'stop press' section at the end of the book. Due to their late entry, we were unable to include them in our overall 'best buy' assessments.

Also, please note that the prices shown in this survey are typical retail prices ex VAT, based upon a dealer survey, carried out shortly before going to press. They should only be regarded as an indication and are likely to change at any time.

And finally, the author and publisher would like to thank all those who have given either practical help and/or advice, and have thus contributed to the success of this project.

Especially thanks go to the author's wife, Marianne Colloms who was of great assistance throughout, in typing and checking the text, and also to the hardworking assistant, Stephen Liebmann of Warwick University. Thanks are also due to the following who helped by contributing ears, equipment or advice: Chris Bryant, Charlotte Craste, Joan Coulsen, Tony Faulkner, Roger Furness, Alan Harris, Wyndham Hodgson, Noel Keywood, S.K. Pramanik, and Chris Rogers.

The following organisations loaned or made available equipment and material. B&O—test software, BSR/ADC—supplies of spare headshells, Decca Records Ltd—music tapes and discs, EMI Records Ltd—music tapes and discs, Enigma Records Ltd—music tapes and discs, Hayden Laboratories—test software, KEF Electronics Ltd—R103 loudspeaker systems, Natural Sound Systems—Yamaha NS1000M loudspeaker systems and B2/C2 amplifier unit, Phonogram—tape programme; Rank, Leak/Wharfedale—disc programme; Sansui—AU1100 integrated amplifier, Shure Electronics Ltd—test software, Shiroo UK Ltd—supplies of spare headshells, SME Ltd—supplies of spare headshells, Spendor Audio Systems—BCI loudspeaker systems.

Consumer introduction.

What is the difference between a gramophone, a record player, a record deck and a turntable?

Dictionaries will tell you that a gramophone (or a 'phonograph' in the USA) is something that plays gramophone records. That's accurate but needs elaboration. A *gramophone*, which is the same as a *record player*, is a unit with a platter (a flat, round plate that carries the disc record) which is rotated on bearings by a drive motor. The record on the platter is tracked by the stylus (or needle) of a cartridge which is mounted at the free end of a pick-up or tone arm. The tone arm, drive motor and rotatable platter are supported on a plinth, usually with some form of hinged or lift-off lid. Also, a gramophone or a record player incorporates an amplifier and one or more loudspeakers, so that the unit needs only mains (or sometimes battery) power to produce sounds from gramophone records. It's all very convenient, but it is impossible to get a true hi-fi sound quality out of any system that has loudspeakers built into the same cabinet as the amplifier, tone arm, platter, and so on. For one thing, proper stereo reproduction is unlikely, because the size of the cabinet limits the distance between the stereo pair of loudspeakers. Equally important, audio quality, be it in mono or stereo, will always be relatively poor. This is because there is a perpetual risk of sound from the loudspeakers running mechanically through the cabinet and back to the pick-up cartridge, and round in circles, to produce acoustic feedback. This is similar to, but usually of lower frequency than the howl-round you hear when a pop star or politician gets the microphone too close to the loudspeakers reproducing his voice.

However, it is possible to get true hi-fi sound quality from a gramophone or record player that has its loudspeakers removed from the central system and housed in separate cabinets. This kind of arrangement is the basis of the modern '*musicentre*', and the future may see more and more musicentres that can genuinely be regarded as hi-fi.

A *record deck* is essentially a gramophone or record player, without either the amplifier or the loudspeakers. In other words, it's a platter, drive motor and tone arm, mounted on a plinth, usually with a lid. A record deck may be sold complete with a cartridge already fitted into the arm, or the customer may be left to choose his own cartridge.

The term *turntable* is usually used to describe a record deck without the arm, the customer then being left to choose his own arm and cartridge to match the turntable. Sometimes a turntable is sold

complete with plinth, sometimes as a 'raw' chassis unit for the customer to fit into his own plinth.

The terms *tone arm*, *pick-up arm*, or *cartridge* should now need no extra definition.

What is the difference between a separate and an integrated unit?

If you go out and buy an arm, a cartridge and a turntable on their own you are buying *separates*. You then put these separate parts together yourself to make up a complete record deck. An *integrated* deck is one that is sold complete with all the separate parts already matched and connected, one to the other, so it's ready to plug in and switch on. An extension of this, which can conveniently be called a *fully integrated system*, is one in which all the separate parts are peculiar to one manufacturer and specifically designed for each other. When buying separates, there is a wide range of choice over which cartridge to use with which arm and which turntable and so on, and when buying an integrated deck you can usually replace the supplied make or type of cartridge with another. But when you buy a fully integrated system it will be virtually impossible for anything, even the cartridge, to be substituted. This is deliberate and considered policy on the part of manufacturers marketing fully integrated units, intended to optimise performance. The only latitude may be in the choice between two or more grades of similar cartridge.

Which is the best approach, integrated unit, fully integrated unit, or pick-and-mix separates?

There isn't a simple answer to this question. It is all too easy to build up a record deck from turntable, arm and cartridge separates, which all have fine reputations in their own right, fit physically conveniently together and look impressive, but produce decidedly unimpressive sounds. On the other hand, it is possible to buy an integrated unit (either from a manufacturer who makes or assembles all the components or a retailer who makes up his own combinations) which produces equally unimpressive sounds. But, it's possible, with the right kind of knowledge (or for that matter a great deal of luck!) to build up a record deck from a combination of separates made by different manufacturers, that produces superb sounds.

The key to success is correct matching. We are testing the performance of integrated units as well as separates used in different combinations. The difference in performance which one separate can give in a variety of combinations has proved very

Turntables: absolute speed accuracy; wow and flutter; rumble.

revealing. There is also another important aspect of choice that is all too often overlooked. Without a doubt, there exists an inter-action between domestic environment and record-playing equipment. Equipment that works well for your friend down the road may not be ideal for you. Apart from more subtle considerations, we don't all live in the same kind of room and like the same kind of music played at the same kind of volume. And, we don't all buy the same kind of amplifiers or loudspeakers and use them in the same way. Our tests have shown how certain deficiencies in record playing equipment can in fact become advantages when combined with some domestic environments, or be worsened by others. Likewise, apparently desirable characteristics of record playing equipment may, under other practical domestic circumstances, turn to disadvantage. This is why the 'perfect record deck' will never exist. We aim to help you choose the best deck for you.

Let's get down to technical specifics. What tests are we running on turntables, and what are they intended to show?

The function of a turntable is really very basic. It must rotate a gramophone record at an exact speed, without any variation about that speed, and without creating any noise or vibrations that will find their way into the pick-up cartridge for reproduction along with the programme. It follows that we are testing primarily for absolute speed accuracy, wow and flutter with respect to that absolute speed, the presence of rumble noise, and the degree of resonance.

How absolute is 'absolute' for speed accuracy?

Until recently, it was acknowledged that if the rotational speed of a turntable (33 $\frac{1}{3}$ RPM for LP records) was accurate to around 0.1% it was very good, and consistent (rather than fluctuating) errors of around 0.2% were tolerable. Now, however, with the arrival of quartz controlled turntable drives, speed accuracies in the order of 0.025% are possible. However, this degree of accuracy, is unlikely to be of any real advantage. This is mainly because, provided the attained speed is constant, even a musically trained human ear will rarely be able to hear a speed error of less than 1%. It is also important to remember that many records are cut with an inherent speed or pitch error, either due to slight speed inaccuracy on the part of the studio turntable used for cutting or as a result of errors introduced by cutting from tapes which have

stretched slightly in use and thus effectively run slow. Constant speed inaccuracies, whether inherent in the record being played, or due to minor inadequacies of the reproduction turntable, or as a result of variations in mains supply frequency, are most likely to show up (unless they exceed several per cent) when an attempt is made to tune a musical instrument to the recorded sound. Thus a variable speed facility may be a far more valuable feature than extremely accurate performance.

What are wow and flutter?

Wow and flutter are speed inconsistencies or variations on the basic speed at which the turntable rotates. Even an untrained or unmusical human ear is far more sensitive to variations on a constant speed than it is to inaccuracies within that constant speed.¹ Speed variations about the constant speed may be fluctuations of low frequency (1-10 Hz or cycles-per-second), in which case they are called wow; or of higher frequency (over 10 Hz), in which case they are called flutter. Once you have heard wow and flutter, you will know why the terms were chosen—wow on a musical tone sounds like the word 'wow', and flutter adds a sound like rippling water, or just plain distortion.

The human ear is most sensitive to wow and flutter fluctuations when listening to tones at around 1kHz (ie the mid-range), and virtually all speech and music programme material contains some of these frequencies. In practice, wow and flutter fluctuations of anything over 0.1% may be audible to some listeners with musically trained ears and most people will be able to hear fluctuations of 0.25% or more. There is, of course, no disadvantage in a turntable that offers figures better than these, provided that you are not paying dearly for the privilege of a barely audible benefit.

One point easily overlooked is that what really matters is how the turntable unit performs under load, that is when a disc it carries is being tracked by a cartridge stylus. Especially where loud recorded passages are being tracked, a drag will be imposed on the turntable and its drive mechanism must be able to override this so that its speed does not vary according to the music being played. It is in fact possible for a turntable to have an excellent measured performance but wow audibly when actually required to play loud music!

What is rumble?

Rumble is any noise mechanically generated by the moving parts of the platter and drive motor, for

Turntables: resonance.

instance as caused by spindles rotating in their bearings. Rumble noise can be pitched anywhere between 2Hz-1kHz and, to be unobtrusive, it must be at least 65dB below the average level of programme sound being reproduced. But it is only half the story to talk of rumble in a turntable. It's here that we start to see how the reaction between the various parts of a record deck and between the whole unit and the playing environment can degrade the overall result. If, for instance, a turntable produces an excessive amount of rumble at the very low frequency end, and this frequency coincides with the resonance of some other component in the deck, then there will be a magnification of the rumble out of all proportion to its true value.

What is resonance?

Every object has a resonant frequency. If you tap a solid object, it will 'ring' at a fixed pitch—that is its resonant frequency. A hollow box or cabinet is tuned to a pitch dictated by the enclosed volume. This is why an organ pipe produces a musical tone, as does a bottle when you blow across its open mouth. It follows that all parts of a record deck have resonant frequencies. And it also follows that if the resonant frequency of one part corresponds with the resonant frequency of another, there will be an unnatural predominance of unwanted sound at that frequency. The cumulative and combined effect of all this is generally referred to as 'colouration'.

What can be done about resonance?

Resonance can be damped, but only partially. Thus, just as you can damp the panels of a car door to make them 'drum' less during driving, so you can damp the platter and structure of a turntable either by making it of a heavy substance or by adding extra material. A heavy platter also helps the motor to rotate it at constant speed, because the platter then acts as a flywheel. But, although you can't overdamp a platter, if it becomes too heavy, it will impose excessive strain on the bearings and will also increase its start-up time. In any event, nothing can be completely damped.

Is there an alternative approach, then, to curing resonance problems?

It's more an additional, rather than an alternative approach. What the system designer does is simply ensure that the resonances of different parts of the deck are damped and thus can't interact. In basic terms, he ensures that whatever resonances exist in the pick-up arm and cartridge, they do not coincide

with any resonant frequencies in the turntable unit. This may be logical, but it isn't as easy as it sounds.

The resonant characteristics of the turntable unit may not be determined simply by the resonant frequency of the structure on its own. It is, for instance, necessary to mount the motor of a belt or rim drive unit resiliently, for instance on some kind of springing device. This is to prevent its mechanical vibrations reaching the platter and thus being sensed by the pick-up cartridge and reproduced, along with the programme. Likewise, it is necessary to isolate at least some of the parts of the deck from the environment in which it is being used, and the vibrations in that room. This prevents any vibrations created by you in the room from being transmitted through to the platter. If they are, then the cartridge stylus may be physically bounced right out of the record groove, or the sound of the vibrations picked up by the cartridge and reproduced through the loudspeakers.

Not only may this create a vicious circle of sound and acoustic feedback and introduce audible distortion of the reproduced programme, it may also physically damage the loudspeakers. Many high powered modern amplifiers are capable of feeding signals to the loudspeakers which are of such low frequency that they are inaudible but of such strength that they can physically damage the cone suspensions of the speaker units. Low cut or subsonic filters are often provided on amplifiers, to help guard against this risk. You might be surprised at the amount of inaudible and useless low frequency energy that is often fed to the loudspeakers. Try looking at the bass cone of a loudspeaker while it is playing a silent passage of a record, for instance between tracks. Often you will see the cone making large excursions to produce low frequency sounds you cannot hear, these excursions being triggered, for instance, by quite routine room activities—like putting down a record sleeve near the record deck. Although the movements are themselves inaudible, they can seriously degrade the sound being reproduced.

Designers seek to minimise such effects by using resilient mountings to isolate sensitive parts of the deck from the room as far as possible. But complete success is a chimera. Resilient mounting can in itself contribute to resonance problems, because it is all too easy for the resiliently interconnected parts to become resonant in combination. It is also easy to overlook the fact that the air space defined when the plinth lid is closed is also resonant in its own right. Furthermore, and as we shall see, to track a record

Turntables: types of drive unit; start-up time.

successfully a cartridge stylus must have inherent resilience or compliance. This means that yet another resonant combination is created whenever the stylus is resting on a disc, which in turn is resting on the platter—which, of course, is exactly the circumstance whenever a record is played!

By now it should start to become clear how it is impossible to consider and evaluate each part of a record deck *in vacuo*. It should also by now be clear why a good designer, with freedom to dictate, or at least recommend, the parts of a deck to be used in combination, stands a better chance of ensuring that there is no disadvantageous matching and interaction of resonances.

Before moving on to other parts of the deck, can you clarify the different types of turntable drive, and explain the term 'start-time', used earlier?

There are currently three types of turntable drive. In the cheapest, the idler type, a fast-revving motor rotates the turntable platter via a step-down gear train formed by an idler running between the small motor spindle and the large rim of the platter. For obvious reasons, this type of drive is also called 'rim' drive. However, there are no 'rim' drive units reviewed in this book, as the only high quality designs made are intended for heavy duty professional use. This is because the main advantage of this system is its quick start-up time at relatively low cost—an essential facility for professional discotheque use. The term 'start-up time' means exactly what it implies. When you switch on the power to a turntable motor, it is required to start turning the platter from zero speed up to the required record playing speed. The heavier the platter or the weaker the drive torque, the more difficult the job and the longer it is likely to take. Fast start-up time is also available, although at increased cost, by using the direct-drive technique (though the cheaper models available are still quite slow). In this case, the platter itself is made a part of a low-revving motor, so no step-down gear or idler wheel is necessary.

The third type of drive unit—belt drive—lies, in general, halfway between the idler-rim and direct drive types, both in price and start-up time performance. The spindle of a high-revving motor carries a small pulley, and a rubber-like belt runs around this pulley and a part of the platter rim (usually out of sight under the plinth), so that a step-down drive is again achieved. Although belt drives are, by their very nature, unlikely to provide a truly fast start for a heavy platter, they are reasonably

cheap to produce. They are also reliable in operation (except when the belt finally breaks), and by virtue of the resilience of the belt helpfully isolate the platter from the mechanical vibrations of the motor.

What else matters on a turntable?

That about exhausts the subject, except that the main bearing must be of good quality or it will wear out over a long period of use.

What does a pick-up or tone arm do?

Essentially a pick-up arm serves a simple purpose, that is to hold the cartridge over the rotating gramophone record so that its stylus can follow or track the spiral groove from the rim towards the centre. The arm must, therefore, have freedom of movement across the record surface, i.e. in a horizontal plane. Because the arm must be able to play records of varying thicknesses, and cope with warped rather than truly flat pressings, it must also have movement up, and down, i.e. in the vertical plane. And of course, arm movement in the vertical plane is also necessary to allow the stylus to be lifted onto and off the record. There are two ways in which the arm can enable the cartridge and stylus to track across the record surface.

The first method, called parallel tracking, conforms with the way in which records are cut in the studio. (Incidentally, it also conforms with the way in which Edison cylinders were cut a hundred years ago!) The cartridge is mounted at the end of an arm which slides along a guide rod, so that the cartridge and stylus are free to move only in a straight line direct from the edge to the centre of the record, that is along the radius of the record circle. For this reason, parallel tracking is also sometimes called radial tracking.

In theory, such radial movement could be automatic, the spiral groove physically carrying the stylus and cartridge with it towards the centre. But in practice, the tiny groove and stylus (a record groove is similar in size to the thickness of a human hair) are just too small to drag the arm across the disc and along the guide rod with any degree of reliability and without causing distortion of the reproduced sound. For example, in pulling the arm along the rod towards the centre of the disc, the stylus will inevitably drag heavily along one side of the record groove, causing either excessively loud reproduction of the signal on that groove wall and consequent stereo imbalance, or damage to the groove wall, or, more likely, both.

For this reason, a power drive for the arm is

Pick-up arms: tracking error; friction; tracking weight.

necessary, so that it moves along the rod from disc edge to centre of its own accord. But this in turn presents problems, because the power drive must be sufficiently precise to ensure that the stylus does not press unduly heavily on either groove wall, and be able to cope with different groove pitches (because the spacing of the grooves on a modern LP record varies with the volume of sound recorded). The drive must also cope with a disc pressing in which the spiral is slightly eccentric. Sophisticated servo control systems are necessary to ensure controlled movement of the arm, cartridge and stylus over the disc surface. It is for this reason that parallel or radial tracker turntables are both uncommon and expensive. They can, however, produce high quality sound if well engineered.

A much simpler approach to carrying a cartridge across the record surface is to mount it at the free end of an arm which is pivoted and counterbalanced at the other end. In this way, the cartridge is carried in a sweep across the record surface, along an arc centred on a fixed point. This, of course, is the conventional type of pick-up arm with which we are all familiar. The disadvantage inherent in such an arm is that it must introduce 'tracking error'.

What is tracking error?

Because the groove in the record you buy was pressed from a master disc cut with a parallel tracking arm, it cannot be accurately tracked by an arm sweeping around a fixed pivot. With a parallel tracking arm, the axes of the cartridge and its stylus always lie truly tangential to the groove spiral (another word for parallel or radial tracking is tangential tracking), whereas the cartridge and stylus axis of a pivot arm can only lie truly tangential to the groove spiral at one point of the arm's sweep into the centre. The geometrical error introduced elsewhere in its sweep is called tracking error. It is in fact far less important than might at first appear likely, and can be made insignificant by careful design. But clearly, to achieve geometrical accuracy in this respect requires that the arm pivot be located at a carefully considered position on the turntable plinth with respect to the centre spindle of the platter. So, if you buy a separate turntable and arm and put them together yourself, you must be prepared to follow the instructions provided to ensure correct geometry and alignment of the combination. This involves the use of a template and a simple instrument called a protractor, usually provided with your purchase.

What else is important on an arm?

The fixed pivot arms which form the lion's share of this report all sweep in from the edge to the centre of the record solely under power generated by rotation of the record and continual contact of the spiral groove with the cartridge stylus. An ideal arm would thus have, among other features, effectively zero mass and zero friction in the horizontal and vertical directions, so that the cartridge and stylus were effectively floating in space. But of course this is impossible.

Apart from anything else, a downforce is needed to hold the stylus in the groove and keep it in sufficiently pressured contact with the undulations on the groove walls in order to generate electrical signals in the cartridge. These must correspond accurately to the movement of the stylus over those groove walls. As one would expect, a complicated set of compromises has to be reached.

What are the compromises over friction?

Because the cartridge must have freedom to move in two planes, horizontal (or lateral) and vertical, there are two components of friction which need consideration. It is a fact of physics that whenever any two bodies move relative to one another there is friction between them, that is to say, resistance to that movement. Apart from the inevitable friction created by movement of the arm through air (which can be regarded as insignificant), the main source of friction in an arm is the bearing which gives the arm its freedom of lateral and vertical movement, i.e. the pivot bearings. Essentially, the better quality the bearings the less friction they will exhibit. And generally, the less the friction the better the arm will perform, because whatever friction exists in the bearings will limit the ability of the cartridge stylus to follow the groove across the record, and to move up and down with any warp. The practical effect of an arm with too much friction will be that the cartridge mistracks—meaning that the stylus will not follow the groove accurately, will try to cut corners, and produce a distorted sound. In general, designers aim to keep friction at below one-twentieth the tracking weight of the cartridge, that is to say, if the recommended tracking weight is 2 grams, friction should be no greater than 100 milligrams.

What is tracking weight?

Although tracking weight will be discussed soon in the context of cartridges, it can be explained briefly by taking up a comment made above, namely that the cartridge stylus needs to be forced down into the

Pick-up arms: effective arm mass; resonance.

groove sufficiently to keep the stylus tip in contact with the undulating groove walls. As the record rotates, the movement will tend to bounce the stylus up out of the groove, and a downforce is necessary to counteract this. Downforce is synonymous with tracking weight, although strictly speaking the latter term is sometimes a misnomer. For instance, the pick-up arm may be counter-balanced into equilibrium like a precision see-saw, and the necessary downforce on the cartridge stylus then applied by a spring. More often, however, the arm counterbalance is set just off equilibrium so that gravity acts on the cartridge end to produce the necessary small downforce.

Conventionally, arms are provided with a calibrated dial which enables the user to adjust the downforce or tracking weight. The dial slightly moves the position of the counterbalance weight or alters the tension of the spring. It is important that this control be accurate, with no more than a ten per cent error between the downforce displayed and actually applied (preferably on the heavy side). Especially where an arm and cartridge are combined by a constructor, it is necessary to zero the scale so that zero downforce displayed equals zero downforce applied. This follows from the fact that different cartridges and arms have different masses and require different counterbalance settings for see-saw equilibrium.

What should the mass of an arm and cartridge be?

What really matters for performance is the effective mass of the arm, rather than its actual mass. The actual mass of an arm and cartridge combination is the weight that would register if it were removed from the pivot and placed on a pair of scales. The effective mass is the load or drag which is 'felt' by the stylus. In addition to the actual mass of the arm, the stylus will also feel any extra load created by additional components. This can include any mechanical resistance, created, for instance, by auto stop mechanisms or electrical connections pulling, however lightly, on the arm from where they run to the plinth. Generally, it is good policy to keep the effective mass of the arm as low as possible. There is, however, nothing inherently good or bad about high or low mass because there is another important and inter-related consideration – resonance.

How can a small, rigid arm suffer from resonance?

The stylus is mounted on a springy cantilever in the

cartridge, which is fixed securely at the end of the arm. When the stylus rests on the record groove, a springy combination is created—the arm and cartridge can move up and down with the record, while the stylus remains in the groove, due to the flexibility of the cantilever, which is the only connecting link between record and arm. And of course, any springy system has a resonant frequency.

The resonant frequency of the arm-cartridge-cantilever-stylus-disc combination depends largely on the effective mass of the arm and cartridge combination. Thus, the effective resonance of an arm will depend to a considerable extent on the type of cartridge with which it is fitted, some cartridges being heavier than others. Also, different cartridge cantilevers have different flexibility. Incidentally, the inherent springiness of a cantilever is usually referred to as the 'compliance' of a cartridge, and we shall return to compliance along with tracking weight when looking more closely at cartridge characteristics. It should, however, by now be clear that to ensure that the resonances of a turntable unit do not coincide with the resonance of the arm requires careful consideration of several factors. It also becomes easier to see how some arm-cartridge-turntable combinations can be more prone to resonances than others.

What kind of resonant frequencies can be expected from arm combinations?

The order of frequency is usually subsonic at around 10 Hz; it may be lower, e.g. down to 4 to 8 Hz, or it may be higher, e.g. up to 14 or 15 Hz. If the resonance is put too low, the combination will be very susceptible to external shock, for instance room movements. The cartridge and stylus will then be likely to jump out of the groove as you walk round the room. As a general guide, such dangerously low resonances stem from high mass arms used with high compliance cartridges (with soft sprung cantilevers). To raise the resonant frequency above these dangerously low levels requires that the effective mass of the arm be reduced, or the compliance reduced (i.e. the cantilever made less springy) or both.

This presents problems, because there is obviously a practical limit to how much you can reduce the effective mass of anything. Also, low compliance cartridges are incapable of tracking difficult programme material such as high level (i.e. loud) musical sounds, because the cantilever is too stiff to let the stylus follow the groove excursions. If

Pick-up arms: resonance bias; trackability; cue control.

the resonance is put too high, it will move dangerously close to the audible frequency spectrum and colour the reproduced sound. As a general guide, one reasonable arrangement would be a turntable unit with a chassis resonance of between 2 and 4 Hz and an arm-cartridge-stylus-disc resonance of around 7 Hz higher, i.e. around 9-11 Hz. This will leave the record deck reasonably immune from room vibrations and the arm will be able to track warped records without resonating at the frequency of the warp (always below 10 Hz and usually around 6 Hz). The two resonances are also sufficiently widely spaced apart to be independent and act in effect as a combined filter for mechanical vibrations.

It is, however, important not to treat these guiding principles as gospel. What really matters is how individual combinations perform on test. There is, of course, a real difficulty in carrying out fair comparative tests in this field, because, for reasons which should by now be becoming increasingly clear, a given cartridge may perform differently with one arm and turntable from another.

Can the resonance in the arm be damped?

Subsonic resonances can be damped in a variety of ways. According to one technique, the counterweight on the end of the pick-up arm is connected to the arm by a soggy, rubber material. An alternative possibility is to use a viscous fluid encased around part of the arm. Properly applied, such damping techniques can control the otherwise unacceptable resonances of a high mass arm. Used clumsily, however, they can create other problems, for instance increasing friction and thereby impairing tracking and causing audible distortion. Another, more subtle, risk is that the damping material, for instance soggy rubber at the counterbalance, will itself serve as a spring and create a secondary resonance of its own, possibly in the higher and thus audible frequency range. This will make the arm 'ring' audibly at the resonant frequency and 'colour' the sound like a bad loudspeaker. But arms may have audible resonances purely as a result of basic bad design.

I notice most record decks have a bias control on the pick-up arm. What is bias?

As the stylus tip of a cartridge mounted on a pivotal arm is drawn in towards the record centre by movement of the spiral record groove, there is an inevitable imbalance of lateral forces. As a result, the tip bears down rather more strongly on one wall

of the groove than the other. Bias is an additional force provided on the pick-up arm, intended to correct this imbalance by providing an opposing lateral force. In fact, the importance of bias compensation is easily overrated, and is really only necessary on the loudest passages of a recording, that is to say the passages where the groove wall undulates most vigorously with maximum modulation.

The bias calibration controls on pick-up arms are often poor, for the simple reason that no one really knows what scale to use. It is thus better to set the bias control by trial and error, rather than by looking at a dial reading. But, to set bias by trial and error requires the use of a test record intended for the purpose. It is also important to bear in mind that although there are numerous means adopted by pick-up designers to provide bias compensation (including magnetic arrangements, weights on the ends of threads and springs) they may well not be actually functioning until a fairly high number on the bias scale has been set. Also, of course, the bias setting depends on the type of cartridge fitted in the arm. To fit a cartridge at random in an arm and then vaguely twiddle the bias control may well degrade rather than improve performance. As a general guide, bias should be around twice the arm friction and a tenth the tracking weight, i.e. 200 mgm at a tracking weight of 2 g.

What else matters on pick-up arms?

Tracking error, or the discrepancy between the angle which the cartridge actually makes with the spiral groove and the truly tangential position which it should, in theory, occupy, has already been mentioned. In practice, this can range from anything between 2° to 10°, but unless the equipment is otherwise superb, errors of less than 5° are seldom noticeable. Trackability is often referred to and is really a combination of all other factors. The only way it can be measured is to put a cartridge into an arm on a turntable and see what happens when a test record is played. The mass of the headshell holding the cartridge on the arm can also be of importance, because, of course, it affects the effective mass of the arm. Thus changing the headshell can alter the characteristics of any given arm or cartridge. In a fully integrated arm and cartridge combination, there need be no headshell, because the arm and cartridge can be custom made to interconnect or plug directly, one into the other.

Finally, although a cue control is unlikely to affect sound reproduction, its performance is important. A

Cartridges: compliance; tracking weight.

cue control, of course, enables the pick-up arm to be mechanically raised and lowered, either under manual control or automatically or both, so that the stylus is gently moved into and out of the record groove. A too slow cue rate will irritate the user, because the arm and stylus will seem to take an age when coming down onto the record to start playing. If the cue rate is too fast, audible thumps will be heard as the stylus touches the record groove or lifts off. Cue accuracy is also important, because it is infuriating to have an automatic system which lowers the stylus onto the record a few grooves into the recording so that the first few bars of music are lost. Equally irritating (and potentially dangerous to the stylus), is an inaccurate cue which lowers the stylus off the edge of the record. A user adjustment for both cue rate and accuracy is a useful feature, because it enables the individual to set for himself the rate at which the arm moves up and down and exactly where on a record it touches down and lifts off.

What are the points to look for and test on a cartridge?

It's best to start with what a cartridge is and does and take it from there. The cartridge is secured at the end of the pick-up arm in any one of a variety of ways. It can be fitted into the arm itself, or plugged or screwed into the headshell which is itself attached to the arm. But all these methods of mounting have one thing in common—they are rigid, or at least intended to be. Thus, the cartridge cannot move with respect to the arm, other than when a locking means is deliberately slackened to allow a change of cartridge or a geometrical adjustment.

The record groove is tracked by the stylus, now always a shaped and polished diamond, which is carried at one end of the tiny cantilever rod. As previously explained, the cantilever is resilient. In fact, to be accurate, it is the connection of the cantilever to the cartridge body that is resilient rather than the cantilever itself, and the more resilient the connection the more compliance the cartridge is said to have. As we have also already seen, the compliance of the cartridge affects the resonance of the system while it is playing a record, and it is thus dangerous to talk in terms of a cartridge as having 'good' or 'bad' compliance *per se*. Within a reasonable range, whether the compliance is good or bad depends mainly on the combination in which it is used. Outside the reasonable range (lower than 10 cu and higher than 50 cu where 1 cu = 10^{-6} cm/dyne) the cartridge may perform badly in other

respects. If the compliance is excessively high (the cantilever connection is too springy), there will be a risk that the stylus will disappear inside the cartridge housing if used with anything even slightly over the recommended tracking weight. If the compliance is too low (the cantilever connection too stiff), the stylus will be unable to follow the more extreme undulations of the groove, and there will be mis-tracking at the recommended weight. In practice, mis-tracking produces buzzing and scratching sounds. It also creates listening fatigue, a subconscious feeling that life would be more pleasant with the record player turned off.

Can you now explain some more about tracking weight?

As the stylus runs along the groove, it maintains contact with the undulating groove walls by the downforce applied through the pick-up arm, either by gravity or some other means such as spring loading. Every cartridge and stylus combination has a recommended tracking weight, and these can now often be as low as 1 gram. Incidentally, tracking weights used to be in the order of 10 g.

The recommended tracking weight is the downforce on the stylus which the cartridge manufacturer regards as the best compromise between various conflicting requirements. On the one hand, a large weight or downforce will keep the stylus tip firmly in contact with even the most complex and extreme undulations of the groove; but at the same time it will tend to wear away the groove, especially where the excursions are very rapid and stylus acceleration is thus very high, as in the reproduction of high frequency sounds. On the other hand, a small weight or downforce will usually cause less wear of the groove (because there is less pressure between the hard, diamond tip and the soft vinyl record), but will tend to let the stylus follow its own route along the groove, cutting corners round difficult passages and producing a distorted sound.

But the weight recommendation presupposes that the cartridge is mounted in a suitable arm. It is pointless to use a sophisticated cartridge with a low recommended tracking weight in an arm which has a high amount of friction or excessive mass, because the friction force or mass will then override the downforce and tracking will be interfered with. One result will be that the stylus bounces vertically in the groove. Then, especially if it is of elliptical form, it will literally chisel chunks out of the groove, damaging the record for ever afterwards. And even if 'under-tracking' in this way does not damage the

Cartridges: tracking weight; frequency response; distortion; effect of the amplifier used.

groove, the reproduced sound may well be inferior to that which would have been obtained from a cheaper cartridge mounted compatibly in the same arm.

Given that a cartridge is mounted in a suitable arm what else is important?

For a start, its ability to track the record groove may well vary over the frequency range. For this reason, it is important to test the trackability of a cartridge at low, medium and high frequencies, by using test discs with low, medium and high frequency signals, and separately analysing the amount of distortion introduced by the cartridge in each case.

Surely what matters more than anything is the ability of the cartridge to reproduce different frequencies at equal levels, i.e. to have a flat frequency response?

This is true, provided that the reproduced frequencies are clean. There is no point in having a flat frequency response if some bands of the spectrum are spoilt by mis-tracking. It is also important to ensure that the cartridge provides a matched response between left and right channels. Remember that inside the cartridge body there is an electromagnetic motor (coils, magnets and metal of varying arrangement, depending on the cartridge type) which transduces the mechanical vibrations created by movement of the stylus in the record groove and thus transmits the signal through the cantilever. The motor is a wide band transducer, which means it converts not only audible frequencies, but even sub and ultra-sonic frequencies as well, into electrical signals. Indeed, because a cartridge has such wide band transducing characteristics, it makes rumble and other resonance problems so important. There is also the problem of distortion.

What is distortion in this context?

Distortion is best described as any signal present in the reproduced sound which shouldn't be there. It thus embraces problems produced by mis-tracking at high, medium and low frequencies, along with intermodulation distortion. This latter term means that the cartridge response at one frequency is affected by its response at another frequency, even outside the normal range of human hearing.

Another type of distortion is 'harmonic'. As the cartridge tracks one recorded frequency it generates another, different but related, frequency—for instance, the harmonic introduced may be double or

some other exact multiple of the tracked frequency. Conventionally, distortion is defined in percentage terms, that is the percentage of unwanted sound in amongst the wanted sound. The ear is surprisingly tolerant of distortion: we can, for instance, unknowingly listen to even several whole per cent of distortion from loudspeakers and cartridges, so don't be surprised if distortion figures look higher than you would expect.

Also, it is important to bear in mind that the frequency response of a cartridge can vary, dependent on the amplifier with which it is used. So a flat curve in the adverts may not mean a flat curve for you.

How can the amplifier affect the performance of the cartridge?

A cartridge is an electrical circuit and, as such, it has an impedance (which is an electrical characteristic similar to a tuned resistance). To perform as intended, a cartridge must be connected to a circuit of matching impedance, just as a power amplifier can only perform as intended if used with loudspeakers of correct output impedance. The standard loading for most cartridges is now 47 Kohms. However, most moving coil cartridges (in which the moving part of the transducer motor is a coil in a fixed magnet rather than a piece of metal or magnet moving in a fixed coil), are usually intended to feed an input of below 100 ohms. Because these are not generally available on amplifiers, moving coil cartridges have until now needed to be connected to an amplifier via a transformer or special pre-amplifier. Most manufacturers recommend a loading for their cartridges, so to be fair on any cartridge it is necessary to test its frequency response both on standard and recommended loading. An impedance mis-match between cartridge and amplifier input is shown by a bumpy frequency response, some frequencies being reproduced at too much power and some at reduced power. However, occasionally neither standard nor recommended loading is ideal.

A separate but related issue is that of matching cartridge electrical output level to amplifier input sensitivity. As most modern amplifiers either have switched or continuously variable input level controls, or can cope with a wide range of input levels without overload, this is not usually a practical problem. The special equipment provided to match the impedance of a moving coil cartridge to a normal amplifier also serves to boost the cartridge low output signal level sufficiently to match it to the amplifier sensitivity.

Cartridges: stereo separation; stylus.

What else affects the performance of a cartridge?

Inter-channel or stereo separation is an important factor. A stereo cartridge (and we are testing only stereo cartridges) tracks a groove with different signals modulated on each groove wall. The vibrations created by this tracking are transmitted up the cantilever as two different signals, effectively polarised at right angles to each other. But the two tracks of vibration are, of course, effectively combined by the cantilever into one highly complex vibration signal. This, in turn, is transduced and separated by the cartridge motor from one mechanical vibration into two electrical signals, one for the left channel and one for the right. The more you think about it, the more magical the whole process seems.

But inevitably with such a system some signal from one channel leaks over to the other channel and vice versa, and this is referred to as crosstalk. A cartridge with good separation has little crosstalk, and a cartridge with bad separation has high crosstalk figures. Often, the crosstalk figure varies with frequency, different leakage occurring at different frequencies. Such crosstalk, especially at higher frequencies, weakens the stereo effect of the finally reproduced sound. Thus when the stereo separation of a cartridge is evaluated, all audible frequencies must be considered. As a general guideline, inter-channel separation of a cartridge for the frequency band 100Hz-5kHz, where it is most important, should be better than 20dB. Separation in the order of 30dB or more is very good.

What should one look for on the cartridge stylus?

Strictly speaking, there is nothing that you yourself can look for on the stylus, because it is physically too small to reveal anything useful to the naked eye. Stylus examination must be carried out with the aid of a microscope; but unless you know what to look for, even the most powerful microscope won't reveal anything useful. Moreover, there is good reason to believe that some manufacturers pay far too little attention to the quality of the stylus fitted to their cartridges.

It's easy to forget that the whole record reproduction chain relies on the contact of a tiny diamond with an equally tiny record groove. However impressive and expensive everything else in the chain may be, if the diamond and groove don't interact as intended, the final sound will be poor. To take just one example, if a high cost, high

quality cartridge is fitted with a sub-standard diamond-tipped stylus some aspects of its performance will then be no better than a cheap, run-of-the-mill cartridge. To understand how the groove and stylus tip should interact, it is necessary to digress briefly and look at how a record is cut and pressed.

In a recording studio, the record-cutting lathe is fed with a signal either from a tape produced in the studio or direct from the studio microphones and mixer (this is the so-called 'direct cut' disc). In either case, the signals are heavily amplified and fed to the coils of a cutter head mounted on a parallel tracker arm. The cutter head functions in the manner of a cartridge working in reverse (just as an ordinary electric motor can often be used in reverse as a generator). Thus as the amplified signals are fed into the cutter coils they cause the cutter stylus to vibrate and cut a modulated spiral groove in the blank disc over which it is being radially guided. The cutter head stylus is, in fact, shaped like a chisel, and to cut the groove the coils must be driven with a high powered signal—often around 100 watts per stereo channel. Such high level signals generate a great deal of heat, so the cutter head is much larger than a gramophone cartridge and has to be specially cooled, usually by a stream of helium gas. In accordance with the world standard now adopted for cutting, the cutter chisel is shaped to plough a groove through the record surface with nominally plane groove walls. They meet at right angles at the groove bottom and each make an angle of 45° with the disc surface. This is the standard 45/45° cut. Conventionally, one stereo channel is recorded on each groove wall.

The discs we buy in record shops are produced by a pressing process. The master cut by the chisel is electroplated in several stages to produce negative versions of the disc in metal which are pressed together to mould a lump of molten plastic into a positive, flat disc with a spiral groove on each side. For various reasons, including the fact that the negative versions of the disc have delicately pointed spiral protrusions, rather than grooves, over their surface, the bottom of the groove in the final pressed disc can never be totally free of debris. Also, dust inevitably accumulates at the groove bottom during domestic use. It is thus important that the stylus should not track along the very bottom of the groove. Thus, the ideal stylus is one which contacts the groove walls or sides, but not the bottom.

Clearly, this requires careful angling and dimensioning of the stylus. Likewise, because each

Cartridges: stylus.

groove wall carries a different undulation, it is essential that the stylus be symmetrical, so that each of its sides presses against its adjacent groove wall with similar pressure and in an exactly similar manner. Any asymmetry of the stylus will produce an asymmetrical frequency response, asymmetrical distortion and imbalance of sound through the loudspeakers. This in turn causes poor stereo imaging, and either noticeably more distortion in one channel than in the other, or a subconscious fatiguing effect on the listener.

It is not practical to make the stylus in a chisel shape to match that of the cutter. No available stylus is an exact match of the cutting stylus, and thus represents a degree of compromise in its ability to track the groove. Various stylus shapes have been proposed, and of these the conical or spherical stylus is the most common and cheapest to produce. Clearly, the size and angle of the cone and the extent to which its tip is rounded into spherical shape will govern the manner in which the stylus tracks the undulations on the groove walls while clearing the groove bottom. If the stylus is improperly shaped or worn, it will mis-track and 'bottom', producing distortion and background noise through the loudspeakers.

An elliptical stylus can simply be regarded as a laterally squashed cone, the object being to minimise the area of contact on the groove walls, whilst still avoiding contact of the stylus tip with the groove bottom. The smaller the area of groove contact, at the elliptical stylus side, the more nearly it approaches a line up the groove walls and the more accurately the stylus will be able to track the tiny modulations which are necessary to reproduce high frequencies. But not only are elliptical styli more difficult to make, and thus more expensive, they may also tend to wear rather more quickly, especially if misused, because the area of contact is smaller and thus the pressure at the point of line contact greater. Also, as previously mentioned, if the cartridge is mis-tracking (e.g. through use in a poor arm) so that the stylus bounces vertically in the groove as it tracks difficult passages, it is likely to serve as a chisel and gouge lumps out of the groove wall every time it lands from a bounce.

Other types of stylus are continually appearing, and all are variations on a similar elliptical theme. Where a cartridge must track quadraphonic discs of the carrier type (CD-4, UD-4 and, in the future, 45J), the ultrasonic carrier frequencies which must be tracked and converted into high frequency electrical signals for demodulation can only be followed by a

stylus with a fine line of contact on each side which extends right up the groove wall. Cartridges intended for the reproduction of discrete discs must also be electrically designed to have an extended frequency response. Available cartridges usually have styli of the Shibata or Pramanik line-contact type (named after their designers). Some normal stereo cartridges are now available with line contact styli of various types—all of which are basically similar.

Given that the stylus dimensions are crucial to good reproduction, what else should a reviewer look for in a stylus?

The angle at which the stylus tracks the groove, that is its rake angle from the vertical, is important. Because the diamond is usually secured at right angles to the cantilever, the tracking angle can often be defined as the angle which the cantilever makes with the disc surface. Generally this is in the order of 20°. But not all diamond tips are secured to the cantilever shank in right-angle fashion or the cantilever shank may be cranked, so don't be disturbed at the angle which your cantilever or diamond makes with the groove. In practice, the angle of stylus/groove contact always looks rather awkward and odd to the casual observer, but don't try to alter it by bending anything, because you will almost certainly only succeed in ruining the stylus or cartridge or both. If in doubt, seek advice from the manufacturer.

Another matter on which the user cannot hope to form any valuable impression on his own concerns stylus shape, accuracy, polish and grain. The working part of the stylus is, of course, a small piece of contoured diamond. If it is not accurately dimensioned to the chosen shape it will mis-track. Also, if the surface is not smoothly polished, noise will be created as the stylus tracks the groove. Correct orientation of the grain is also important, to ensure that the hardest plane of the diamond is aligned for contact with the record groove, so that the stylus has maximum working life.

Another important point is the manner in which the diamond tip is mounted on the cantilever shank. Sometimes, a bare or naked diamond is secured direct to the shank (which is usually, but not always, of metal) and other times it is mounted in a metal cup which is then secured to the shank. Manufacturers are usually very secretive about the types of glue used to secure these integers together, but it is as well to bear in mind that some types of solvent may loosen this glue. Thus use only

Cartridges: stylus; stylus replacement; squarewave response; resonance in the complete turntable system.

recommended fluids to clean the stylus.

And that brings to mind an all-important reminder. However accurately dimensioned, beautifully polished and correctly orientated the grain of a stylus may be, it will produce an awful sound if it is not cleaned. You would be surprised at how many people spend a considerable amount of money on meticulously selecting hi-fi systems, and then degrade the sound to radiogram level by using a dirty or damaged stylus.

What about stylus replacement?

Most cartridges have a replaceable stylus and cantilever unit. Thus if you damage the stylus, or use it so much as to wear it out, you do not have to throw away the whole cartridge. Instead you simply buy a replacement for the worn or damaged part. This can cut the cost of damage, although in practice not by very much because replacement styli are surprisingly expensive. It is now being argued with increasing frequency that a fully integrated cartridge is preferable, because the major part of the cost of a cartridge and stylus combination is accounted for by the stylus and cantilever, the cartridge body and electrical components being, in comparison, very cheap to produce. It is also argued that a stylus and cartridge combination can only provide optimum performance if the stylus and cantilever are factory-matched to the cartridge body. Thus user replacement is likely to produce sub-standard results.

Are there any other tests worth carrying out?

It can be revealing to see how a cartridge reacts to a squarewave signal. Although no musical programme material contains squarewaves, a squarewave can be regarded as built up from a complex interrelationship of many separate signals of different frequencies. Thus, it is usually safe to say that if a cartridge can handle a squarewave well it can handle more or less anything it is ever likely to encounter in a musical programme. Also, the ability of a cartridge to track pulsed sound reveals any deficiencies, for instance resonances that leave the reproduced signal 'ringing' after the pulse has finished. Here it should be noted that although we have talked throughout of mechanical resonance, it is possible for a cartridge to have an electrical resonance, especially if mis-matched to an amplifier, the circuit acting rather like an electrical spring. Squarewave and pulse response tests will show up such electrical resonances.

Now that we have examined turntables, pick-up arms and cartridges separately, what tests can be run on the various combinations possible?

Hopefully, the train of thought followed so far will have indicated the kind of tests that are necessary. The most important of these is to establish and evaluate the significance of low frequency resonances that are created when a cartridge is fitted in an arm which is suitable for that cartridge. Low frequency resonance means what it says. It is the resonant behaviour of the cartridge in the arm with the stylus tip down on a record, when subjected to low frequencies, that is to say a few tens of Hz. What matters is what audible and sub-audible sounds are produced when the combination is subjected to record warps or room vibrations—people walking on the floor, the noise of traffic or something being dropped.

These sort of noises can affect an undamped arm with a dangerous resonance making it wobble like a jelly at subsonic frequencies. This will impair tracking. At the same time, the cartridge will transduce the low frequency wobbles into low frequency signals, which will set the loudspeaker cone wobbling at a similar rate and create a potential risk for the loudspeaker, confusion of stereo image and distortion of reproduced sound.

Another source of low frequency noise is, of course, the turntable itself, of which the motor is inevitably generating some mechanical vibrations. At the same time, one should test for how the arm reacts to other, higher, frequencies, e.g. in the audible band, because as previously mentioned some arms have resonances which are higher in frequency than the subsonic resonances discussed at length. As also explained, these can colour the sound audibly. Likewise, the whole turntable structure (plinth, lid, platter, even the disc being played) can have resonances which are again higher in frequency than the subsonic resonances discussed. These, too, can colour the reproduced sound. As a general guide, then, the subsonic resonances mainly affect the mechanical and tracking performance of the deck while the higher resonances directly colour the sound and indirectly affect the sound.

So far many of the tests have been of laboratory style, and although the possible sound of some deficiencies has been mentioned, how can these be evaluated?

The only way to evaluate deficiencies of sound is to listen to them; and the only meaningful way to listen

Resonance in the complete turntable system; listening tests.

is in comparative tests. The human ear/brain combination is remarkably adept at adjusting itself to the most dire audio situations, so that a very poor set-up can sound fairly reasonable, especially to the listener who does not know what a good system sounds like. Granted, listening fatigue may set in, but this is subconscious, and you can't have subjective tests relying on subconscious effects. For this reason it is necessary to evaluate turntable noise and turntable colouration subjectively by using the unit under test in comparison with a reference turntable of known character. Obviously, problems now arise in choosing a reference because, especially when judging colouration, choice of a poor reference will make it difficult to get meaningful results from comparisons. For this reason, the tests carried out make clear what the reference turntable was and why it was chosen.

The character of a cartridge can best be judged subjectively by using it to track a disc which is recorded with pink noise. Although nobody in their right mind listens to pink noise at home for entertainment, it does provide a very useful reference. When you tune an FM radio between stations (with any muting controls switched off) you hear inter-station noise which is effectively totally random noise over the whole frequency spectrum. This is white noise. Pink noise is laboratory generated noise, which is special in that there is constant energy per percentage band width. This is to compensate for the fact that the frequency spacing between octaves increases as you move up the pitch scale. As a result, pink noise sounds rather more 'bassy' than random white noise. In fact, what matters is not so much the technical 'difference between white noise and pink noise, but the fact that pink noise is particularly well suited to showing up differences between reproduction chains. Thus, a recording of pink noise played through two different cartridges will sound different, if there is any difference between the characteristics of those cartridges. And the character of the noise heard tells a great deal about the frequency characteristics of the cartridge. For instance, if the reproduced noise sounds rather high pitched and hissy through one cartridge, and rather low pitched through the other, then you know for certain that the cartridges have a different frequency response characteristic.

Unfortunately, what you don't know is which is correct. Is the hissy sound correct and the more ~~bassy~~ sound wrong, or vice versa? So, in order to draw some meaningful conclusions, the pink noise test needs to be carried out with a standard

reference turntable. The reasons for choosing this turntable are explained in the technical introduction.

Another valuable test goes to the root of the whole problem. After all, the reason we all buy record decks is to reproduce music. It is instructive simply to listen to music through a given record deck and hear how it sounds. It is, however, much more instructive to compare the sound of the reproduced record with the sound of the master tape from which that record was originally cut. But, for this test to be useful there must have been no deliberate or unintentional changes made in the sound when it was transferred from tape to disc in the studio cutting room. So it is necessary to know the pedigree of any tape and disc used for such comparative tests. It would, for instance, be only too easy to pour quite unjustified scorn on a cartridge by wrongly attributing a hump in the bass response to colouration of the cartridge frequency response, rather than deliberate bass lift introduced by the cutting engineer. The pedigree of the discs and tapes used in our tests is explained.

All this is all very well, but it is no consolation to me, the customer, if I go out and buy a piece of equipment that is highly recommended by viewers and find that I have got a sub-standard sample. Even worse, how am I to know whether what I have bought is standard or sub-standard?

This is a crucially important point. Inevitably, the manufacturer supplying equipment for review will do his best to ensure that that equipment is of optimum quality. Whether you, the customer, get something of equal quality will depend entirely on the manufacturer's quality control arrangements. To gain something from the tests by way of guidance on quality control, and the attitudes of individual manufacturers and agents and importers, we have included in the test procedures some general observations. We are for instance checking the quality of packing, because if equipment is poorly packed when it leaves the factory there is a good chance that the customer will receive a sub-standard item, even if our tests have shown it to be of potentially high quality. It is also indicative to look at the instructions. Inadequate instructions will mean that many users will be left mishandling and misusing equipment, and either obtain poor results or even damage what they have bought. The question of what maintenance is necessary, for instance, how, where, and when to oil, is also important, because over-lubrication usually does more damage than under-lubrication. If the

Sample variability.

manufacturer does not advise on this then users may well create trouble for themselves.

You can also tell a great deal about a manufacturer's attitude to quality control, durability and overall customer satisfaction by looking at the finish of the final product. If a fine laboratory design reaches the public looking shoddy, then the manufacturer may not be too concerned with control over technical quality in the less obvious aspects of production run—for instance in the material used for moving parts such as hidden bearings. A laboratory design may work well in prototype form when it is carefully handled by the laboratory staff; but it should not be necessary to handle a record deck so diligently in everyday home use. Obviously, one is not suggesting that decks should be mishandled, because they are, after all, intricate pieces of sophisticated fine engineering. But 'bent tin' construction is unlikely to give long

term satisfaction, even to the most careful user, and, even more important, does not bode well for production run consistency.

Finally, the number of facilities provided on a deck and its versatility are also of interest to the potential purchaser, not only on the superficial level of value for money but also because they give a clue to how seriously the manufacturer has thought through the design and customers requirements before launching it onto the market. Likewise, how the unit 'feels' in use is an important factor. Cheap plastic knobs that split and fall off (with no chance of a replacement) tell a great deal about the manufacturer's attitudes. They also suggest that what is hidden out of sight inside the unit may be equally, or even more, shoddily made. So, to complete the picture we shall be looking at both the inside and outside and reporting on the general standard of engineering.



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Test Programme

Most reviews published to date on turntables and cartridges have tended to be fairly superficial. Two major factors are responsible; in the first instance measurement aspects are poorly specified and generally inconsistent due to a lack of accurate test records. Secondly, the importance of subjective assessment in the context of the acoustic and vibrational complexity of a record playing system has only recently gained general acceptance. In addition to the problem of arm/cartridge compatibility, the improved quality of both disc and hi-fi systems in recent years has shown that the turntable/arm assembly may itself be a source of audible colouration and general quality degradation.

Accordingly, a highly detailed test programme was devised which sought to qualify and quantify in a comparative and absolute manner every possible aspect of cartridge, turntable and arm performance considered relevant to the quality of the sound produced. This required over forty tests and measurements for each cartridge, in addition to more than fifty for each turntable/arm combination, the total nearing five thousand.

Cartridge tests

Using the Technics EPA1000 universal arm which incorporates variable damping, the optimum tracking downforce was established after an initial investigation with several music and 'tracking' discs. This value was subsequently adopted for all the remaining measurements. A subsonic sweep frequency track (B&K QR2010), 5Hz to 20Hz, was then played to establish the main arm/cartridge resonance and hence to allow calculation of the dynamic compliance. The magnitude of the resonance as recorded on the pen chart also provided information on the cantilever damping at low frequencies.

Preliminary research showed that few reliable test records exist for the purpose of determining frequency response, as beyond 20kHz, the test discs that are usually employed are in error by up to as much as 10dB. Those intended for replay at 45rpm were rejected since this is not a normal operating speed, and wavelength and translation losses will be atypical! In addition, it was decided to extend the measurement up to 40kHz – not because of the obvious CD4 consideration, but rather to establish the location of the tip mass resonance and its severity. A special record had thus to be obtained, and this required equalisation at low frequencies to correct for known residual errors.

Using a B&K 2305 recorder and a B&K 4416 equaliser/synchroniser, left and right response traces were taken on a 50dB vertical scaling. The degree of separation of these two curves is a measure of the channel balance, with well superimposed traces indicative of excellent balance. The crosstalk or channel separation curve represents an average of the left and right crosstalk and was originally recorded using a tracking $\frac{1}{2}$ octave filter, (B&K 1614). Crosstalk below 100Hz was not recorded since it is strongly affected by the subsonic resonance and by residual crosstalk on the test disc.

Incidentally, having produced over 300 response traces from the 40 models of cartridge in this report by using the test procedure outlined above, I am convinced that a number of cartridge responses published by both magazines and the manufacturers themselves are probably in error. The set of traces in Fig. 1 were plotted using the same cartridge but a variety of test discs, and they clearly demonstrate a lack of agreement, even below 20kHz.

Curve Illustration

The two lower traces in Fig. 1 are from the same B&K record, the uppermost on an 'outer' band and the second using an 'inner' band. The difference is attributable to tracing loss – the shorter recorded wavelengths on the inner band being recovered with less accuracy. This result was achieved by using a good quality diamond tip with an 0.2thou minor radius, and a correspondingly greater loss would have been shown by an 0.7thou spherical tip. Objectively speaking, the frequency response of a given stylus is not a fixed quantity, as for example, the output at 20kHz, 33 $\frac{1}{2}$ rpm, is reduced by typically 4dB at the innermost groove radii compared with the rim. All the curves published in this report were taken near the rim, at 33 $\frac{1}{2}$ rpm.

The squarewave characteristics of each cartridge were assessed from a photograph of the unequalled wave from as generated by the CBS Labs record, STR112. No transformer was used for the moving coil models. The STR112 was found to have 300Hz lateral and vertical bands of extremely low harmonic content, and these were used for the distortion measurements. A Rhode and Schwarz Spectograph was used to measure both distortion and intermodulation levels. While a cartridge's distortion content is primarily second harmonic, significant third or higher harmonics were occasionally present and were duly noted.

A further distortion measurement concerned the quality of the crosstalk signal. With good examples,

Technical introduction.

both the lateral modulation and the crosstalk distortion readings were typically 0.2-0.3%, but they could reach as much as 2-3% with suspect designs. The vertical modulation readings were typically ten times higher, with the best around 2-3% and the worst as high as 11%. (The test level for lateral distortion was +9dB and for the vertical modulation, +6dB.)

All the measurements, particularly distortion and crosstalk, are strongly affected by cartridge alignment, and this was consequently set with great care. While it was found that vertical misalignment of moderate proportions, for example, $\pm 3^\circ$, had little measureable effect on the results, a minor misalignment in the lateral plane (incorrect 'overhang') could reduce separation by as much as 5dB, and double an otherwise intrinsically low lateral modulation distortion result.

Throughout the lab tests, close watch was kept on the visual aspects of the wave forms produced by the cartridges, particularly at the higher frequencies, where distortion and resonances may be readily

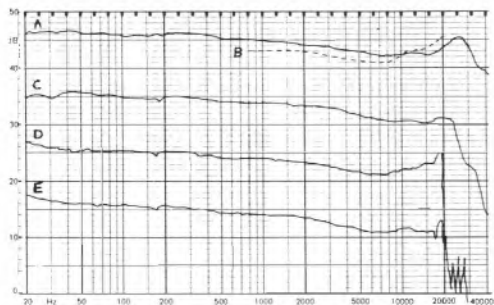


Fig 1. Variations in frequency responses on available test records, using the Grace F9L cartridge. A—Hi-Fi Choice reference, $33\frac{1}{3}$ rpm; B—Audio Technical, $33\frac{1}{3}$ rpm, C—B & K 2010, $33\frac{1}{3}$ rpm; D—B & K 2009 band 1, 45rpm, E—B & K 2009 band, 5.45rpm.

perceived which would otherwise require further lengthy investigation. In addition, all the output and hum measurements, test levels, etc., were referenced to a nominal zero modulation level, namely 5cm/sec, rms lateral at 1kHz, which is equivalent to 5cm/sec peak at 45° , L or R at 1kHz.

Further investigation of mid and high frequency distortion was undertaken using the intermodulation bands on the Shure lab disc, TTR103. No equalisation was employed and tests were made at a fairly high modulation level to investigate both

distortion and trackability; (the 1kHz + 1.5kHz band, 25cm/sec peak lateral, and 10kHz pulsed at 270Hz, at 24cm/sec peak lateral velocity). Lower frequency 300Hz tracking tests were also made using STR112, to ascertain the minimum downforce required to track a vertical and lateral modulation band, (+15dB and +12dB respectively.) Finally, the so-called 'supertrack' was tried, (+18dB, 300Hz lateral) and the required tracking force (within reason!) was determined.

Having established the optimum operating conditions, particularly electrical loading, downforce and arm damping requirements, the cartridges were set up for sequential auditioning. For most listening tests the Technics SP10 II plinth system and EPA100 arm were employed, and the programme was repeated in its entirety to provide greater accuracy and to check on the panel's consistency of judgment. The key factor in the auditioning was the comparison of the cartridge's overall quality—clarity, stereo imaging, balance and colouration—on a given set of good quality discs, with that produced by an optimised high quality open-reel recorder replaying copies of the original mastertapes used to cut the records. It is essential when reading the necessarily brief summaries of sound quality to bear in mind the test conditions, and thus to understand that it is possible for models that were otherwise of good quality but which did not sound particularly 'accurate' to still provide good results in a suitable system.

In addition to the Technics turntable, the reproducing chain used for the listening tests included the Linn Sondek LP12 with a Grace arm, and the Technics SL1700 record deck. The loudspeakers were a pair of Yamaha NS1000M and Sponder BC1s, and power was supplied by a Yamaha C2/B2 and a C.J. Rogers Valve Amplifier, used in conjunction with a LuxC1000 pre-amplifier. The Denon transformer was employed for the appropriate moving coil models and the tape deck was a calibrated Sony 756/2. Tapes were obtained from Decca, Argo, EMI, Enigma Records and Phonogram and the corresponding records were as follows:

- 1) Decca—Kodaly, *Missa Brevis*, (SXL 6803)
- 2) Argo—Vivaldi, *The Four Seasons*, (ZRG 654)
- 3) EMI—Kreiser, *Violin & Piano pieces*, (ASD 3258)
- 4) EMI—Scarlatti, *Harpsicord Sonatas*, (HQS 1365)
- 5) Enigma—Stravinsky, *The Firebird*, (VAR 1022)
- 6) Enigma—Beethoven, *Piano Sonatas*, (VAR

1002)

7) Phonogram—Wharfedale Sound, (6833 168)

Finally, the services of a stylus expert were obtained to provide an evaluation of all the models in the report. This is probably the first time that diamond tip quality has been properly assessed in a review, and the findings fully justified the action. Several manufacturers should clearly pay greater attention to this aspect of their designs. The styli were evaluated on the following basis: measurement of the major and minor radii, tip radius and cone angle, quality of surface polish and mounting, alignment accuracy and estimated mass

Turntable/arm tests

At the outset, the construction of the arm and turntable were carefully examined for engineering quality and accuracy. With respect to the test programme, it can be readily appreciated that the possible permutations and combinations of forty cartridges and sixty turntables is enormous, and that only a limited number of cartridges could be tried in each arm. However, at least one example of a moving coil medium compliance design, and one high compliance, moving magnet cartridge was used with every arm in the survey.

As with the cartridges, a test was applied to the arms to determine compatibility, in this case concerning their effective mass and damping properties. These were coded so as to allow ready matching of arm and cartridge combinations. Employing a calibrated cartridge, the same B&K 2010 sweep record was used to locate the subsonic arm resonance whose magnitude, (with correction for frequency) gives the required information on arm damping.

Arm friction was measured at several points over the record surface and in both planes, the figures quoted being typical starting values before arm movement. A sensitive wire deflection balance was used for both these measurements and the bias force readings. The latter were taken at a nominal 'dialed' setting of 1.5g for an elliptical stylus.

Opinion concerning the degree of bias compensation required is somewhat varied, but experience gained through testing the range of cartridges in this report indicates that while 10-15% of downforce is generally suitable (the higher figures pertaining to the inner groove radii), spherical tips need somewhat less, about 7-12%. The measured values for bias correspond at a 1.5g setting to approximately 150mg of lateral outward force at the

record edge, rising to around 200 mg at the centre. Very low or very high bias values will impair trackability or even promote groove hopping or skating. In addition, the bias mechanisms were all examined for any friction which they might introduce or possible stability deterioration, the latter important with unipivot arms.

The downforce calibration accuracy was measured using a calibrated Shure stylus pressure gauge. Errors of less than 10% are unimportant, particularly if deviating on the high side.

An arbitrary assessment of arm trackability at 300Hz was also made, using two test cartridges, the Fidelity Research FR1 mk II and B&O MMC4000. It was found that some arms impaired cartridge trackability due to high friction, or counterweight and dynamic balance resonances.

An unusual test was also devised to investigate arm resonances in the audible range; (this must inevitably include some contribution from both the mounting board or chassis as well as disc resonances.) It relied on the use of a moving coil cartridge with excellent channel balance and separation, (FR1 mk II and Supex 900 Super.) The two channels were summed, (L + R) while a vertical modulation sweep (L-R, 20Hz to 20kHz, B&K QR2009) was traced. In theory, the result represents a type of crosstalk measurement where the cartridge and arm are fully excited with a reference signal level of 0dB, while the summed output descends to the -30 to -40 crosstalk level. Superimposed on the latter are the arm resonances (torsional and other modes) which alter the exact geometrical alignment of the cartridge relative to the groove, thus worsening the crosstalk. The illustrated resonance analysis shows the magnitude and frequency of the visible resonances, as drawn from the above mentioned crosstalk chart records.

Naturally enough, the alignment of the arms was carefully checked with an alignment protractor and this was compared with the alignment resulting from following the manufacturers' own instructions. It was found that the latter sometimes proved ambiguous and in certain cases, incorrect.

Finally, subjective testing was undertaken. One technique employed was comparison with three turntables that exhibited certain characteristics which revealed colouration in other models. These three record decks were the Linn Sondek/Grace arm, Technics SP10/EPA100 and Micro Seiki DDX1000/Hadcock Unipivot. Where an arm was supplied for review as a separate item, care was taken to ensure that the matching 'platform'

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selected was clear of significant subjective problems, and both vibration and acoustic feedback were also assessed, under controlled gain calibrated conditions in the laboratory and domestic living room environments.

Master tape replay provided an overall reference standard on which to base judgment, and with the exception of those decks which came factory fitted with an essentially non-interchangeable cartridge (for example, the B&O and Dansk models), a reference cartridge was used for subjective testing, namely a matched pair of equalised Ultimo 20As.

We confirmed that significant differences in sound quality do exist between turntable systems and that the causes can be identified, and in some cases dealt with. Influential factors include the method of vibration isolation, (whether rubber feet or fully suspended); the resonant properties of the lid (open or shut), plinth, subchassis and arm, and not least of all, that of the record itself, the latter controlled by the type of disc support.

With some turntable and arm combinations, certain aspects of sound quality were considered to be altered. The bass reproduction—assessed using equalised NS1000M speakers—varied from neutral to dry, lacking in extreme registers and positively boomy, the latter akin to a poorly designed loudspeaker. Higher up the range, colouration could be heard which subtly altered the musical balance—for example, by thickening or hardening the lower-mid-range and making the sound over-rich, or at the other extreme, tending towards the metallic. When any significant colouration was present, the subjective programme detail was impaired, with significant loss of stereo image, depth and perspective, and on occasion, an apparent shift of some instruments in the programme. These latter effects were attributed to the arm or motor section, or combinations of the two.

During the auditioning, the sound quality was also assessed for audible wow, rumble or hum, using a realistic programme level setting of 100dB max. at listening position. It was found that one record in particular, namely the Sheffield Direct Cut Lab 2, Side 2, Band 2, was remarkably useful for exposing wow, and surprisingly enough, wow could be heard on certain direct drive models with measured figures of below 0.04%.

On the lab side, the wow and flutter readings were taken to the DIN peak weighted standard using a Matsushita master acetate disc whose residual flutter level is probably below 0.02% DIN peak

weighted. The rumble content was analysed, both unweighted and DIN B weighted, the latter reading found to have the best correlation with the subjective quality. The results comprise an average of the left and right channel readings, DIN B weighted and with the B&K recorder set to rms on a slow response. The test cartridge was chosen as a reasonable match for the arm to improve stability, and the rumble disc was a Matsushita master acetate whose intrinsic rumble level is of the order of --73dB, DIN weighted.

The absolute speed was measured using a Marconi digital frequency meter TF2340 reading the 3,000Hz tone on the Matsushita acetate. Speed drift over one hour was noted and also the variation under moderate load (a 5g tracking dust bug).

A new test was also evolved to measure the possible colouration and acoustic feedback susceptibility of a turntable system. Simply, the turntable was set up with its lid elevated, a record on the platter (not rotating) and a cartridge resting in the groove. The turntable was then subjected to a calibrated pink noise sound field generated by a nearby loudspeaker (KEF 103). The published curve is the $\frac{1}{2}$ octave analysis of the static cartridge output and shows how much of the air-borne sound is transmitted into the cartridge output. These curves are by no means absolute but as they were all taken under identical conditions, they provide a useful relative indication of the required characteristics. Once again, this measurement will include the contribution of the record and arm, in addition to structural resonances in the turntable system.

At first sight, the curves may all look fairly similar but inspection reveals that great differences can be present, with paired examples exhibiting whole frequency ranges with a 10 or 20dB level difference. The location of the breakthrough is also significant with high values in the over 200Hz region classed as fairly serious and indicative of mid-range colouration.



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ADC QLM mk II

BSR McDonald Limited, Monarch Works, Powles Lane, Cradley Heath, Warley, Worcs. 0384 65191.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This is the lowest priced ADC cartridge in this survey, costing about half as much as the XLM Mk II. Brand similarities emerge as a common induced magnet system and body are employed. However, the compliance is further reduced in this model, making it compatible with ordinary medium to high mass arms, and permitting the use of the supplied headshell.

Aiming at a 10Hz resonance, the effective mass of the arm used with the XLM should not exceed 12.5g, including the contribution of the 7g ADC headshell. In fact, arm masses of up to 20g will not take the combined resonance below 7Hz.

The squarewave response showed some asymmetry but was basically very good. The overall frequency response was similar to that of the VLM, with a marked resonance, 8dB high at 20kHz, which may be partially controlled by increased load capacitance (450-500pf). At 18dB, channel separation was not very good on this sample and the high frequency wave form quality was also poor, suggestive of a low quality stylus tip. However, hum induction was excellent; in fact, some 10dB better than the other two ADCs.

The trackability was down on the VLM level, the supertrack band requiring a 1.8g downforce, probably due to the reduced compliance.

Listening tests placed this model pretty low, and while its balance was considered fairly neutral, it was also described as hard, sibilant and compressed, with only adequate imaging and rendition of detail.

Upon examination, the QLM was found to have a poorly aligned, shank mounted elliptical tip of adequate polish. The radii were 0.3 x 0.6 thou, and while the minor was well shaped the major was rather less so. Both the vertical and the elliptical axes showed evidence of misalignment.

Stylus Data

Stylus Type	shank elliptical
Interchangeability	yes
Finish and Alignment of diamond	poor
HF Resonance	20kHz
Measured Dynamic Compliance at 10Hz	20cu
Replacement Stylus Price ex VAT	£10.62

General Data

Cartridge Mass	5.5g
Test Tracking Force	1.5g
LF Resonance in Standard Arm	8Hz
Induced Hum Level	-75dB
Sensitivity	1.2mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+1.6dB
Subjective Sound Quality	average

Frequency Response and Separation

20Hz-20kHz	±4dB
100Hz-5kHz	±0.25dB
Channel Separation at 100Hz	13dB
Channel Separation at 1kHz	18dB
Channel Separation at 10kHz	16dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0dB

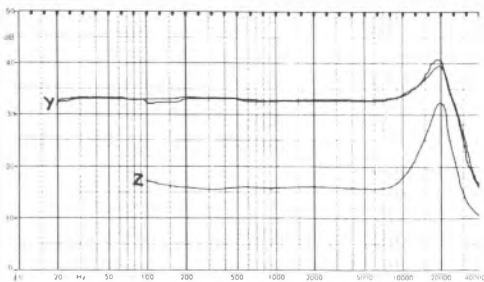
Distortion

HF Wave Form Quality	poor
Lateral Distortion at +9dB 300Hz	0.2%
Vertical Distortion at +6dB 300Hz	6%
Mid-band Intermodulation	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.35%

Trackability

Trackability 300Hz Lateral +14dB	1g
Trackability 300Hz Vertical +11dB	0.9g
Supertrackability 300Hz +18dB Lateral passed at	1Bg
Typical Selling Price ex VAT	£18.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



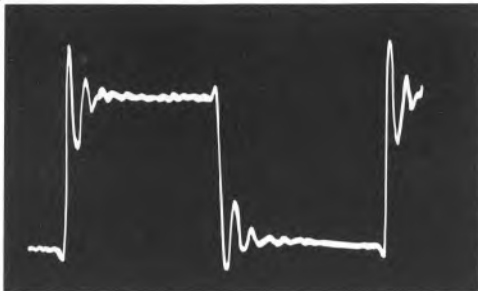
Compatibility

Recommended Loading	47k ohms
Recommended Loading	300-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	B
Damping Rating	M
Medium mass arms suitable	

RECOMMENDED

ADC VLM mk II

BSR McDonald Limited, Monarch Works, Powles Lane, Cradley Heath, Warley, Worcs. 0384 65191.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

The VLM Mk II, which derives from its more expensive brother the XLM, offers a slightly higher tip mass and reduced compliance. The latter makes it compatible with most pick-up arms.

While the trackability at the test 1.5g downforce was undoubtedly very good, all the measured distortion levels were considerably poorer than average.

The frequency response in the mid-range was excellent, as was the channel balance, with the output 4dB greater than the XLM Mk II. The 6dB rise in response at 20kHz can be partially tamed by an increased load capacitance of up to 400pf. The squarewave response closely paralleled that of the XLM Mk II, but with more sustained ringing and a greater overshoot.

The moderate compliance means that conventional arms with effective masses in the 5 to 12g range are suitable for use with the VLM Mk II, and where an SME type fitting is provided, the cast magnesium headshell supplied may be used.

Listening tests revealed its general quality and balance to be similar to the XLM Mk II, but with mildly degraded imaging and detail plus poorer ambience. Qualifications of brightness and harshness were also made, with the total appraisal denoting a slightly below average quality rating.

The stylus report found that the dural shank mounted tip had well shaped 0.3 x 0.6thou radii, exhibiting good polish and alignment.

Stylus Data

Stylus Type	shank elliptical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	21kHz
Measured Dynamic Compliance at 10Hz	.25cu
Replacement Stylus Price ex VAT	£11.00

48 Cartridges

General Data

Cartridge Mass	5.75g
Test Tracking Force	1.5g
LF Resonance in Standard Arm	7Hz
Induced Hum Level	-68dB
Sensitivity	1.3mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+2.3dB
Subjective Sound Quality	average

Frequency Response and Separation

20Hz-20kHz	± 1.25dB
100Hz-5kHz	± 0.5dB
Channel Separation at 100Hz	± 23dB
Channel Separation at 1kHz	27dB
Channel Separation at 10kHz	24dB
Channel Balance at 1kHz	0.5dB
Channel Balance at 10kHz	0.6dB

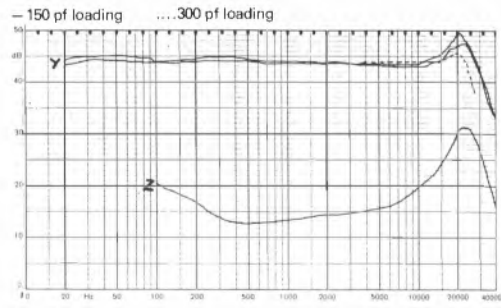
Distortion

HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	1.5%
Vertical Distortion at +6dB 300Hz	6%
Mid-band Intermodulation	-.3%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.38%

Trackability

Trackability 300Hz Lateral +14dB	0.8g
Trackability 300Hz Vertical +11dB	0.8g
Supertrackability 300Hz +18dB Lateral passed at	1.5g
Typical Selling Price ex VAT	£23.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

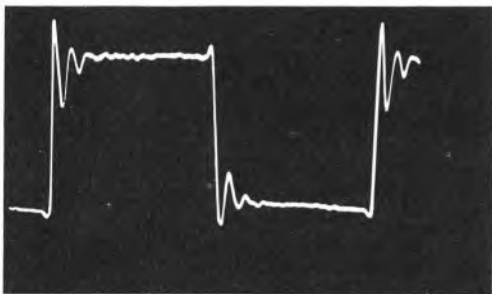


Compatibility

Recommended Loading	.47k ohms
Recommended Loading	252-350pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	M
Low to medium mass arms suitable	

ADC XLM mk II

BSR McDonald Limited, Monarch Works, Powles Lane, Cradley Heath, Warley, Worcs. 0384 65191.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This Mark II version of an established ADC induced magnet cartridge has apparently been modified since its introduction. Compared with a sample I tested one year ago, which possessed a low compliance value of approximately 20cu, the cartridge supplied for this review reverted to the original (Mk I) high level of 50cu. Aiming at a 10Hz arm/cartridge resonance, the arm mass would have to be zero, the cartridge mass alone being sufficient! Compromising at 7Hz, a typical low mass arm (M_e 5g) would be satisfactory. The relatively heavy headshell supplied with the cartridge is unsuitable, as, if it were fitted to any normal arm, the subsonic resonance would be placed at 5Hz, which is too close to floor vibration and record warp frequencies.

On test, the mid-band response was found to be particularly smooth with fair channel balance. At 4% the vertical modulation distortion was slightly high—a characteristic of all ADC cartridges. This could not be attributed to vertical tracking error but cantilever drag is a possible cause. Mid-band intermodulation and distortion levels were a little high but not objectionably so, and the hum induction level was satisfactory. The squarewave response was clean with little phase anomaly and a quickly damped overshoot. The flat tops confirm the even frequency response, which was little affected by changes in loading. The best results were however obtained using the manufacturer's recommended 47K ohms, 275-300pf.

The sound quality was rated well above average, and considered to be quite neutral with fair detail and good imaging. On occasion some harshness was noticed, but this was not too obtrusive.

The stylus was found to be a beneficially small naked diamond, with well shaped 0.3×0.7 thou radii. Both polish and alignment were classed as good.

Stylus Data

Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	24kHz
Measured Dynamic Compliance at 10Hz	50cu
Replacement Stylus Price ex VAT	£15.00

General Data

Cartridge Mass	5.75g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	5Hz
Induced Hum Level	-67dB
Sensitivity	1mV/cm/sec
Sensitivity referred to 1mV/cm/sec	0dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	± 1.25 dB
100Hz-5kHz	± 0.25 dB
Channel Separation at 100Hz	19dB
Channel Separation at 1kHz	21dB
Channel Separation at 10kHz	21dB
Channel Balance at 1kHz	1dB
Channel Balance at 10kHz	1.1dB

Distortion

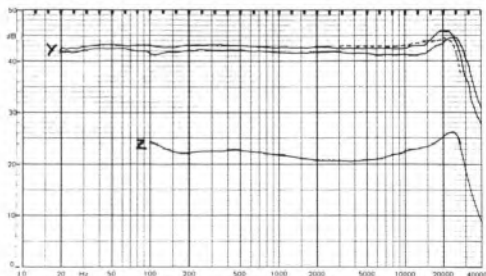
HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.8%
Vertical Distortion at +6dB 300Hz	4%
Mid-band Intermodulation	3%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.3%

Trackability

Trackability 300Hz Lateral + 14dB	0.7g
Trackability 300Hz Vertical + 11dB	0.8g
Supertrackability 300Hz + 18dB Lateral passed at	1.25g

Typical Selling Price ex VAT £26.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.
— 150 pf loading 300 pf loading



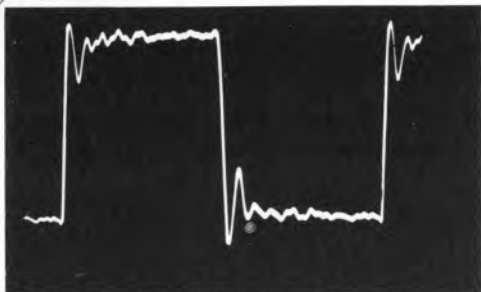
Compatibility

Recommended Loading	47k ohms
Recommended Loading	250-350pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	D
Damping Rating	L
Very low mass arm required	

RECOMMENDED

AKG P7E

AKG Equipment Limited, 182/4 Campden Hill Road, London W.8. 01-229 3695.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

Considerably less expensive than the other two AKG models in the report, the P7E is intended for more robust work with a claimed compliance of 25cu. It measured 27, which although close to spec, was greater than the value recorded for the theoretically high compliance P8E! As it stands, the P7E is suited to arms in the 5 to 10g range, preferably possessing some damping.

The tip mass was higher than that of the other AKGs, as evidenced by the 15kHz upper range resonance which produced increased distortion on the 10kHz intermodulation track. However, it proved to be a secure tracker at mid and low frequencies, and possessed excellent channel balance and good stereo separation. The output was rather low at 3.6dB below the nominal level.

The illustrated curve was taken using the manufacturer's recommended 470pf loading, and with a reduction to 150, the 15kHz peak could well be lowered somewhat. (This effect was also noted with the other two models.) Nevertheless, up to 10kHz the response was commendably uniform.

The squarewave showed an overshoot similar to that recorded by the P8E, although both were quickly damped and should give no cause for concern. However, the induced hum level of the P7E was poorer than average, indicating that magnetic screening is a problem AKG still have to solve.

Listening tests placed the model (on 150pf load) just below average, and it was considered to have a fair frequency balance with good detail and imaging. However, hardness, some roughness and a lack of presence were also evident.

Despite the fairly high price, the diamond fitted was found to be an ordinary, commercial quality steel shank type. Polish was adequate, alignment good, and the 0.2x0.7thou radii were both well shaped. Overall the profile was tending towards a 50 Cartridges

line contact, although this is not specified by the manufacturer.

Stylus Data

Stylus Type	shank elliptical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	15kHz
Measured Dynamic Compliance at 10Hz	27cu
Replacement Stylus Price ex VAT	£14.00

General Data

Cartridge Mass	5.9g
Test Tracking Force	1.5g
LF Resonance in Standard Arm	6.9Hz
Induced Hum Level	-60dB*
Sensitivity	0.66mV/cm/sec
Sensitivity referred to 1mV/cm/sec	-3.6dB
Subjective Sound Quality	average

Frequency Response and Separation

20Hz-20kHz	±2.5dB
100Hz-5kHz	±0.5dB
Channel Separation at 100Hz	19dB
Channel Separation at 1kHz	24dB
Channel Separation at 10kHz	21dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0dB

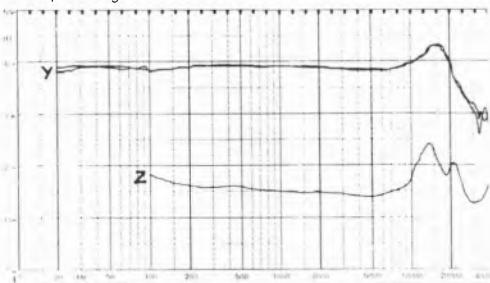
Distortion

HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	0.3%
Vertical Distortion at +6dB 300Hz	2%
Mid-band Intermodulation	0.8%
HF Intermodulation pulsed 10kHz 24cm/sec peak	2.0%

Trackability

Trackability 300Hz Lateral +14dB	0.6g
Trackability 300Hz Vertical +11dB	0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.5g
Typical Selling Price ex VAT	£26.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division. at 400 pf loading

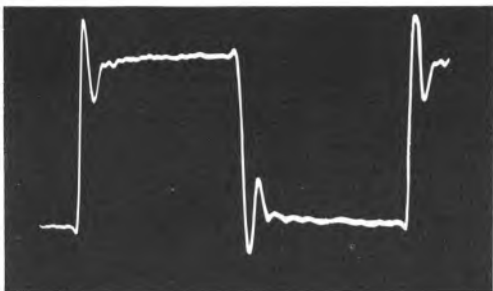


Compatibility

Recommended Loading	47k ohms
Recommended Loading	350-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	M
Low mass arm required preferably damped	

AKG P8E

AKG Equipment Limited, 182/4 Campden Hill Road, London W8. 01-229 3695.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

Judged on the basis of the sample supplied, the P8E, although superficially similar to the P8ES, does not attain the same high standard set by the slightly more expensive model. Channel separation and balance (out 2dB), were both distinctly below par, although distortion values for the P8E were generally better than those for the P8ES, and the output level was up, measured at 2.6dB below nominal.

At 22cu, the compliance was slightly lower than the P8ES, and fell far short of the claimed specification value of 35cu. However, in my view, this is no disadvantage, as it makes it compatible with a wider range of arms. Trackability was excellent at 1.25g.

The squarewave results were similar to those for the P8ES, but showed more overshoot, and the hum induction was a slight problem; not severe, but worse than average. In use, the stylus guard was considered to be too stiff which tended to promote mishandling. (This latter criticism is valid for all three AKG models.) Conversely, the finish and packing of these cartridges was beyond reproach.

While listening tests placed the P8E a little below the P8ES, it was nevertheless well above average on the basis of its stereo imaging, detail, frequency balance and neutrality. Apart from a moderate dulling in the presence range the results were most favourable. Tests suggest that the maker's recommended loading of 470pf is in error, and the lab test value of 47K ohms, 150pf is suggested to achieve the best results.

The stylus examination revealed that the polish of this naked elliptical tip could not be rated higher than 'adequate', and while the alignment was satisfactory, some offset was still visible although much less so than on the P8ES. The 0.3 x 0.8thou radii were well shaped, though out of specification.

Stylus Data

Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	adequate
HF Resonance	19kHz
Measured Dynamic Compliance at 10Hz	22cu
Replacement Stylus Price ex VAT	£31.00

General Data

Cartridge Mass	5.9g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	7.4Hz
Induced Hum Level	-61dB*
Sensitivity	0.74mV/cm/sec
Sensitivity referred to 1mV/cm/sec	-2.6dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	± 1.25dB
100Hz-5kHz	± 0.5dB
Channel Separation at 100Hz	20dB
Channel Separation at 1kHz	27dB
Channel Separation at 10kHz	23dB
Channel Balance at 1kHz	2dB
Channel Balance at 10kHz	1dB

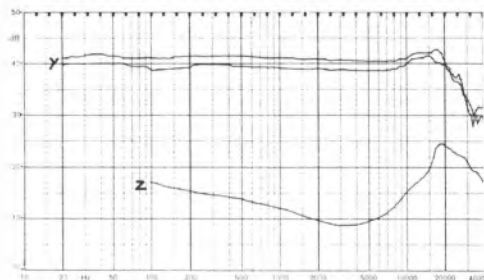
Distortion

HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.8%
Vertical Distortion at +6dB 300Hz	2.8%
Mid-band Intermodulation	1%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.3%

Trackability

Trackability 300Hz Lateral +14dB	0.7g
Trackability 300Hz Vertical +11dB	0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.25g
Typical Selling Price ex VAT	£52.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



Compatibility

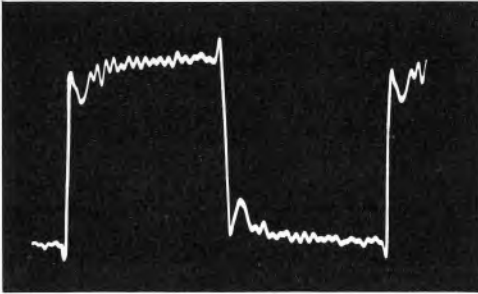
Recommended Loading	47k ohms
Recommended Loading	100-250pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	M
Low to medium mass arms compatible, preferably with damping	

*see text

RECOMMENDED

AKG P8ES

AKG Equipment Limited, 182/4 Campden Hill Road, London W8. 01-229 3695.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This new, top-of-the-line model from AKG is specified as intended for 47k ohms, 470pf loading, but actually gave the best results at the reduced capacitance of 150pf. Using the manufacturer's recommendations, a 2dB peak was recorded at 18kHz.

The measured response was commendably smooth but with a slight downwards tilt in the presence range, although it showed excellent channel separation and balance. The output was low, 5.3dB below the nominal 1mV/cm/sec, and the hum susceptibility was also poorer than average.

Distortion levels were typical for the group, although 1.5g was needed to clear the supertrack band.

The compliance was moderate at 25cu and hence most low to medium mass arms are suitable, and slight arm damping would offer a further improvement in LF stability; (5-12g effective mass).

The squarewave showed some distortion of both phase and frequency, but illustrated a well damped high frequency response with no overshoot.

Listening tests ranked the model high, well above average, and numerically in the top five. It was considered pleasant, smooth and delicate and gave good stereo, with only moderate detail and image depth loss. The balance was felt to be slightly dull with some loss of presence, but nevertheless highly neutral.

The stylus report was surprisingly poor in view of the model's high cost and subjective performance. While the radii were satisfactory at 0.3×0.7 thou and were well shaped and polished, the ellipse major axis was offset to the cantilever axis by over 10° . With a better tip and improved setting this model might have attained an even higher subjective ranking.

Stylus Data

Stylus Type naked elliptical
52 Cartridges

Interchangeability	yes
Finish and Alignment of diamond	poor
HF Resonance	18kHz
Measured Dynamic Compliance at 10Hz	25cu
Replacement Stylus Price ex VAT	£35.00

General Data

Cartridge Mass	5.9g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	7.0Hz
Induced Hum Level	-66dB*
Sensitivity	0.54mV/cm/sec
Sensitivity referred to 1mV/cm/sec.	-5.3dB
Subjective Sound Quality	excellent

Frequency Response and Separation

20Hz-20kHz	± 1 db
100Hz-5kHz	± 1 db
Channel Separation at 100Hz	19dB
Channel Separation at 1kHz	32dB
Channel Separation at 10kHz	25dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0.5dB

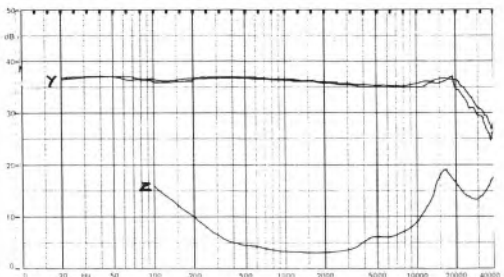
Distortion

HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.9%
Vertical Distortion at +6dB 300Hz	3.2%
Mid-band Intermodulation	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.3%

Trackability

Trackability 300Hz Lateral + 14dB	0.7g
Trackability 300Hz Vertical + 11dB	0.5g
Supertrackability 300Hz + 18dB Lateral passed at	1.5g
Typical Selling Price ex VAT	£58.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



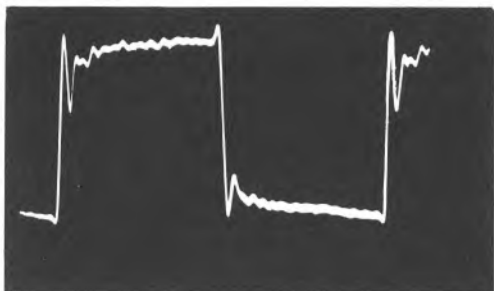
Compatibility

Recommended Loading	47k ohms
Recommended Loading	100-250pf*
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	M
Low mass arm required, damping an advantage	

* see text

Audio Technica AT11EP

Shiro (UK) Limited, Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This modestly priced cartridge did surprisingly well in the listening tests, achieving a slightly above average rating. It was described as possessing good detail and imaging, a fair frequency balance and an occasional brash, forward quality, but was nevertheless pretty accurate overall.

The measured compliance was low at 8.5cu, this value resulting in a 12Hz resonance in our test arm (20g total). This robust cartridge may therefore be used with almost any medium to high mass arm currently available. The internal damping was low and arm damping could well prove advantageous; it is however, admitted that such niceties are often impractical in this price range. The output was high (+5dB) and the hum level low (-75dB), with the channel balance and separation both very good.

Overall, the trackability was of a high standard at the test downforce of 2g – a satisfactory setting for a broad radius, elliptical stylus. Only the supertrack level caused difficulty which is understandable in view of the compliance value.

Distortion levels were low and the frequency response was considered good for the price. The squarewave photograph showed a fast, well damped risetime with moderate phase and frequency distortion.

Despite the very modest price it was found that a good quality, well aligned, steel shanked diamond of 0.2 x 0.8thou radii had been fitted. The polish and shape both rated as good, though the minor radius is clearly out of specification

Stylus Data

Stylus Type	shank elliptical
Interchangeability	yes
Finish and Alignment of diamond	adequate*
HF Resonance	14kHz
Measured Dynamic Compliance at 10Hz	8.5cu
Replacement Stylus Price ex VAT	£5 00

General Data

Cartridge Mass	5.5g
Test Tracking Force	2g
LF Resonance in Standard Arm	12Hz
Induced Hum Level	-75dB
Sensitivity	1.8mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+5.1dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	± 2.5dB
100Hz-5kHz	± 1.5dB
Channel Separation at 100Hz	19dB
Channel Separation at 1kHz	28dB
Channel Separation at 10kHz	13dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0dB

Distortion

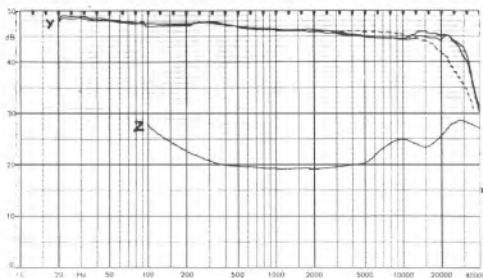
HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.4%
Vertical Distortion at +6dB 300Hz	3%
Mid-band Intermodulation	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.35%

Trackability

Trackability 300Hz Lateral +14dB	1.2g
Trackability 300Hz Vertical +11dB	1g
Supertrackability 300Hz +18dB Lateral passed at	>3.0g
Typical Selling Price ex VAT	£7.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

– 150 pf loading ... 400 pf loading



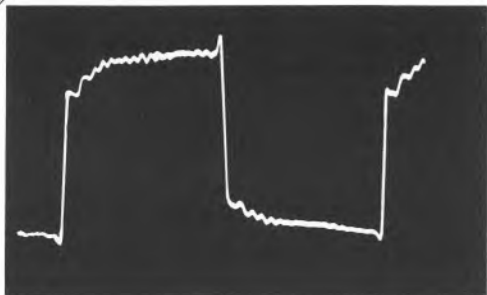
Compatibility

Recommended Loading	47K ohms
Recommended Loading	100-250pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	A
Damping Rating	M
Compatible with high mass arms	

RECOMMENDED

Audio Technica AT13EaP

Shriro (UK) Limited, Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This moderately priced stereo cartridge is characterised by a response which falls with increasing frequency, 150pf loading giving the most extended results.

At typically 25dB mid-band, channel separation was fine, and balance held within 0.5dB over the entire audible spectrum. The frequency response was quite even over the range, and the output was 4dB above nominal. It proved to be a good tracker and the accompanying distortion readings at all frequencies were better than average.

The compliance was high at 34cu and this fact, together with minimal damping at low frequencies, implies that a low mass arm in the 5g range would be required to give an optimum performance in terms of stability and tracking. Arm damping would also be an advantage.

The squarewave was clean and symmetrical with no overshoot, the rounded edge reflecting the falling high frequency response.

Subjective testing rated this model below average but not severely so. The dull, rounded characteristic was mainly to blame for its downgrading and on the plus side, the rendition of detail and stereo image was favoured. A loudspeaker with a bright characteristic could match this model very well.

It is worth noting that in the event of damage or wear, the cost of a replacement stylus represents almost 90% of the purchase price of the original cartridge. The stylus fitted to this sample was found to be a superb quality, naked elliptical diamond. The correct 0.2×0.7 thou radii were accurately shaped; polish and alignment were very good and overall, the assembly was of the highest class.

Stylus Data

Stylus Type naked elliptical
Interchangeability yes
Finish and Alignment of diamond excellent
HF Resonance 18kHz

54 Cartridges

Measured Dynamic Compliance at 10Hz 34cu
Replacement Stylus Price ex VAT £10 50

General Data

Cartridge Mass 5.8g
Test Tracking Force 1.5g
LF Resonance in Standard Arm 6.5Hz
Induced Hum Level -70dB
Sensitivity 1.6mV/cm/sec
Sensitivity referred to 1mV/cm/sec +4dB
Subjective Sound Quality average

Frequency Response and Separation

20Hz-20kHz ± 1.5 dB
100Hz-5kHz ± 1 dB
Channel Separation at 100Hz 15dB
Channel Separation at 1kHz 25dB
Channel Separation at 10kHz 17dB
Channel Balance at 1kHz 0.5dB
Channel Balance at 10kHz 0.3dB

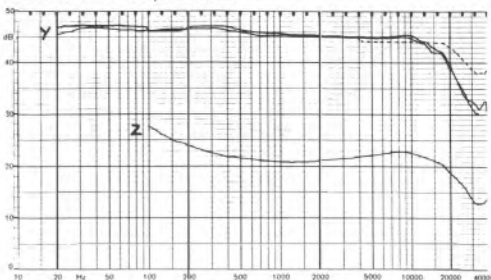
Distortion

HF Wave Form Quality good
Lateral Distortion at +9dB 300Hz 0.5%
Vertical Distortion at +6dB 300Hz 2.2%
Mid-band Intermodulation 1.7%
HF Intermodulation pulsed 10kHz 24cm/sec peak 0.35%

Trackability

Trackability 300Hz Lateral +14dB 0.6g
Trackability 300Hz Vertical +11dB 0.6g
Supertrackability 300Hz +18dB Lateral passed at 1.5g
Typical Selling Price ex VAT £12 50

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



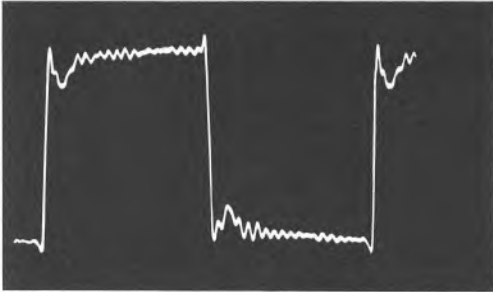
Compatibility

Recommended Loading 47k ohms
Recommended Loading 300-500pf
Match up these letters (A/B/C/D/J/K/L/M) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)
Resonance Rating D
Damping Rating M
Requires low mass arm

RECOMMENDED

Audio Technica AT20SLa

Shriro (UK) Limited, Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This top-of-the-range Audio Technica cartridge comes fitted with a Shibata stylus and is suitable for stereo and CD4 quadrasonic records. Possessing an aluminium body it was fairly heavy at 8 grams, which proved unfortunate in view of its correspondingly high compliance of 34cu. A genuinely low mass arm, preferably one with damping, is essential if optimum performance is to be realised. Only a few fluid damped arms of the unipivot type are likely to offer sufficiently low mass, although the SME (non-detachable) with the new damper may be a suitable choice.

Proving to be an excellent tracker, this model also produced low distortion levels, a wide uniform frequency response, and excellent channel balance and separation. The response was unaffected by moderate loading variations and the output level was reasonable at 2.2dB below nominal. The squarewave photograph illustrated a fast, well controlled rise time with some phase discrepancy after the leading edge. Good symmetry was also shown.

The listening tests indicated an above average ranking for the AT20SLa, with the sound quality classed as well balanced, subtle and clear, if slightly dull, although occasionally it was slightly edgy.

The stylus report showed that a reduced mass, naked Shibata diamond had been fitted. The mounting was superb, with very good shape, polish and alignment. (It is perhaps worth noting that the AT20SLa is a selected version of the cheaper AT15SLa, which should prove very similar for stereo use at a reduced cost.)

Stylus Data

Stylus Type	naked shibata
Interchangeability	yes
Finish and Alignment of diamond	excellent
HF Resonance	30kHz
Measured Dynamic Compliance at 10Hz	34cu
Replacement Stylus Price ex VAT	£23 00

General Data

Cartridge Mass	8g
Test Tracking Force	1.5g
LF Resonance in Standard Arm	6.2Hz
Induced Hum Level	-65dB*
Sensitivity	0.78mV/cm/sec
Sensitivity referred to 1mV/cm/sec	-2.2dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	1.5dB
100Hz-5kHz	1.0dB
Channel Separation at 100Hz	20dB
Channel Separation at 1kHz	35dB
Channel Separation at 10kHz	20dB
Channel Balance at 1kHz	0.0dB
Channel Balance at 10kHz	0.6dB

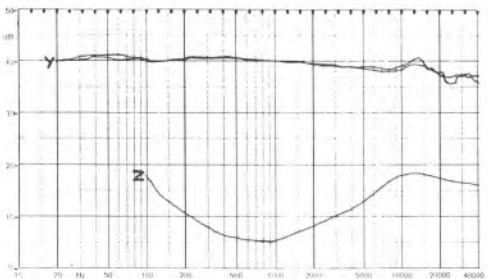
Distortion

HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.6%
Vertical Distortion at +6dB 300Hz	2%
Mid-band Intermodulation	2.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.66%

Trackability

Trackability 300Hz Lateral +14dB	0.7g
Trackability 300Hz Vertical +11dB	0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.5g
Typical Selling Price ex VAT	£36 00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



Compatibility

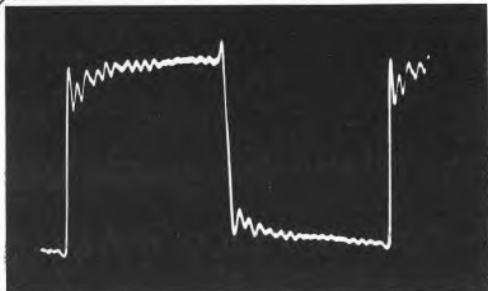
Recommended Loading	47K ohms
Recommended Loading	100-200pF
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	B
Damping Rating	M
Very low mass arm required, preferably with damping	

*see text

RECOMMENDED

Bang & Olufsen MMC3000

Bang and Olufsen (UK) Limited, Eastbrook Road, Gloucester GL4 7DE. 0452 21591.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

A spherical tipped version of the more expensive MMC4000, we noticed a significant temperature effect with both B & O cartridges at an early stage in the testing. Investigation revealed that the manufacturer's excellent claimed response could be met but only in warm (24°C) conditions. Below 20°C, the treble response falls off markedly and at 17°C, (not an unusual domestic temperature) the response can be as much as 7dB down at 15kHz. Other parameters such as trackability also suffered from the same variation. B & O are aware of this effect and agree that operation above 20°C is recommended for optimum performance, and accordingly, lab measurements for both cartridges were taken at an average of 24°C.

Most of the test results were similar to those achieved by the more expensive model, but distortion levels showed some deterioration and the trackability was slightly inferior, although still more than adequate.

Channel separation was satisfactory and channel balance good, as was the overall frequency response at the optimum temperature. The compliance was the same as the MMC4000 and the same arm recommendations also apply here.

Squarewave testing again gave similar results, the degree of rounding on the leading edge understandably being temperature variable, in sympathy with the frequency response.

The stylus examination revealed a commercial quality, dural shank spherical diamond of 0.5 thou tip radius and good shape. The cone angle was rather large, the polish adequate and the alignment good.

As with the MMC4000, a replacement styli is not available.

Stylus Data

Stylus Type shank spherical
Interchangeability *

56 Cartridges

Finish and Alignment of diamond adequate
HF Resonance. > 20kHz
Measured Dynamic Compliance at 10Hz 27cu
Replacement Stylus Price ex VAT. *

General Data

Cartridge Mass 5.5g
Test Tracking Force. 1.25g
LF Resonance in Standard Arm 6.8Hz
Induced Hum Level. -75dB
Sensitivity. 0.9mV/cm/sec
Sensitivity referred to 1mV/cm/sec -1dB
Subjective Sound Quality good

Frequency Response and Separation

20Hz-20kHz 1.5dB*
100Hz-5kHz 0.5dB*
Channel Separation at 100Hz 20dB
Channel Separation at 1kHz 24dB
Channel Separation at 10kHz 18dB
Channel Balance at 1kHz 0.8dB
Channel Balance at 10kHz 0dB

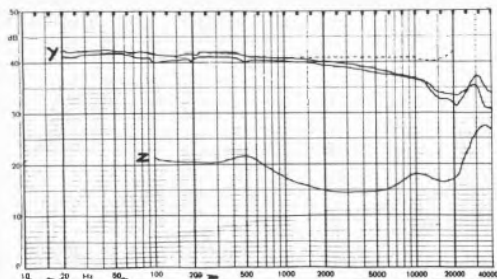
Distortion

HF Wave Form Quality average
Lateral Distortion at +9dB 300Hz. 0.3%
Vertical Distortion at +6dB 300Hz 2%
Mid-band Intermodulation. 2%
HF Intermodulation pulsed 10kHz 24cm/sec peak 0.55%

Trackability

Trackability 300Hz Lateral + 14dB 0.9g
Trackability 300Hz Vertical + 11dB 0.7g
Supertrackability 300Hz + 18dB Lateral passed at 1.7g*
Typical Selling Price ex VAT. £25.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



Compatibility

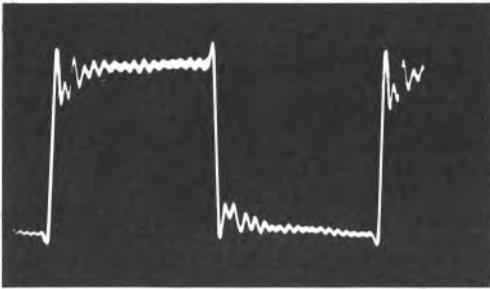
Recommended Loading 47k ohms
Recommended Loading 100-200pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)
Resonance Rating C
Damping Rating M

Low mass arm required, keep it warm

*see text

Bang & Olufsen MMC4000

Bang and Olufsen (UK) Limited, Eastbrook Road, Gloucester GL4 7DE. 0452 21591.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

With the exception of price and stylus type, the two B & O cartridges in this report are very similar (the MMC4000 carries a nude elliptical and the 3000 a shank mounted spherical). The MMC4000 is factory fitted to both the B & O turntables reviewed, and is thus of particular interest.

Stylus and body are a fixed assembly and no replacement styli are available on B & O cartridges—the purchase of a complete new cartridge being necessary. The whole cartridge plugs directly into the B & O arm, or alternatively, with the use of a light plastic adapter, it may be fitted to conventional arms.

Listening tests ranked the cartridge as above average, with good frequency balance especially in the mid-band, but some hardness, roughness and a loss of detail were also noted.

As with the MMC3000, temperature was found to have an effect on performance, and, an average temperature of 24°C was adopted throughout testing. Lab results confirmed the generally good tracking and channel separation, with excellent balance and frequency responses. Distortion levels were satisfactory and the response was little affected by loading. Hum induction was excellent and the output fractionally below nominal.

The compliance was close to specification at 27cu, this value allowing the use of a low (5g) to moderate (10g) effective mass arm, stability being improved by arm damping. B & O claim a low tip mass which was verified by the fast squarewave rise time and location of the high frequency resonance. The former shows good symmetry and only moderate phase anomalies.

Examination of the stylus revealed that improvement was necessary, bearing in mind the cost of the cartridge. Both polish and alignment were poor; the 0.3×0.6 thou radii were out of spec although well shaped, and the offset alignment of

the ellipse was balanced by a slightly twisted cantilever on this sample. The MMC4000 deserves a better tip than this.

Stylus Data

Stylus Type	.....	naked elliptical
Interchangeability	.....	— *
Finish and Alignment of diamond	.....	poor
HF Resonance	.....	>20kHz
Measured Dynamic Compliance at 10Hz	.....	27cu
Replacement Stylus Price ex VAT	.....	— *

General Data

Cartridge Mass	.....	5.5g
Test Tracking Force	.....	1.25g
LF Resonance in Standard Arm	.....	0.8Hz
Induced Hum Level	.....	— 75dB
Sensitivity	.....	0.9mV/cm/sec
Sensitivity referred to 1mV/cm/sec	.....	— 1dB
Subjective Sound Quality	.....	good

Frequency Response and Separation

20Hz-20kHz	.....	± 1.25dB
100Hz-5kHz	.....	± 0.5dB
Channel Separation at 100Hz	.....	20dB
Channel Separation at 1kHz	.....	24dB
Channel Separation at 10kHz	.....	15dB
Channel Balance at 1kHz	.....	0.5dB
Channel Balance at 10kHz	.....	0dB

Distortion

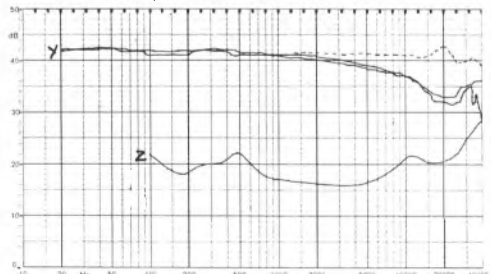
HF Wave Form Quality	.....	good
Lateral Distortion at +9dB 300Hz	.....	0.6%
Vertical Distortion at +6dB 300Hz	.....	0.3%
Mid-band Intermodulation	.....	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	.....	0.28%

Trackability

Trackability 300Hz Lateral + 14dB	.....	0.6g
Trackability 300Hz Vertical + 11dB	.....	0.6g
Supertrackability 300Hz + 18dB Lateral passed at	.....	1.4g

Typical Selling Price ex VAT. £32.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division. at 24°C — at 17°C



Compatibility

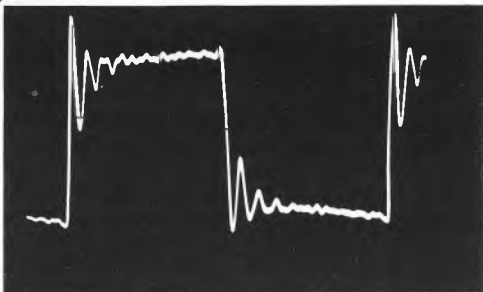
Recommended Loading	.....	47k ohms
Recommended Loading	.....	100-200pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)		
Resonance Rating	.....	C
Damping Rating	.....	M
Low mass arm required. Keep it warm		

*see text

RECOMMENDED

Empire 2000E III

Hayden Laboratories Limited, Hayden House, Churchfield Road, Chalfont St Peter, Bucks. 02813 88447.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

The next model down from the 'Z' in the Empire range is the 2000E II. At typically £18.00, but the cost of a replacement stylus is quite high at £15.00.

The 2000E III is intended to fulfil more down-to-earth applications than the 'Z' and to be compatible with average mass arms. However, the measured compliance value of 32cu indicates its use with low (5g) rather than average mass arms (12g), and damping would offer a further improvement in stability.

It measured well on many aspects including channel balance, separation and frequency response, but the distortion readings were distinctly poor. Hum rejection was excellent and the output 2dB above nominal. Trackability was fairly good, the supertrack band requiring a 1.75g downforce. Empire's recommended loading in the 400pf region was confirmed on test, although the responses were only a trifle worse using 47K ohm, 150pf. The squarewave response photograph showed a fairly strong tip mass resonance together with some phase non-linearity, but otherwise the basic shape was good and ties in with the steady state frequency response.

The sample ranked below average on the listening tests; while the overall sound was considered well balanced, some peaky and edgy effects were noted with a loss of musical detail.

The stylus report may have provided the answer to the subjective assessment. It was found that a well aligned spherical tip of 0.6thou radius and adequate polish had been fitted, and thus despite the clear 'EIII' label and the fact that the cantilever was apparently of the EIII type, it would appear that the wrong tip had been fitted. One might therefore presume a further performance improvement had the specified elliptical stylus been fitted, but there was insufficient time to further investigate the matter.

58 Cartridges

Stylus Data

Stylus Type	shank elliptical*
Interchangeability	yes
Finish and Alignment of diamond	adequate
HF Resonance	19kHz*
Measured Dynamic Compliance at 10Hz	.32cu
Replacement Stylus Price ex VAT	£15.00

General Data

Cartridge Mass	.7g
Test Tracking Force	1.5g
LF Resonance in Standard Arm	6.3Hz
Induced Hum Level	-74dB
Sensitivity	1.3mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+2.1dB
Subjective Sound Quality	average*

Frequency Response and Separation

20Hz-20kHz	±1.25dB
100Hz-5kHz	±1dB
Channel Separation at 100Hz	24dB
Channel Separation at 1kHz	28dB
Channel Separation at 10kHz	23dB
Channel Balance at 1kHz	1dB
Channel Balance at 10kHz	0dB

Distortion

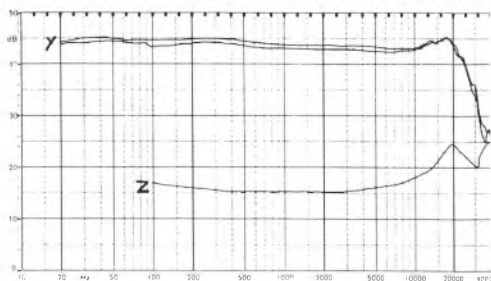
HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	.2%
Vertical Distortion at +6dB 300Hz	.8%
Mid-band Intermodulation	.25%
HF Intermodulation pulsed 10kHz 24cm/sec peak	.07%

Trackability

Trackability 300Hz Lateral +14dB	.0.8g
Trackability 300Hz Vertical +11dB	.0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.75g

Typical Selling Price ex VAT. £18.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



Compatibility

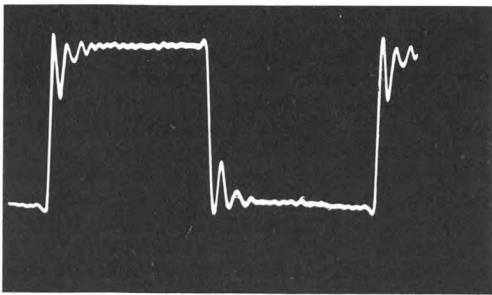
Recommended Loading	47K ohms
Recommended Loading	350-450pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	L
Low mass arm for optimum results	

*see text

RECOMMENDED

Empire 2000Z

Hayden Laboratories Limited, Hayden House, Churchfield Road, Chalfont St Peter, Bucks. 02813 88447.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This cartridge is Empire's most expensive stereo model, and while it sounded good, judging by the compliance of this sample, great care must be taken in selecting a matching arm.

The compliance was extremely high at 65cu, measuring more than twice the specified value, and consequently, only the very lowest mass arms are suitable, preferably possessing damping to provide additional control.

Overall, the distortion values were low, excepting the mid-band intermodulation pack which caused some difficulty. Channel separation and balance were reasonable, and the output was -3.4dB below the nominal 1mV/cm/sec level.

The squarewave photograph showed a fast, well controlled rise time with good symmetry, a flat top and negligible anomalies. Optimum frequency response was obtained with the manufacturer's recommended $47\text{K ohms } 300\text{pf}$, this loading improving the illustrated responses by a dB or so in the 6kHz to 20kHz frequency range. The trackability was high including the supertrack band. Note should however be taken of the all-metal body which may need the use of insulating plastic screws and washers when using certain metal headshells.

Judged on the basis of listening tests, the 2000Z was highly ranked and came in the top six models of the forty reviewed. It was described as slightly dull but delicate, with fair stereo imaging and possessing both good detail and an extended clean bass. Some hardness and muddling were however noted on highly modulated passages.

The stylus/body fit was a trifle loose and the cost of a replacement stylus was high, at $\text{£}35.00$ odd. It was found that a well shaped naked elliptical diamond has been fitted, slightly out of spec at $0.3 \times 0.7\text{thou}$. The alignment was good but the surface finish was poor; to quote the report,

'polishing the radius would make it a very good diamond.'

Stylus Data

Stylus Type	.....	naked elliptical
Interchangeability	.....	yes
Finish and Alignment of diamond	.....	adequate
HF Resonance	.....	24kHz
Measured Dynamic Compliance at 10Hz	.....	65cu
Replacement Stylus Price ex VAT	.....	£34.50

General Data

Cartridge Mass	.....	7g
Test Tracking Force	.....	1g
LF Resonance in Standard Arm	.....	4.5Hz
Induced Hum Level	.....	-70dB
Sensitivity	.....	0.67mV/cm/sec
Sensitivity referred to 1mV/cm/sec	.....	-3.4dB
Subjective Sound Quality	.....	good

Frequency Response and Separation

20Hz-20kHz	.....	+2dB
100Hz-5kHz	.....	$\pm 1\text{dB}$
Channel Separation at 100Hz	.....	18dB
Channel Separation at 1kHz	.....	23dB
Channel Separation at 10kHz	.....	20dB
Channel Balance at 1kHz	.....	1.5dB
Channel Balance at 10kHz	.....	0dB

Distortion

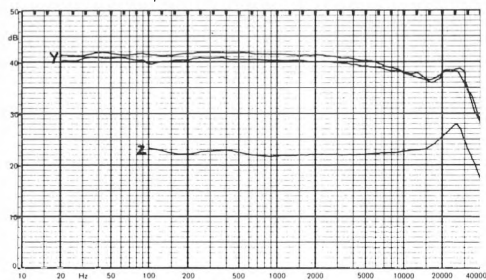
HF Wave Form Quality	.....	average
Lateral Distortion at +9dB 300Hz	.....	0.6%
Vertical Distortion at +6dB 300Hz	.....	2%
Mid-band Intermodulation	.....	2.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	.....	0.6%

Trackability

Trackability 300Hz Lateral +14dB	.....	0.9g
Trackability 300Hz Vertical +11dB	.....	0.75g
Supertrackability 300Hz +18dB Lateral passed at	.....	1.1g

Typical Selling Price ex VAT..... $\text{£}53.00$

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



Compatibility

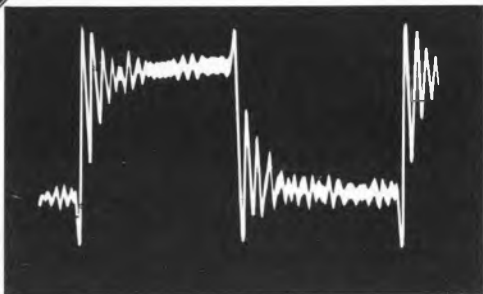
Recommended Loading	.....	47K ohms
Recommended Loading	.....	250-350pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)		
Resonance Rating	.....	D
Damping Rating	.....	L

Very low mass essential to extract optimum performance, preferably damped
*see text

RECOMMENDED

Fidelity Research FR1 mk II

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

At first sight, this cartridge (a low output moving coil model) seems reasonably priced considering its performance standard. However, it has the complication of requiring a special pre-amplifier ('Fidelex' recommended), as very few pre-amplifiers possess a moving coil input. Alternatively, one of several available transformers may be used, (Nakamichi, Ortofon, FR) ranging in quality and price from £20.00 to over £60.00. However, while the least costly model from Ortofon is satisfactory, greater expenditure is required to exploit this model's potential to the full, and the tests were accordingly carried out using the large Denon transformer set to 3 ohms.

Considering the cartridge's substantial mass (9.5g) the compliance was fairly high at 20cu, but it was considered to be well damped. Consequently, most low mass arms (5-10g M_a) of good rigidity will work well with the FR1, and excessive arm damping may in fact impair tracking. Channel balance and separation were both excellent; the response comedably even, albeit with a slight droop with rising frequency, and the distortion levels were satisfactorily low. Trackability was generally very good, with success on the supertrack band realised at 0.1g above the recommended 1.7g downforce. The squarewave photograph illustrated a poorly damped upper resonance (fortunately supersonic), and both the symmetry and the phase characteristics were good. However, the output was rather low even for a moving coil.

Listening tests put this cartridge among the top four models. While the balance was considered to be a little dull and rounded, qualities of good imaging, depth, detail and mid-band naturalness won the day. Slight hardness in the extreme treble was occasionally observed.

Specified as an 0.3 x 0.8thou 'super' elliptical, the

tip on this model was found to be of excellent quality, with a naked mount, finely shaped 0.3 x 0.7 radii and very good alignment and polish

Stylus Data

Stylus Type	..... naked elliptical
Interchangeability	..... no
Finish and Alignment of diamond	..... excellent
HF Resonance	..... 30k Hz
Measured Dynamic Compliance at 10Hz	..... 20cu
Replacement Stylus Price ex VAT	..... £34.00

General Data

Cartridge Mass	..... 9.5g
Test Tracking Force	..... 1.7g
LF Resonance in Standard Arm	..... 7.5Hz
Induced Hum Level	..... -56dB*
Sensitivity	..... 1mV/cm/sec
Sensitivity referred to 1mV/cm/sec	..... 0dB
Subjective Sound Quality	..... excellent

Frequency Response and Separation

20Hz-20kHz	..... ± 1dB
100Hz-5kHz	..... ± 1dB
Channel Separation at 100Hz	..... 25dB
Channel Separation at 1kHz	..... 35dB
Channel Separation at 10kHz	..... 35dB
Channel Balance at 1kHz	..... 0.3dB
Channel Balance at 10kHz	..... 0.4dB

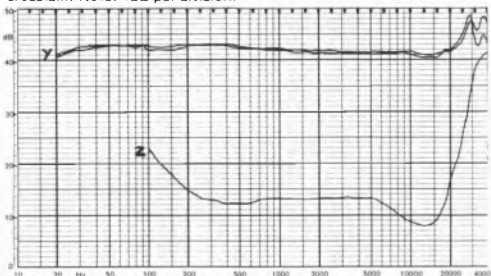
Distortion

HF Wave Form Quality	..... poor
Lateral Distortion at +9dB 300Hz	..... 0.3%
Vertical Distortion at +6dB 300Hz	..... 3.5%
Mid-band Intermodulation	..... 1.3%
HF Intermodulation pulsed 10kHz 24cm/sec peak	..... 0.22%

Trackability

Trackability 300Hz Lateral + 14dB	..... 1g
Trackability 300Hz Vertical + 11dB	..... 0.6g
Supertrackability 300Hz + 18dB Lateral passed at	..... 1.8g
Typical Selling Price ex VAT	..... £45.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



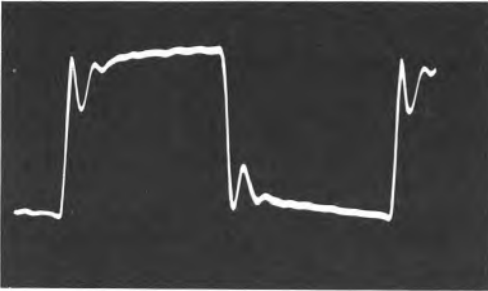
Compatibility

Recommended Loading	..... - ohms*
Recommended Loading	..... - pF*
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	..... B
Damping Rating	..... J
Suits moderate mass arm, damping not required	

*see text

Goldring G820

Goldring Manufacturing Co. Ltd., Anglian Lane, Beetons Way, Bury St. Edmonds, Suffolk. 0284 64011.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

Goldring proudly claim a tip mass of 1 milligram for the G820, but in fact these days, values below 0.4mg are commonplace, albeit usually at a higher price level. This model has a low compliance of 12.5cu and is well suited to medium and fairly high mass pick-up arms.

The frequency response was fairly smooth but showed a pronounced droop in the presence range amounting to 4dB. Channel separation and balance were classed as good, distortion values as fair, and trackability as only adequate. Over 3g down-force was required to clear the supertrack and even the lower levels, typically passed at 0.6-1.0g, needed 2g in the case of the G820. Hum induction levels were satisfactory and the output measured slightly above the nominal 1mv/cm/sec.

The squarewave response was fairly good, the initial overshoot being quickly damped, and few anomalies were visible. The overall tilt reflected the frequency response trend.

Listening tests classed this design as well below average, with comments of coarseness, boom, considerable detail loss plus a thick, veiled balance.

The stylus examination confirmed the use of a normal, commercial quality steel shank mounted spherical diamond, of good 0.5thou radius, with an adequate polish and satisfactory alignment.

Stylus Data

Stylus Type	shank spherical
Interchangeability	yes
Finish and Alignment of diamond	adequate
HF Resonance	16.5kHz
Measured Dynamic Compliance at 10Hz	12.5cu
Replacement Stylus Price ex VAT	£3.75

General Data

Cartridge Mass	7g
Test Tracking Force	2g
LF Resonance in Standard Arm	10Hz
Induced Hum Level	70dB
Sensitivity	1.2mV/cm/sec

Sensitivity referred to 1mV/cm/sec	+1.5dB
Subjective Sound Quality	poor

Frequency Response and Separation

20Hz-20kHz	±3dB
100Hz-5kHz	±2.5dB
Channel Separation at 100Hz	22dB
Channel Separation at 1kHz	25dB
Channel Separation at 10kHz	19dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0dB

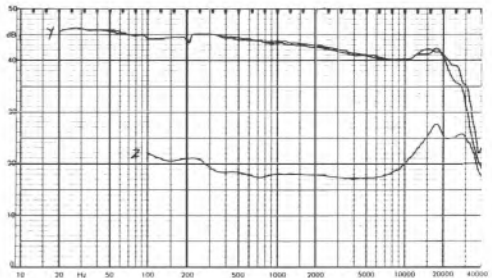
Distortion

HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	1.3%
Vertical Distortion at +6dB 300Hz	4.2%
Mid-band Intermodulation	11%
HF Intermodulation pulsed 10kHz 24cm/sec peak	1.2%

Trackability

Trackability 300Hz Lateral +14dB	2g
Trackability 300Hz Vertical +11dB	2g
Supertrackability 300Hz +18dB Lateral passed at	>3g
Typical Selling Price ex VAT	£8.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



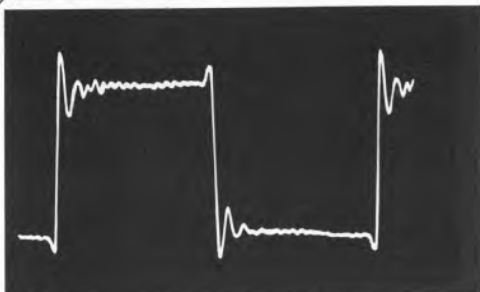
Compatibility

Recommended Loading	47K ohms
Recommended Loading	100-300pF
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	A
Damping Rating	L
Will work in high mass arms	

RECOMMENDED

Goldring G900SE

Goldring Manufacturing Co. Ltd., Anglian Lane, Beetons Way, Bury St. Edmonds, Suffolk. 0284 64011.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This refined Goldring model bears little resemblance to either the G800 or the G820 series and comes fitted with a low mass cantilever and naked elliptical diamond tip, which is rather reminiscent of the Shure V15111. The lateral compliance was measured at 39cu, very close to the specified 40, with little damping in evidence. A low mass arm (5g odd) is thus recommended, preferably with some additional damping.

As with the two B&O models, the G900SE was found to be temperature sensitive, and at 20°C and below, a drooping treble response became apparent namely 2.5dB down at 15kHz. 24° to 26°C produced a ruler flat curve over the vital 100Hz to the 5kHz mid band, and a peak then developed at 22kHz which lifted the 20kHz point to +3dB.

Distortion was low, with channel balance and separation fairly good and wave form quality at high frequencies to a fine standard. However, the 900SE was not too happy on the supertrack band, where it required a 1.7g downforce, although lower modulation levels were tracked at a much reduced downforce.

Squarewave shape was classed as good, with a mild, fairly well damped overshoot and good symmetry. Output was nearly 2dB below nominal and showed fairly good resistance to hum induction.

Listening tests placed the 900SE moderately above average, with characterisations of delicacy and an open balance (when warm!) Conversely, the reproduction seemed to lack deep bass and the image was flattened and distant, with some associated harshness occasionally noted, possibly the result of tracking problems.

The naked diamond tip carried an 0.2 x 0.6 radii of good chape, polish and alignment, distinctly above average quality for European cartridges in this price range!

Stylus Data	
Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	22kHz
Measured Dynamic Compliance at 10Hz	39cu
Replacement Stylus Price ex VAT	£18.50

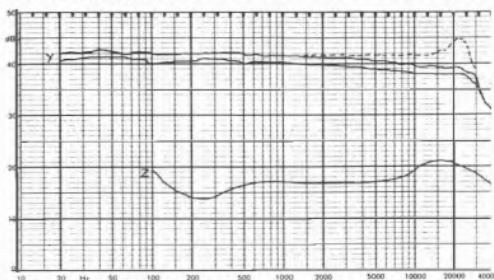
General Data	
Cartridge Mass	5g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	5.6Hz
Induced Hum Level	-67dB*
Sensitivity	0.8mV/cm/sec
Sensitivity referred to 1mV/cm/sec	-1.9dB
Subjective Sound Quality	good

Frequency Response and Separation	
20Hz-20kHz	+1.5dB*
100Hz-5kHz	+0.5dB*
Channel Separation at 100Hz	22dB
Channel Separation at 1kHz	22dB
Channel Separation at 10kHz	19dB
Channel Balance at 1kHz	1.2dB
Channel Balance at 10kHz	1.2dB

Distortion	
HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.2%
Vertical Distortion at +6dB 300Hz	3%
Mid band intermodulation	1.5%
HF modulation pulsed 10kHz 24cm/sec peak	0.3%

Trackability	
Trackability 300Hz Lateral +14dB	0.7g
Trackability 300Hz Vertical +11dB	0.7g
Supertrackability 300Hz +18dB Lateral passed at	1.7g
Typical Selling Price ex VAT	£35.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.
 — at 20°C at 26°C



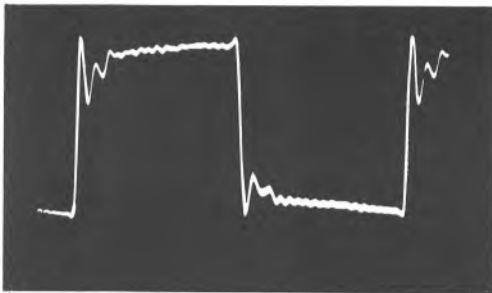
Compatibility	
Recommended Loading	47K ohms
Recommended Loading	150-225pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	D
Damping Rating	M
Low mass arm required preferably with damping	

*see text

RECOMMENDED

Grace F9L

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

The F9 series includes several other models in addition to the 'L' type presented in this report. Of Japanese origin, a moderate compliance is specified, (20cu) which was confirmed on test. As such, the Grace will prove compatible with a number of low and medium mass arms, (up to 12gMe) especially as it does not require any additional damping.

A degree of temperature sensitivity was noted below 20°C, which revealed itself as an additional 2dB odd depression in the upper presence range, 4-10kHz. Above 20°C the basic response was seen to fall gently with frequency, levelling out at around -2dB from 4kHz onwards. However, a touch of lift on the associated pre-amplifier could easily correct this. Channel balance and separation were both good, high frequency wave form quality fair and the output level 3.3dB above reference.

Distortion levels were average, and trackability fairly good, except on supertrack where greater than 2.5g downforce was needed. On squarewave, some asymmetry was visible together with a minor phase anomaly immediately following the initial overshoot.

Despite the visibly dull response trend, the F9L fared quite well on audition. Ranked in the top ten, its above average sound quality was classed as smooth and rounded, with fairly good imaging, although a loss of depth and a moderately veiled character was also noted.

The stylus was found to have a fine 0.2 x 0.7 thou naked elliptical diamond of good shape, alignment and polish

General Data

Cartridge Mass	6.0g
Test Tracking Force	1.5g
LF Resonance in Standard Arm	7.8Hz
Induced Hum Level	-70dB
Sensitivity	1.5mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+3.3dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	±2dB
100Hz-5kHz	±2dB
Channel Separation at 100Hz	20dB
Channel Separation at 1kHz	24dB
Channel Separation at 10kHz	13dB
Channel Balance at 1kHz	0.4dB
Channel Balance at 10kHz	0dB

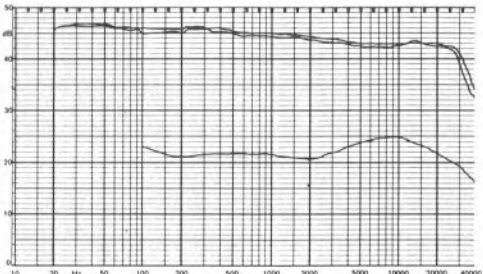
Distortion

HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	0.7%
Vertical Distortion at +6dB 300Hz	0.4%
Mid-band Intermodulation	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.55%

Trackability

Trackability 300Hz Lateral +14dB	1g
Trackability 300Hz Vertical +11dB	1g
Supertrackability 300Hz +18dB Lateral passed at	>2.5g
Typical Selling Price ex VAT	£65.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



Compatibility

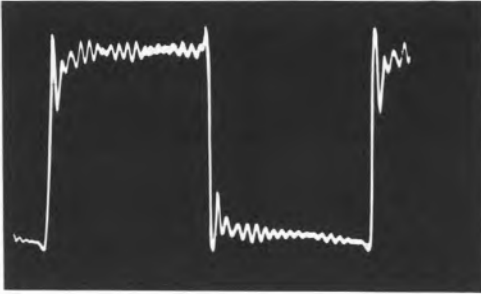
Recommended Loading	47K ohms
Recommended Loading	100-200pF
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	B
Damping Rating	J
Compatible with most medium mass arms, damping not required	

Stylus Data

Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	23kHz
Measured Dynamic Compliance at 10Hz	21cu
Replacement Stylus Price ex VAT	£48.75

JVC Z1

JVC (UK) Ltd., Eldonwall Trade Est., Staples Corner, 6/9 Priestly Way, London NW2 7AF. 01-450 2621.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This is a higher output version of the established JVC X1 cartridge, and is a universal/CD4 type equipped with a Shibata tip. Compliance is specified at 10 (test frequency unknown), but measured at 27cu below 10Hz. Not much damping is present and judged on the evidence of this sample, a low mass arm with some damping will be required to realise its full potential.

The frequency responses were smooth and flat in the audible range, and met fine $\pm 0.5\text{dB}$ limits in the important 100Hz to 5kHz band. A high output was obtained, 4.6dB above nominal, which might conceivably embarrass certain older pre-amplifiers with a small input overload margin. Channel balance and separation were both reasonable and distortion a little above average, except at the very highest frequencies. With most cartridges, the distortion is 'even' rather than 'odd' but the Z1 was found to have a considerable 'odd' harmonic content—a feature common to its more expensive relative, the X1.

Trackability was excellent at the recommended 1.7g downforce and the hum induction was negligible. Squarewave response revealed a very fast rise time with some continued ringing. Since the steady state response is still only -1dB at 45kHz this is not really surprising and the ringing can be ignored as it is supersonic.

On listening tests, it was ranked below average with characterisations of harshness, and an 'odd' quality to the mid range, noticed particularly on choral works. Otherwise the frequency balance was good, stereo perspective fair with reasonable rendition of detail.

The stylus report showed the Z1 to possess a top class naked diamond Shibata tip of very good alignment and polish, which was also superbly fitted.

64 Cartridges

Stylus Data

Stylus Type	..... naked Shibata
Interchangeability	..... yes
Finish and Alignment of diamond	..... excellent
HF Resonance	..... 35kHz
Measured Dynamic Compliance at 10Hz	..... 27cu
Replacement Stylus Price ex VAT	..... £35 00

General Data

Cartridge Mass	..... 5.5g
Test Tracking Force	..... 1.7g
LF Resonance in Standard Arm	..... 6.8Hz
Induced Hum Level	..... -72dB
Sensitivity	..... 1.7mV/cm/sec
Sensitivity referred to 1mV/cm/sec	..... +4.6dB
Subjective Sound Quality	..... acceptable

Frequency Response and Separation

20Hz-20kHz	..... $\pm 1\text{dB}$
100Hz-5kHz	..... $\pm 0.5\text{dB}$
Channel Separation at 100Hz	..... 18dB
Channel Separation at 1kHz	..... 20dB
Channel Separation at 10kHz	..... 18dB
Channel Balance at 1kHz	..... 1.2dB
Channel Balance at 10kHz	..... 1.2dB

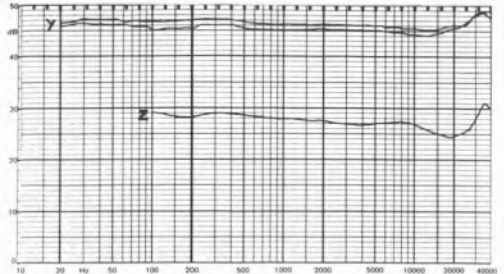
Distortion

HF Wave Form Quality	..... average
Lateral Distortion at +9dB 300Hz	..... 1%
Vertical Distortion at +6dB 300Hz	..... 5.5%
Mid-band Intermodulation	..... 1.4%
HF Intermodulation pulsed 10kHz 24cm/sec peak	..... 0.28%

Trackability

Trackability 300Hz Lateral +14dB	..... 0.8g
Trackability 300Hz Vertical +11dB	..... 0.7g
Supertrackability 300Hz +18dB Lateral passed at	..... 1.7g
Typical Selling Price ex VAT	..... £40 00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

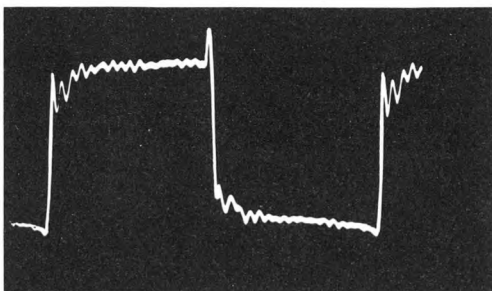


Compatibility

Recommended Loading	..... 47K-100K ohms
Recommended Loading	..... 100-200pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	..... C
Damping Rating	..... L
A moderate mass arm recommended possibly with some damping	

Micro Acoustics QDC282E

Webland International Ltd., Mirabel House, 117/121 Wandsworth Bridge Rd., London SW6. 01-736 0987.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This American cartridge is unusual in utilising the piezo electric effect. An internal micro-circuit equalises and matches the output so that it is suitable for feeding normal magnetic cartridge inputs. However, the high internal impedances imply a sensitivity to hum fields and indeed, a hand passed near the cartridge dramatically increased the hum level. On the test rig, a level of -66dB was recorded, which although not outstanding, proved to be entirely satisfactory.

The cartridge compliance measured a moderate 21cu with reasonable damping, which means that a wide variety of medium-to-low mass arms are compatible.

The overall frequency responses met ± 2 dB limits and were characterised by about 2dB of shelf lift below 400Hz. Channel balance was fairly good, separation fine, and overall distortion levels low. However, an analysis of the crosstalk signal gave 1.5% distortion at 1kHz which is rather greater than the 0.3% typical of most of the other models.

Trackability was of a high order except on the supertrack +18dB 300Hz lateral band, which required a 1.7g downforce. On squarewaves, some asymmetry was noted together with a well damped initial rise time.

Listening tests ranked the QDC 282E as somewhat below average. Essentially the bass lift was audible in the subjective frequency balance. Higher up, it was considered quite open with pleasant voice rendition and detail, but just occasionally it was judged a trifle sibilant.

The tip mass was low, as the 30kHz resonance indicates, the stone being a naked elliptical diamond. The radii were measured at 0.3×0.7 thou with a good shape, but for a manufacturer who produces in-house styli, it was surprising to find that the polish was only adequate and the ellipse

alignment on the cantilever was definitely poor

Stylus Data

Stylus Type	.....	naked elliptical
Interchangeability	.....	yes
Finish and Alignment of diamond	.....	poor
HF Resonance	.....	30kHz
Measured Dynamic Compliance at 10Hz	.....	21cu
Replacement Stylus Price ex VAT	.....	£19.56

General Data

Cartridge Mass	.....	5.2g
Test Tracking Force	.....	1.25g
LF Resonance in Standard Arm	.....	7.7Hz
Induced Hum Level	.....	-66dB*
Sensitivity	.....	1mV/cm/sec
Sensitivity referred to 1mV/cm/sec	.....	0dB
Subjective Sound Quality	.....	acceptable

Frequency Response and Separation

20Hz-20kHz	± 2 dB
100Hz-5kHz	± 1.25 dB
Channel Separation at 100Hz	.....	17dB
Channel Separation at 1kHz	.....	28dB
Channel Separation at 10kHz	.....	18dB
Channel Balance at 1kHz	.....	1.3dB
Channel Balance at 10kHz	.....	0.8dB

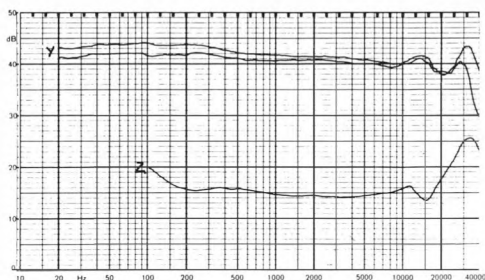
Distortion

HF Wave Form Quality	.....	poor
Lateral Distortion at +9dB 300Hz	.....	0.5%
Vertical Distortion at +6dB 300Hz	.....	2.5%
Mid-band Intermodulation	.....	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	.....	0.25%

Trackability

Trackability 300Hz Lateral + 14dB	.....	0.8g
Trackability 300Hz Vertical + 11dB	.....	0.7g
Supertrackability 300Hz + 18dB Lateral passed at	.....	1.7g
Typical Selling Price ex VAT	.....	£43.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



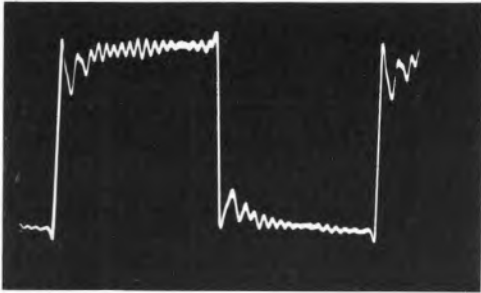
Compatibility

Recommended Loading	.....	47K ohms
Recommended Loading	.....	100-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	.....
Resonance Rating	.....	B
Damping Rating	.....	K
Compatible with most arms damping not required	.....

*see text

National Panasonic EPC205C mk IIL

National Panasonic (UK) Limited, 107/109 Whitby Road, Slough, Bucks. 01-753 4522. -



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

Although this is a Technics cartridge, due to the close similarity between this manufacturer's name and another leading hi-fi company, it is marketed under the National Panasonic label.

The model reviewed is the 'L', low output version, but the 'S' normal output and the 'H' high output versions should be very similar and carry an otherwise identical specification. The output of the 205 IIL measures -3dB at the normal reference level, but actually this is higher than several other conventional designs in the report! A very low output impedance is specified, and the unit is thus highly insensitive to loading variations. The specified compliance is 12.5cu at 100Hz; our sample measuring 25cu at below 10Hz, with little internal damping. Low-to-medium mass arms are therefore compatible, and if a 10Hz system resonance is aimed for, the headshell supplied must be discarded and a 5g effective mass arm employed; in any case, extra arm damping would improve matters.

The frequency response was found to vary with temperature; below 20°C the output dropped a further couple of dB above 10kHz, and the mid upper resonance was suppressed. At 25°C the overall response met ± 2 dB limits, ± 0.5 dB sufficing for the mid band. Channel separation was fairly good and balance excellent. Both distortion and trackability were better than average and although the supertrack required 1.6g, this is not unusual with medium compliance models. The squarewave showed a well damped, fast rise time with some mild supersonic ringing and phase shift.

Listening tests placed this cartridge as just about average. Smoothness, clarity and clean bass were all noted, but the balance was described as dulled with a loss of depth and only average imaging.

A superb naked elliptical diamond of 0.3×0.7 thou radii was fitted and polish, alignment and

shape were all beyond reproach.

Stylus Data

Stylus Type	Naked elliptical
Interchangeability	Yes
Finish and Alignment of diamond	Excellent
HF Resonance	21kHz
Measured Dynamic Compliance at 10Hz	25cu
Replacement Stylus Price ex VAT	£21.00

General Data

Cartridge Mass	6.5g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	7Hz
Induced Hum Level	-70dB
Sensitivity	0.7mV/cm/sec
Sensitivity referred to 1mV/cm/sec	-3.1dB
Subjective Sound Quality	Average

Frequency Response and Separation

20Hz-20kHz	1.0dB
100Hz-5kHz	0.5dB
Channel Separation at 100Hz	19dB
Channel Separation at 1kHz	22dB
Channel Separation at 10kHz	17dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0.7dB

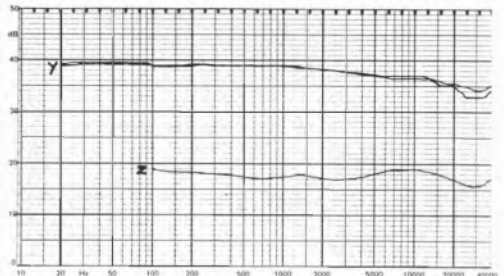
Distortion

HF Wave Form Quality	Good
Lateral Distortion at +9dB 300Hz	0.25%
Vertical Distortion at +6dB 300Hz	3.5%
Mid-band Intermodulation	1.2%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.3%

Trackability

Trackability 300Hz Lateral +14dB	0.8g
Trackability 300Hz Vertical +11dB	0.7g
Supertrackability 300Hz +18dB Lateral passed at	1.6g
Typical Selling Price ex VAT	£43.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



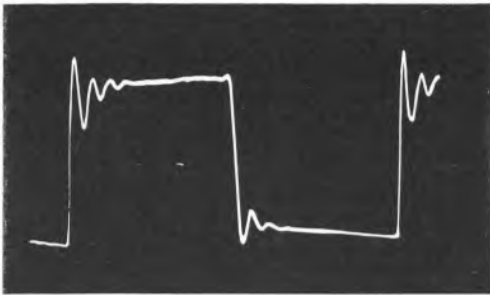
Compatibility

Recommended Loading	10K-100K ohms
Recommended Loading	100-500pF
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	M
Low to medium mass arm ideal, preferably with damping	

BEST BUY

Ortofon FF15E

Tannoy Products Limited, St Johns Road, Tylers Green, High Wycombe, Bucks HP10 8HR. 049 481 5221.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This model is a low cost equivalent of the VMS20E, but possesses a lower compliance and higher output. The output was 3.6dB above nominal and the hum induction excellent, and although the compliance measured 35cu which was down on the VMS20E, it was still quite high. Ortofon are aware of this and guarantee in future to hold compliance between 20-25cu and to exchange any unsatisfactory samples. The compatibility in that tables relate to these guaranteed figures.

The tip mass was somewhat greater than that of the VMS20E although the upper resonance still appears at a respectably high 20kHz. The loading/matching is so well optimised at 400pf that the resonance is barely visible on the fine frequency response traces. ±0.5dB limits sufficed for the mid-band when the recommended 400pf load capacitance was used. The trackability was very good, distortion levels moderate and channel separation and balance both excellent. The squarewave response was similar to the VMS20E with a reasonably clean and flat top, but the ringing after the rise time overshoot was slightly prolonged and some mild assymetry is noticeable.

Listening tests ranked this modestly priced cartridge as well above average, placing it among the top ten models. The sound quality was generally to a high standard but with some evidence of a constrained, slightly boxy effect in the mid-range, together with a trace of hardness.

Upon examination, the tip radii proved to be closer in dimensions to a spherical rather than the elliptical shape specified. While the alignment was good, the surface polish was rated adequate, and the steel shank mount is typical of European cartridges in this price range. Potentially, this model would have fared even better with a diamond quality closer to that of the VMS20E.

Stylus Data

Stylus Type	shank elliptical
Interchangeability	yes
Finish and Alignment of diamond	adequate
HF Resonance	20kHz
Measured Dynamic Compliance at 10Hz	35cu*
Replacement Stylus Price ex VAT	£9.00

General Data

Cartridge Mass	5g
Test Tracking Force	1.5g
LF Resonance in Standard Arm	6Hz
Induced Hum Level	-75dB
Sensitivity	1.5mV/cm/sec
Sensitivity referred to 1mV/cm/sec.	+3.6dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	±1dB
100Hz-5kHz	±0.5dB
Channel Separation at 100Hz	22dB
Channel Separation at 1kHz	34dB
Channel Separation at 10kHz	21dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0.6dB

Distortion

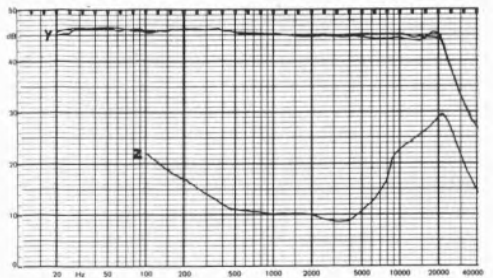
HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	0.2%
Vertical Distortion at +6dB 300Hz	4%
Mid-band Intermodulation	1.7%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.8%

Trackability

Trackability 300Hz Lateral +14dB	1.25g
Trackability 300Hz Vertical +11dB	1.25g
Supertrackability 300Hz +18dB Lateral passed at	1.5g

Typical Selling Price ex VAT. £12.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



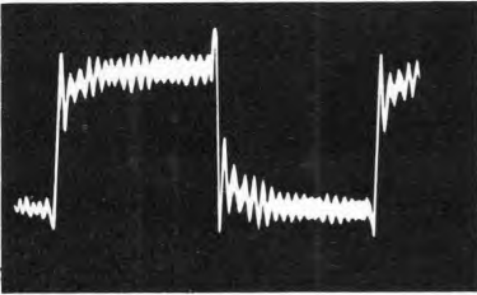
Compatibility

Recommended Loading	47K ohms
Recommended Loading	350-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	B*
Damping Rating	M*
Medium mass arm recommended	

*See text

Ortofon MC20

Tannoy Products Limited, St Johns Road, Tylers Green, High Wycombe, Bucks HP10 8HR. 049 481 5221.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This is Ortofon's latest model in their long line of moving coil designs and is equipped with a 'line contact' stylus (Essentially the only difference between this model and the SL20E and SL20Q is in their tip shapes, elliptical or Shibata.) The cost of an accompanying pre-amplifier or transformer must also be taken into consideration, in addition to the quoted purchase price.

On test, the MC20 was found to have an adequately damped low compliance of 16cu, giving good compatibility with the majority of rigid, medium mass arms (8-15g), without the need for additional damping.

The response was quite uniform in the audible range, but showed a strong resonance at 35kHz which dominated the squarewave response. The latter nevertheless showed evidence of a down-tilt towards the treble range, which was sufficient to require $\pm 0.75\text{dB}$ limits to contain the mid-band region. (Incidentally, this and all the other squarewave photographs of moving coil cartridges were taken without a transformer which would have distorted the picture.) Separation was classed as good, channel balance excellent and distortion as satisfactorily low. Trackability rated only average, with the supertrack band requiring over 3g downforce. The output level was 2dB above the FR1, delivering 1.3mV/cm/sec from the Denon '3 ohm' transformer setting, and hum induction was satisfactory for a moving coil model if care was taken with the transformer location.

Listening tests placed this model at an only average position, despite evidence of some of the favourable qualities of depth and mid-band naturalness so often associated with moving coil designs. Criticisms included an apparent loss of bass, a hint of harshness and muddying of detail, particularly on the higher level passages.

The diamond was found to be a top class naked stone with excellent 'line contact' shape and polish.

Stylus Data

Stylus Type	.....	naked line contact
Interchangeability	.....	no
Finish and Alignment of diamond	.....	adequate
HF Resonance	.....	36kHz
Measured Dynamic Compliance at 10Hz	.....	16cu
Replacement Stylus Price ex VAT	.....	£37.33

General Data

Cartridge Mass	.....	7g
Test Tracking Force	.....	1.8g
LF Resonance in Standard Arm	.....	3Hz
Induced Hum Level	.....	approx -57dB
Sensitivity	.....	1.3mV/cm/sec
Sensitivity referred to 1mV/cm/sec	.....	+2dB*
Subjective Sound Quality	.....	average

Frequency Response and Separation

20Hz-20kHz	.....	$\pm 1.5\text{dB}$
100Hz-5kHz	.....	$\pm 0.75\text{dB}$
Channel Separation at 100Hz	.....	21dB
Channel Separation at 1kHz	.....	24dB
Channel Separation at 10kHz	.....	23dB
Channel Balance at 1kHz	.....	0dB
Channel Balance at 10kHz	.....	0.5dB

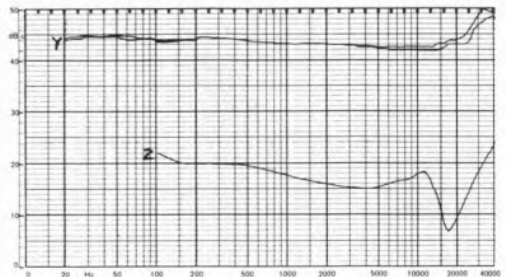
Distortion

HF Wave Form Quality	.....	poor
Lateral Distortion at +9dB 300Hz	.....	0.2%
Vertical Distortion at +6dB 300Hz	.....	3.3%
Mid-band Intermodulation	.....	2%
HF Intermodulation pulsed 10kHz 24cm/sec peak	.....	0.32%

Trackability

Trackability 300Hz Lateral + 14dB	.....	1.2g
Trackability 300Hz Vertical + 11dB	.....	1g
Supertrackability 300Hz + 18dB Lateral passed at	.....	3g
Typical selling price	.....	£53.00*

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



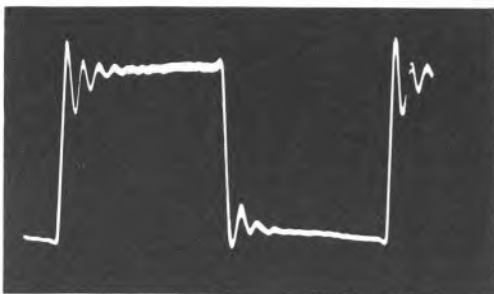
Compatibility

Recommended Loading	.....	— ohms*
Recommended Loading	.....	— pF*
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	.....
Resonance Rating	.....	B
Damping Rating	.....	K
Medium mass arm suitable, damping unnecessary	.....

*see text

Ortofon VMS20E

Tannoy Products Limited, St Johns Road, Tylers Green, High Wycombe, Bucks HP10 8HR. 049 481 5221.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This model comes from Ortofon's induced magnetic range of cartridges and it should be noted that stylus replacement is expensive, accounting for just over 70% of the original purchase price. On test, the compliance was rather higher than specified, measuring 47cu, and indicates that the use of very low mass arms, preferably ones with a damping facility, is necessary. A minimum total effective mass of 15g or so (inclusive of cartridge) is probable with conventional detachable headshell arms, which would result in an unsatisfactorily low resonance below 6Hz.

The manufacturer's recommend 47K ohms, 400pf (approx) loading was confirmed on tests as producing the optimum frequency response, measuring ± 1 dB, 20Hz to 20kHz. Channel balance and separation were excellent with a remarkable 27dB separation noted even at 10kHz. Distortion levels were a little above average, but on the plus side, trackability was excellent, the supertrack being disposed of at the nominal test downforce of 1.25g.

The output level was fractionally above nominal, (+1.1dB) and the hum induction very satisfactory. Squarewave testing revealed a generally clean, symmetrical wave form with a fairly well damped tip mass resonance at a supersonic 24kHz.

When auditioned, the VMS20E ranked marginally above average, and was considered to have fairly good depth and stereo imaging, but also exhibited some hardness and a rather dead quality on voice reproduction. The stylus report showed that a naked elliptical diamond with well shaped 0.2×0.7 thou radii was fitted. Both polish and alignment were considered good and the overall finish above average for this class of European cartridge.

Stylus Data

Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	good

HF Resonance	24 kHz
Measured Dynamic Compliance at 10Hz	47cu
Replacement Stylus Price ex VAT	£22 00

General Data

Cartridge Mass	5g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	5.1Hz
Induced Hum Level	-70dB
Sensitivity	1.1mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+1.1dB
Subjective Sound Quality	average

Frequency Response and Separation

20Hz-20kHz	± 1 dB
100Hz-5kHz	± 0.75 dB
Channel Separation at 100Hz	24dB
Channel Separation at 1kHz	36dB
Channel Separation at 10kHz	27dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0.2dB

Distortion

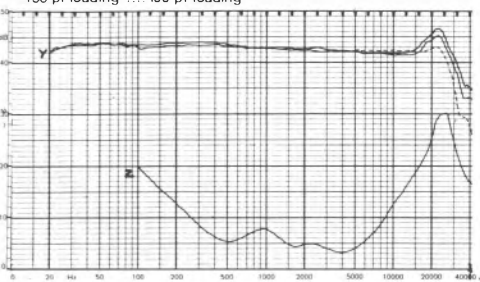
HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.8%
Vertical Distortion at +6dB 300Hz	5%
Mid-band Intermodulation	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.32%

Trackability

Trackability 300Hz Lateral +14dB	0.6g
Trackability 300Hz Vertical +11dB	0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.25g
Typical Selling Price ex VAT	£27 00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

- 150 pf loading ... 400 pf loading

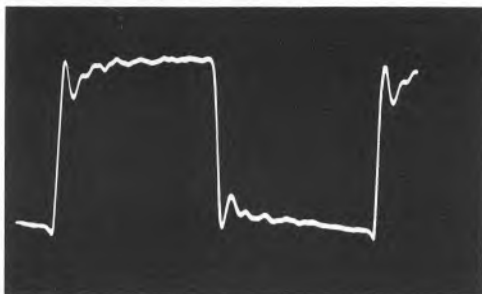


Compatibility

Recommended Loading	47K ohms
Recommended Loading	350-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	D
Damping Rating	M
Low mass damped arm required for optimum results	

Philips GP400 mk II

Philips Electrical Limited, Century House, Shaftesbury Avenue, London WC2H 8AS. 01-689 2166.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This cartridge is fitted to several of the cheaper Philips record decks and hence is of particular interest. Modestly priced (typically below £10), it is equipped with a spherical tip and is intended for use at around a 2g downforce. The compliance was somewhat higher than specified at a measured 33cu, and the design thus requires a low mass arm for optimum results, preferably one with additional damping. It would appear that the compliance of both Philips' cartridges in this report are a little high for the arms incorporated in Philips' turntables. We also found that an increase in loading to 400pf gave best results. On test, a gently falling response trend was shown, sufficiently shallow to allow $\pm 1\text{dB}$ limits to contain the 100Hz to 5kHz mid-band.

The output level was similar to that of the GP412 mk II at +3.3dB and once again, the hum level was exemplary. Distortion levels were higher than average, particularly on the vertical modulation band, which may indicate a lack of cantilever constraint in the fore and aft direction. Trackability was very good with channel separation and balance both excellent. The squarewave photograph shows a clean response with a quickly damped 20kHz tip mass resonance, the slight rounding related to the drooping response.

On audition, it was rated as a little above average and was considered to have fair detail and imaging, accurate bass, some constriction at high levels, and a slightly distant and 'nasal' mid-range.

Stylus examination revealed a commercial quality 0.6 thou spherical diamond in a brazed steel shank mount. The alignment was satisfactory and the polish just adequate.

Stylus Data

Stylus Type shank spherical
 Interchangeability yes
 Finish and Alignment of diamond adequate

70 Cartridges

HF Resonance 20kHz
 Measured Dynamic Compliance at 10Hz 33cu
 Replacement Stylus Price ex VAT £4.75

General Data

Cartridge Mass 6g
 Test Tracking Force 2g
 LF Resonance in Standard Arm 6.3Hz
 Induced Hum Level -78dB
 Sensitivity 1.5mV/cm/sec
 Sensitivity referred to 1mV/cm/sec +3.3dB
 Subjective Sound Quality good

Frequency Response and Separation

20Hz-20kHz $\pm 2\text{dB}$
 100Hz-5kHz $\pm 1\text{dB}$
 Channel Separation at 100Hz 20dB
 Channel Separation at 1kHz 32dB
 Channel Separation at 10kHz 19dB
 Channel Balance at 1kHz 0.2dB
 Channel Balance at 10kHz 0.1dB

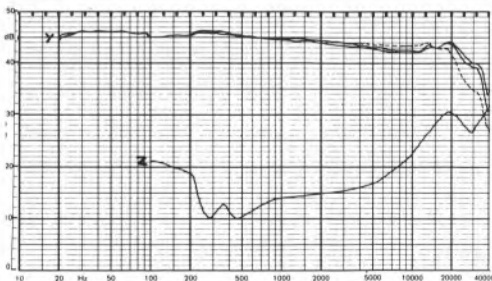
Distortion

HF Wave Form Quality average
 Lateral Distortion at +9dB 300Hz 0.7%
 Vertical Distortion at +6dB 300Hz 8%
 Mid-band Intermodulation 3%
 HF Intermodulation pulsed 10kHz 24cm/sec peak 0.75%

Trackability

Trackability 300Hz Lateral +14dB 0.7g
 Trackability 300Hz Vertical +11dB 0.8g
 Supertrackability 300Hz + 18dB Lateral passed at 2g
 Typical Selling Price ex VAT £9.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.
 — 150 pf loading 400 pf loading

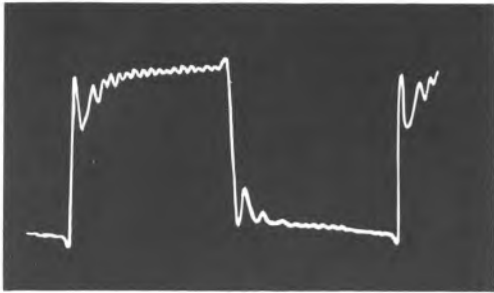


Compatibility

Recommended Loading 47K ohms
 Recommended Loading 300-500pf
 Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance Rating D
 Damping Rating M
 Needs low mass arm for optimum performance

Philips GP412 mk II

Philips Electrical Limited, Century House, Shaftesbury Avenue, London WC2H 8AS. 01-689 2166.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This cartridge is the most expensive of the stereo models, and is supplied with a shank mounted elliptical tip and a loading recommendation of less than 250pf.

As with the GP400 mk II, on test we found a 400pf loading to offer an improvement in response uniformity, and even with the latter, a gently falling trend is present with rising frequency. Nevertheless, the 100Hz to 5kHz mid-band was held within good $\pm 1.25\text{dB}$ limits. The output was 3.8dB above nominal, and the induced hum level excellent, as were both channel balance and separation.

The stylus compliance measured 42cu with low damping, which was a little higher than specified. Hence, a genuinely low mass arm is necessary for optimum stability and tracking. Theoretically, this makes the arms in Philips' own turntables nominally incompatible, since the combination resonance is not likely to exceed 7Hz.

Distortion values were moderate and trackability very good. The squarewave photograph illustrates fair symmetry with the initial overshoot quite quickly damped. Few anomalies are visible.

Listening tests placed the design slightly above average and it was considered to have good detail, stereo imaging and depth, allied with a degree of nasality and brashness, and a dulling in the presence band.

The audible 'brash' quality may in fact be associated with the poor quality of diamond that was fitted to the sample supplied. Upon examination, it was found to have a 0.7×0.3 thou tip, with a very bad shape on both radii; small chips were actually visible on the major axis. This is disappointing in view of the long manufacturing experience that this company possesses, and the relatively high cost of the cartridge. Had a better tip been fitted, its rating could well have been

improved.

Stylus Data

Stylus Type	shank elliptical
Interchangeability	yes
Finish and Alignment of diamond	poor
HF Resonance	21kHz
Measured Dynamic Compliance at 10Hz	42cu
Replacement Stylus Price ex VAT	£15.45

General Data

Cartridge Mass	6g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	5.4Hz
Induced Hum Level	-76dB
Sensitivity	1.5mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+3.8dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	$\pm 2\text{dB}$
100Hz-5kHz	$\pm 1.25\text{dB}$
Channel Separation at 100Hz	21dB
Channel Separation at 1kHz	35dB
Channel Separation at 10kHz	33dB
Channel Balance at 1kHz	0.3dB
Channel Balance at 10kHz	0.0dB

Distortion

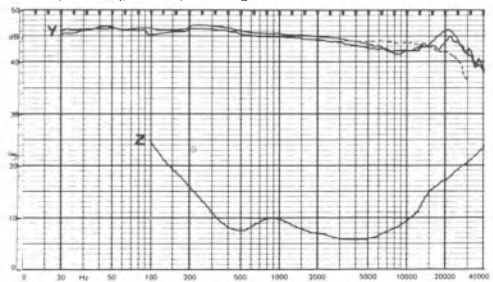
HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	0.4%
Vertical Distortion at +6dB 300Hz	0.3%
Mid-band Intermodulation	0.3%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.55%

Trackability

Trackability 300Hz Lateral +14dB	0.7g
Trackability 300Hz Vertical +11dB	0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.25g
Typical Selling Price ex VAT	£30.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

- 150 pf loading ... 400 pf loading



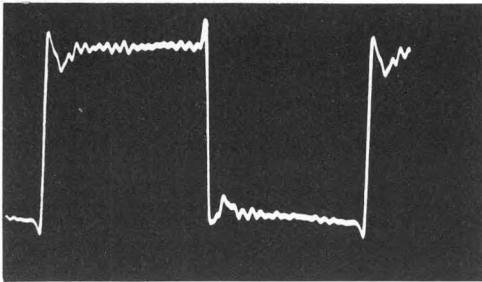
Compatibility

Recommended Loading	47K ohms
Recommended Loading	300-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	D
Damping Rating	L
Needs very low mass arm for optimum performance	

RECOMMENDED

Pickering XSV3000

Highgate Acoustics Limited, 38 Jamestown Road, London NW1. 01-267 4937.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This is Pickering's top stereo cartridge which has been developed from their CD4 range and carries a new 'line contact' diamond tip. An induced magnet type similar to the Stantons, the makers recommend a 47K ohms, 275pf loading for the XSV3000, which was agreed on test. The measured compliance value of 27cu was judged sensible although little damping was present. A low mass arm in the 5g range is ideal, but the use of arm models up to 10g is possible, particularly if some form of damping is available.

While ± 2 dB limits were needed to contain the overall response, the mid-band was commendably flat, meeting ± 0.5 dB limits. Channel separation and balance were classed as good, distortion satisfactory and trackability very good, the supplied tracking brush being discarded as it interfered with the testing and could potentially have been a source of colouration. Distortion in the crosstalk signal was however higher than average. Output was slightly greater than nominal (± 1.3 dB) and hum rejection was excellent. The squarewave response was also essentially good, bar the minor phase and frequency anomalies following the rise.

On listening tests, the XSV3000 ranked well above average, and was placed in the top eight. Overall, it was considered to be musical and pleasant if at times a trifle 'shut-in', distant and nasal, and occasionally mid-dominant.

The stylus report confirmed the line contact form of the naked diamond tip and the radii were considered to be of fine shape. Unfortunately, the alignment, surface polish and mounting quality were all felt to be below par in view of the cost of the cartridge.

Stylus Data
 Stylus Type naked line contact
 Interchangeability yes
 Finish and Alignment of diamond good

72 Cartridges

HF Resonance >20kHz
 Measured Dynamic Compliance at 10Hz 27cu
 Replacement Stylus Price ex VAT £29.00

General Data

Cartridge Mass 5.5g
 Test Tracking Force 1.25g
 LF Resonance in Standard Arm 6.7Hz
 Induced Hum Level -75dB
 Sensitivity 1.2mV/cm/sec
 Sensitivity referred to 1mV/cm/sec +1.3dB
 Subjective Sound Quality good

Frequency Response and Separation

20Hz-20kHz ± 2 dB
 100Hz-5kHz ± 0.5 dB
 Channel Separation at 100Hz 21dB
 Channel Separation at 1kHz 24dB
 Channel Separation at 10kHz 22dB
 Channel Balance at 1kHz 0dB
 Channel Balance at 10kHz 0.8dB

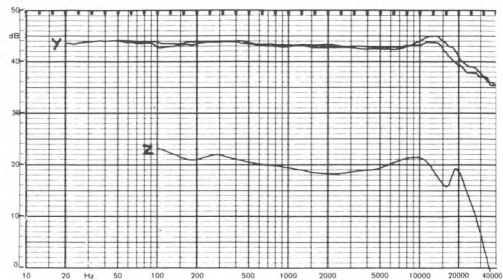
Distortion

HF Wave Form Quality good
 Lateral Distortion at +9dB 300Hz 0.35%
 Vertical Distortion at +6dB 300Hz 3.5%
 Mid-band Intermodulation 2%
 HF Intermodulation pulsed 10kHz 24cm/sec peak 0.3%

Trackability

Trackability 300Hz Lateral +14dB 0.6g
 Trackability 300Hz Vertical +11dB 0.6g
 Supertrackability 300Hz +18dB Lateral passed at 1.25g
 Typical Selling Price ex VAT £53.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

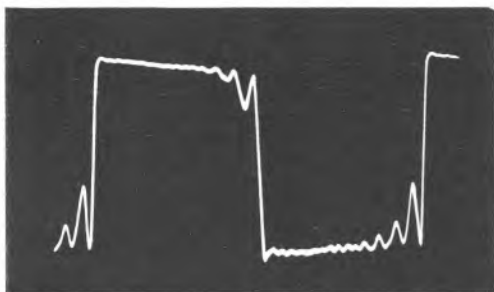


Compatibility

Recommended Loading 47K ohms
 Recommended Loading 250-350pf
 Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance Rating C
 Damping Rating M
 Low mass arm recommended, preferably with damping

Pickering XV15 625E

Highgate Acoustics Limited, 38 Jamestown Road, London NW1. 01-267 4937.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This medium priced cartridge is fitted with a 0.3×0.7 thou elliptical tip intended to track between 1 and 1.5g. The measured compliance was moderate at 20cu, allowing the use of medium mass arms, preferably with additional damping. A 15g arm would place the main resonance near 7Hz, and would thus be rather heavy.

The response trace shows a falling trend with frequency which is accentuated by additional capacitance, and the 275pf recommended loading is thus agreed to be optimal. Reasonable ± 1.5 dB limits served to contain the mid-band; channel separation and balance were good, trackability was of an average standard, (the supertrack needed 2g) and distortion levels quite typical. The tip mass was moderate as the 19kHz upper resonance indicates, this being well damped, and the squarewave photograph showed a fairly clean wave shape, with the resonance under good control. The output level was exactly 1mV/cm/sec and the hum level low. (As with the XSV3000, and for the same reasons, the brush was abandoned on test.)

On audition, the XV15 625E fared a little worse than the XSV3000, but was still ranked in the top 10. Essentially pleasant, the criticisms included a slight nasality, veiling and loss of detail.

The stylus report confirmed the 0.3×0.7 thou specification, describing a well shaped radii and a well finished dural shank mount, with good radii, surface polish and alignment.

Stylus Data

Stylus Type	.....shank elliptical
Interchangeability	.....yes
Finish and Alignment of diamond	.....good
HF Resonance	.....19kHz
Measured Dynamic Compliance at 10Hz	.....20cu
Replacement Stylus Price ex VAT	.....£19 00

General Data

Cartridge Mass	.....	approx 6g
Test Tracking Force	.....	1.25g
LF Resonance in Standard Arm	.....	8Hz
Induced Hum Level	.....	-71dB
Sensitivity	.....	1mV/cm/sec
Sensitivity referred to 1mV/cm/sec	.....	0dB
Subjective Sound Quality	.....	good

Frequency Response and Separation

20Hz-20kHz	± 2.5 dB
100Hz-5kHz	± 1.5 dB
Channel Separation at 100Hz	± 21 dB
Channel Separation at 1kHz	.....	23dB
Channel Separation at 10kHz	.....	15dB
Channel Balance at 1kHz	.....	0.2dB
Channel Balance at 10kHz	.....	1dB

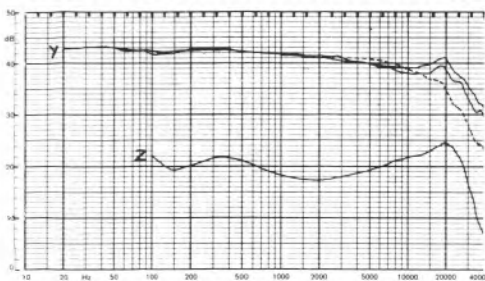
Distortion

HF Wave Form Quality	.....	100d
Lateral Distortion at +9dB 300Hz	.....	0.7%
Vertical Distortion at +6dB 300Hz	.....	1.5%
Mid-band Intermodulation	.....	2.4%
HF Intermodulation pulsed 10kHz 24cm/sec peak	.....	0.3%

Trackability

Trackability 300Hz Lateral +14dB	.....	1.1g
Trackability 300Hz Vertical +11dB	.....	1g
Supertrackability 300Hz +18dB Lateral passed at	.....	2g
Typical Selling Price ex VAT	.....	£25.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

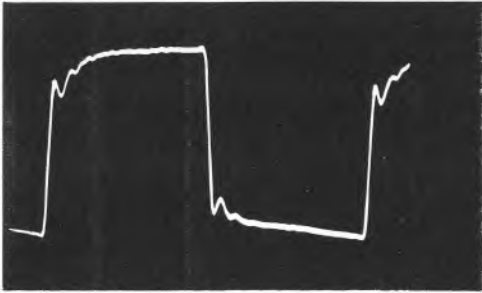


Compatibility

Recommended Loading	.....	47K ohms
Recommended Loading	.....	250-350pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	.....
Resonance Rating	.....	B
Damping Rating	.....	M
Compatible with most arms	.....

Shure M75B II

Shure Electronics Limited, Ecclestone Road, Maidstone ME15 6AU. 0622 59881.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This model is a heavier tracking, spherical tipped version of the M75ED II and is intended for use in medium quality arms. While the suggested 2g downforce is in agreement, the compliance remains rather high at a measured 27cu, with only moderate damping. Consequently, a low mass arm (5-12g) would be optimal, and this will rule out certain budget models which have greater mass components.

Once again, Shure's 450pf (approx) capacitance loading gives the best response, but the falling trend with frequency common to many of the cartridges in this report, was quite pronounced in this model. ± 1.5 dB limits were required to contain the mid-band 100Hz to 5kHz range. Distortion was low, trackability average (the supertrack required 2.5g), and the output was 2.3dB above nominal, with the hum suppression excellent. The squarewave shape relates strongly to the steady state frequency response and both the balance and the separation were classed as satisfactory.

The ranking based on the listening tests placed the M75B II in a low position and it was considered inferior to the M75ED II. Nasality and hardness were observed, in addition to a thick, recessed quality lacking detail or ambience.

In contrast to its elliptical tipped brothers, the dural shank mounted spherical diamond was found to have a good quality 0.6thou radius, of satisfactory polish and alignment.

Stylus Data

Stylus Type	shank spherical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	17.5kHz
Measured Dynamic Compliance at 10Hz	27cu
Replacement Stylus Price ex VAT	£8.00

74 Cartridges

General Data

Cartridge Mass	6g
Test Tracking Force	2g
LF Resonance in Standard Arm	6.7Hz
Induced Hum Level	-73dB
Sensitivity	1.3mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+2.3dB
Subjective Sound Quality	poor

Frequency Response and Separation

20Hz-20kHz	± 2.25 dB
100Hz-5kHz	± 1.5 dB
Channel Separation at 100Hz	19dB
Channel Separation at 1kHz	24dB
Channel Separation at 10kHz	17dB
Channel Balance at 1kHz	1dB
Channel Balance at 10kHz	1dB

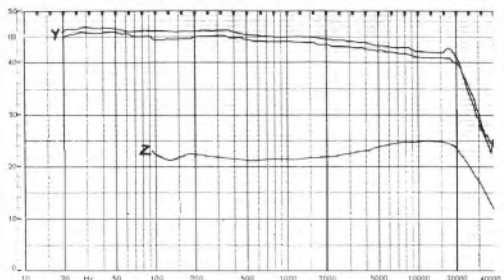
Distortion

HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.3%
Vertical Distortion at +6dB 300Hz	3.7%
Mid-band Intermodulation	1.1%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.6%

Trackability

Trackability 300Hz Lateral +14dB	1.2g
Trackability 300Hz Vertical +11dB	1.3g
Supertrackability 300Hz +18dB Lateral passed at	2.5g
Typical Selling Price ex VAT	£11.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

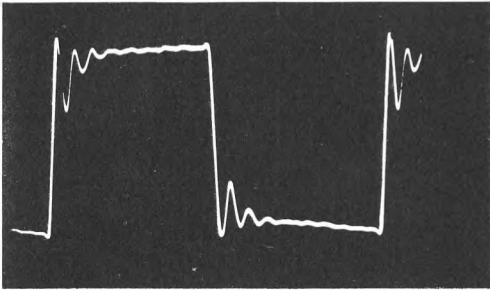


Compatibility

Recommended Loading	.47K ohms
Recommended Loading	350-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	L
Medium to low mass arm ideally required	

Shure M75ED II

Shure Electronics Limited, Ecclestone Road, Maidstone ME15 6AU. 0622 59881.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

As with the M95ED II a naked elliptical diamond is fitted and in this case, the stylus assembly represents about three-quarters of the total purchase price. The recommended 450pf loading again provided the best response, with the nominal 150pf load resulting in +3dB region peak at 19kHz and increased 'suck-out' in the 5-15kHz region. The compliance measured the same as the M95ED II at 30cu, and the same low mass arm recommendations will therefore apply here.

The overall response met ± 1 dB limits with the approved loading, the trend characterised by a slight (2dB) suck out in the upper presence band. The squarewave showed moderate damping at the upper resonance but was basically 'clean'. Balance was very good and separation fairly good, with distortion better than average and the trackability very good (the supertrack only required 1.5g). The output level was 2.9dB above nominal with excellent hum rejection.

Listening tests placed the M75ED II on a similar level to that of the M95ED II, well below average. Criticisms concerned its stereo imaging, a noted detail loss and harshness, with a distant presence band and an over-prominent mid-band.

The stylus examination revealed an out-of-spec 0.3×0.5 thou tip, naked set, with poorly shaped radii. The surface polish was described as adequate and the alignment as good. Again, a disappointing result since this stylus costs around £12.00.

Stylus Data

Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	poor
HF Resonance	19kHz
Measured Dynamic Compliance at 10Hz	30cu
Replacement Stylus Price ex VAT	£13.00

General Data

Cartridge Mass	.6g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	6.5Hz
Induced Hum Level	-75dB
Sensitivity	1.4mV/cm/sec
Sensitivity referred to 1mV/cm/sec.	+2.9dB
Subjective Sound Quality	acceptable

Frequency Response and Separation

20Hz-20kHz	± 1 dB
100Hz-5kHz	± 1 dB
Channel Separation at 100Hz	19dB
Channel Separation at 1kHz	23dB
Channel Separation at 10kHz	17dB
Channel Balance at 1kHz	0.5dB
Channel Balance at 10kHz	0dB

Distortion

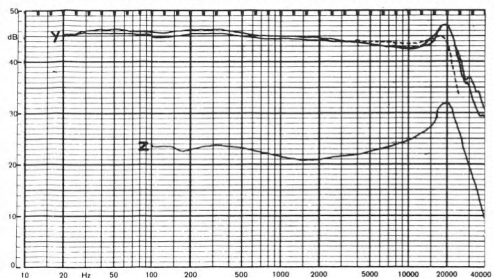
HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.3%
Vertical Distortion at +6dB 300Hz	2%
Mid-band Intermodulation	0.9%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.3%

Trackability

Trackability 300Hz Lateral +14dB	0.6g
Trackability 300Hz Vertical +11dB	0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.5g

Typical Selling Price ex VAT. £16.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

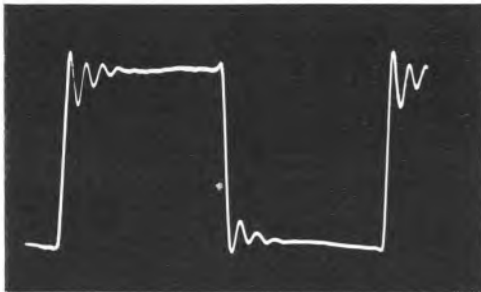


Compatibility

Recommended Loading	.47K ohms
Recommended Loading	350-500pt
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	L
Low mass arm and optimum loading ideally required	

Shure M95ED II

Shure Electronics Limited, Eccleston Road, Maidstone ME15 6AE. 0622 59881.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This medium priced cartridge is fitted with a naked elliptical tip and among the Shure models, it ranks second in line to the V15III. At 30cu the measured compliance was lower than that of the V15III, although the cantilever damping was somewhat reduced. A low mass arm is recommended for use with this cartridge and additional damping might improve matters if a heavier arm were to be employed.

The test results mirrored those for the V15III the only real difference being a slightly higher distortion value. In all other respects, namely trackability, frequency response, output, balance and separation, the two were very similar. Again, the 450pf 'Shure' loading was confirmed as producing the best response, and the squarewave shape proved particularly clean with reasonable damping of the tip mass resonance at approximately 20kHz.

On listening tests, the M95ED II fared slightly worse than did the V15III, as the mid-band nasality and hardness, together with a rather flat stereo presentation were all considered to be obtrusive.

The stylus report revealed an 0.3×0.6 thou tip radii of unexceptional shape and only 'good' polish and alignment. Considering the high replacement stylus cost of around £16.00 this result was a disappointment, particularly from a company with such a good reputation, and both radii were out of specification.

Stylus Data

Stylus Type	naked elliptical
Interchangeability	Yes
Finish and Alignment of diamond	adequate
HF Resonance	20kHz
Measured Dynamic Compliance at 10Hz	30cu
Replacement Stylus Price ex VAT	£16.50

General Data

Cartridge Mass	6g
Test Tracking Force	1.25g

76 Cartridges

LF Resonance in Standard Arm	6.5Hz
Induced Hum Level	-75dB
Sensitivity	1.2mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+1.3dB
Subjective Sound Quality	acceptable

Frequency Response and Separation

20Hz-20kHz	± 1 dB
100Hz-5kHz	± 5 dB
Channel Separation at 100Hz	20dB
Channel Separation at 1kHz	24dB
Channel Separation at 10kHz	22dB
Channel Balance at 1kHz	0.25dB
Channel Balance at 10kHz	0dB

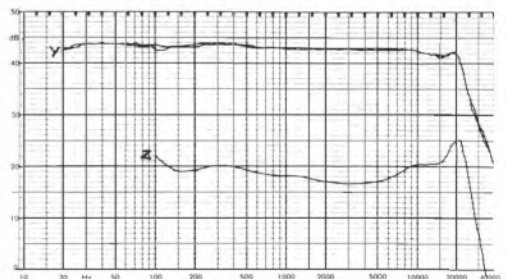
Distortion

HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.4%
Vertical Distortion at +6dB 300Hz	3%
Mid-band Intermodulation	1.2%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.4%

Trackability

Trackability 300Hz Lateral +14dB	0.7g
Trackability 300Hz Vertical +11dB	0.6g
Supertrackability 300Hz +18dB Lateral passed at	1.25g
Typical Selling Price ex VAT	£25.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

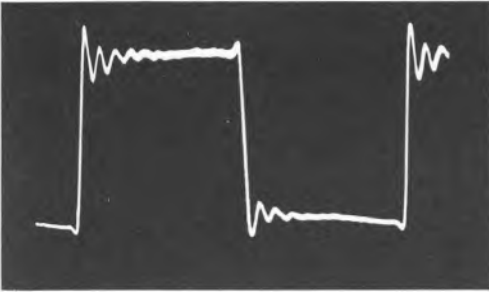


Compatibility

Recommended Loading	47K ohms
Recommended Loading	350-500pF
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	C
Damping Rating	L
Requires low mass arm	

Shure V15III

Shure Electronics Limited, Eccleston Road, Maidstone ME15 6AU. 0622 59881.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This established top-of-the-line cartridge from Shure has been available for some years now and possesses an enviable pedigree. The cantilever is specified as carrying a low mass naked elliptical tip of 0.2×0.7 thou nominal radii, and examination revealed a well shaped 0.3×0.7 tip (0.2 is quite difficult in practice to produce to any degree of accuracy). The surface polish and alignment were, however, only classed as 'good', which is a trifle disappointing in view of the price level.

Shure do not quote compliance values; this sample measured a well damped 40cu and is suited to genuinely low mass arms. Even with a 5g arm the basic resonance will not be above 7Hz, some distance from the 10Hz optimum. The output level was 1.6dB above nominal with excellent hum rejection. Tested with the recommended 47K ohms plus 450pf (approx) loading, commendably flat response traces were obtained, ± 1 dB sufficing overall. Balance was excellent and separation good, with distortion low and trackability exemplary. The squarewave was clean and well balanced, and showed the reasonably damped tip mass resonance at approximately 21kHz.

Unfortunately, the V15III proved to be rather disappointing on audition, and was ranked slightly below average. The sound quality was described as possessing an upper-mid emphasis, only fair depth and imaging, with a degree of hardness unexpected from the lab results.

Stylus Data

Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	21kHz
Measured Dynamic Compliance at 10Hz	40cu
Replacement Stylus Price ex VAT	£1B 00

General Data

Cartridge Mass	6g
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Test Tracking Force	1.25g
LF Resonance in Standard Arm	5.5Hz
Induced Hum Level	-75dB
Sensitivity	1.2mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+1.6dB
Subjective Sound Quality	average

Frequency Response and Separation

20Hz-20kHz	± 1 dB
100Hz-5kHz	± 0.5 dB
Channel Separation at 100Hz	24dB
Channel Separation at 1kHz	24dB
Channel Separation at 10kHz	21dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0dB

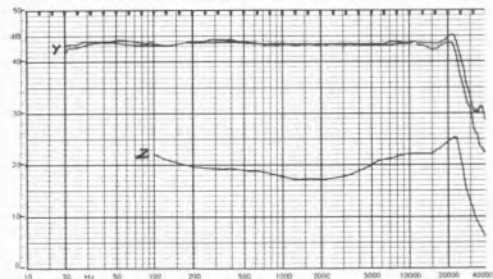
Distortion

HF Wave Form Quality	good
Lateral Distortion at +9dB 300Hz	0.35%
Vertical Distortion at +6dB 300Hz	2.6%
Mid-band Intermodulation	1.8%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.3%

Trackability

Trackability 300Hz Lateral +14dB	0.75g
Trackability 300Hz Vertical +11dB	0.5g
Supertrackability 300Hz +18dB Lateral passed at	1.25g
Typical Selling Price ex VAT.	£47 00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

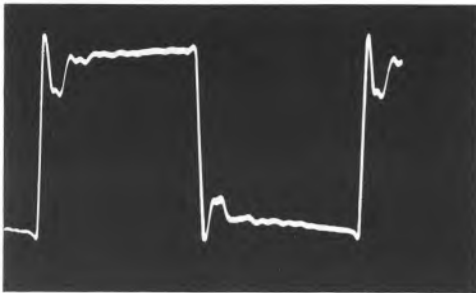


Compatibility

Recommended Loading	47K ohms
Recommended Loading	350-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	D
Damping Rating	J
Needs low mass arm but arm damping not required	

Sonotone V100

Vernitron Limited, Thornhill, Southampton SO9 5QF. 0703 444811.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This budget cartridge is equipped with a spherical tip and is one of the cheapest to be included in the survey. Costing around £5.00, it comes ready fitted to the Prinzsound PL15 turntable which is also reviewed in this report.

The measured compliance was relatively low at 16cu, allowing the use of low to medium mass arms of up to 15g, exclusive of cartridge mass.

The mid-band frequency range fell within $\pm 1.25\text{dB}$ limits which is creditable for the price and in fact, over 20Hz to 15kHz, $\pm 2\text{dB}$ proved sufficient. The output level was 3.5dB above nominal, with excellent hum rejection and exemplary channel balance and separation. Distortion levels were, however, on the high side, although not disastrously so. Judged from the 14kHz upper resonance, tip mass was fairly high and some anomalies were present on the otherwise good squarewave shape. Tracking performance was only average.

On listening tests this model was ranked low, in a similar position to the Shure M75B II. The frequency balance was good, but unfortunately, noticeable break-up and gritty effects were present which accounted for the down-grading.

A commercial quality, steel shanked diamond of good alignment was fitted with adequate polish and a satisfactory 0.6thou tip radius.

Stylus Data

Stylus Type	shank spherical
Interchangeability	yes
Finish and Alignment of diamond	adequate
HF Resonance	14kHz
Measured Dynamic Compliance at 10Hz	16cu
Replacement Stylus Price ex VAT	£4 00

General Data

Cartridge Mass	approx 6g
Test Tracking Force	2.25g
LF Resonance in Standard Arm	8.8Hz
Induced Hum Level	-75dB

Sensitivity	1.5mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+3.5dB
Subjective Sound Quality	poor

Frequency Response and Separation

20Hz-20kHz	$\pm 3\text{dB}$
100Hz-5kHz	$\pm 1.25\text{dB}$
Channel Separation at 100Hz	26dB
Channel Separation at 1kHz	35dB
Channel Separation at 10kHz	19dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0.2dB

Distortion

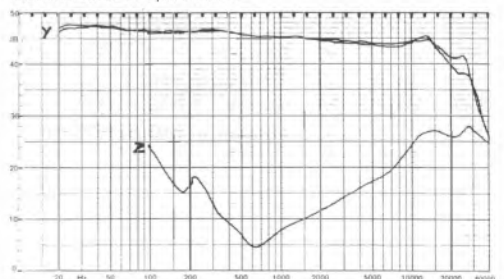
HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	0.8%
Vertical Distortion at +6dB 300Hz	.8%
Mid-band Intermodulation	.3%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.6%

Trackability

Trackability 300Hz Lateral +14dB	1.2g
Trackability 300Hz Vertical +11dB	1.1g
Supertrackability 300Hz +18dB Lateral passed at	2.5g

Typical Selling Price ex VAT £5 00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



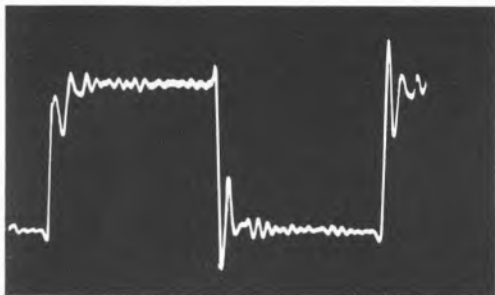
Compatibility

Recommended Loading	47K ohms
Recommended Loading	100-300pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	B
Damping Rating	M
Compatible with most arms	

RECOMMENDED

Sonus Blue

CE Hammond & Company Limited, 111 Chertsey Road, Byfleet, Surrey. Byfleet 41131.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This costly cartridge proved to be a surprise, as it produced a measured and subjective performance considerably superior to that of a sample tested a year or so ago. Clearly the design has been improved.

This recent induced magnet design is fitted with a line contact naked diamond, and was insensitive to loading, the usual 47K ohms plus 150pf proving fine. The frequency response was extraordinarily flat, $\pm 0.25\text{dB}$ sufficing for the mid-band. Channel balance was near perfect, with separation and trackability both very good. Distortions were a little on the high side, but not unduly so. Some asymmetry was evident on the squarewave shape but the main overshoot (28kHz) was quickly damped and the remaining wriggles are not significant. The output was 1.9dB below nominal, with very good hum rejection.

On listening tests, the Blue ranked number one. Rendition of detail, subjective frequency balance, stereo imaging and depth were all highly praised, although the mid-band reproduction was not quite correct.

The stylus report indicates that the potential exists to improve the diamond tip quality, which the manufacturers should bear in mind in view of the high purchase price. The radii on the line contact tip were slightly asymmetrical, the polish only adequate and the general alignment satisfactory. A reasonably damped compliance of 48cu was measured, which indicates the use of a low mass arm (around 5g) for best results, and damping should not be necessary.

Two further points are worthy of note. Firstly, the packing is poor, our sample arrived loose in the box and covered in the mock velvet dust from the mounting pad, secondly, a small click (not static) was observed when the cartridge was lifted from the

groove, and this we were not able to account for

Stylus Data

Stylus Type	.....	naked line contact
Interchangeability	.....	yes
Finish and Alignment of diamond	.....	good
HF Resonance	.....	28kHz
Measured Dynamic Compliance at 10Hz	.....	48cu
Replacement Stylus Price ex VAT	.....	£34.50

General Data

Cartridge Mass	.....	5.5g
Test Tracking Force	.....	1g
LF Resonance in Standard Arm	.....	5.1Hz
Induced Hum Level	.....	-70dB
Sensitivity	.....	0.8mV/cm/sec
Sensitivity referred to 1mV/cm/sec	.....	-1.9dB
Subjective Sound Quality	.....	excellent

Frequency Response and Separation

20Hz-20kHz	.....	$\pm 1.5\text{dB}$
100Hz-5kHz	.....	$\pm 0.25\text{dB}$
Channel Separation at 100Hz	.....	22dB
Channel Separation at 1kHz	.....	28dB
Channel Separation at 10kHz	.....	26dB
Channel Balance at 1kHz	.....	0dB
Channel Balance at 10kHz	.....	0dB

Distortion

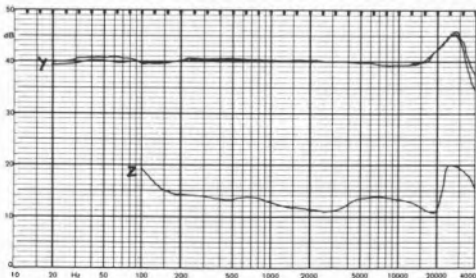
HF Wave Form Quality	.....	average
Lateral Distortion at +9dB 300Hz	.....	1.5%
Vertical Distortion at +6dB 300Hz	.....	4.5%
Mid-band Intermodulation	.....	2%
HF Intermodulation pulsed 10kHz 24cm/sec peak	.....	0.33%

Trackability

Trackability 300Hz Lateral +14dB	.....	0.7g
Trackability 300Hz Vertical +11dB	.....	0.6g
Supertrackability 300Hz +18dB Lateral passed at	.....	1.25g

Typical Selling Price ex VAT. £58.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

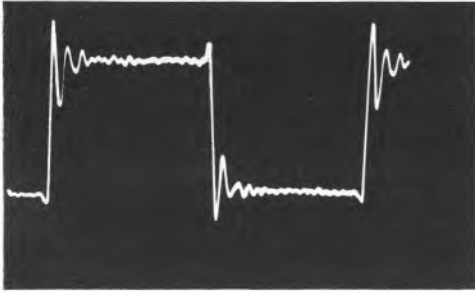


Compatibility

Recommended Loading	.....	47K ohms
Recommended Loading	.....	100-300pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)		
Resonance Rating	.....	D
Damping Rating	.....	K
Very low mass arm recommended but no damping required		

Sonus Silver P

CE Hammond & Company Limited, 111 Chertsey Road, Byfleet, Surrey. Byfleet 41131.



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

On paper, the indications were that the performance of this half-price version of the Blue should in fact approach that of its more expensive brother. A similar line touch diamond tip is fitted, although in this case a brazed metal shank is employed, rather than the naked mount of the Blue. Surprisingly enough, the stylus examination revealed that the shape of both the major and the minor radii were rather better than those of the Blue, as was the polish, and was rated as good. However, it was commented that rather a lot of adhesive had been used in securing the tip.

By comparison with the Blue, the frequency response was similarly uniform, rising to a +6dB peak at a supersonic 26kHz. ± 0.5 dB limits sufficed for the mid-band. Output was 0.4dB below nominal and hum induction was very good. However, distortions were even higher than with the more expensive model, with the vertical level at 11% which was considered more than a little excessive for the price. Tracking was very good as was separation, while channel balance was only fair. The squarewave shape was also similar to that of the Blue with little to distinguish between the two.

While the compliance was lower than spec at 34cu, this still rates as a high value, requiring a genuinely low mass arm of less than 7g effective mass to give the best results.

On audition, the Silver P did poorly, rating a well below average position. While the basic frequency balance was considered neutral and open with good potential, the cartridge appeared to alter the harmonic structure of both voice and instruments, producing a reedy and harsh effect which may be the result of the high distortion values.

Stylus Data

Stylus Type shank line contact

80 Cartridges

Interchangeability yes
 Finish and Alignment of diamond good
 HF Resonance 26kHz
 Measured Dynamic Compliance at 10Hz 34cu
 Replacement Stylus Price ex VAT £18.50

General Data

Cartridge Mass 5.5g
 Test Tracking Force 1.25g
 LF Resonance in Standard Arm 6.1Hz
 Induced Hum Level -70dB
 Sensitivity 0.95mV/cm/sec
 Sensitivity referred to 1mV/cm/sec -0.4dB
 Subjective Sound Quality acceptable

Frequency Response and Separation

20Hz-20kHz ± 2.5 dB
 100Hz-5kHz ± 0.5 dB
 Channel Separation at 100Hz 22dB
 Channel Separation at 1kHz 37dB
 Channel Separation at 10kHz 30dB
 Channel Balance at 1kHz 1dB
 Channel Balance at 10kHz 1.2dB

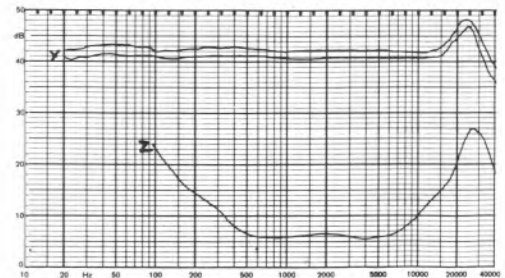
Distortion

HF Wave Form Quality average
 Lateral Distortion at +9dB 300Hz 1.2%
 Vertical Distortion at +6dB 300Hz 11%*
 Mid-band Intermodulation 4%
 HF Intermodulation pulsed 10kHz 24cm/sec peak 0.28%

Trackability

Trackability 300Hz Lateral +14dB 0.65g
 Trackability 300Hz Vertical +11dB 0.7g
 Supertrackability 300Hz +18dB Lateral passed at 1.25g
 Typical Selling Price ex VAT £35.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



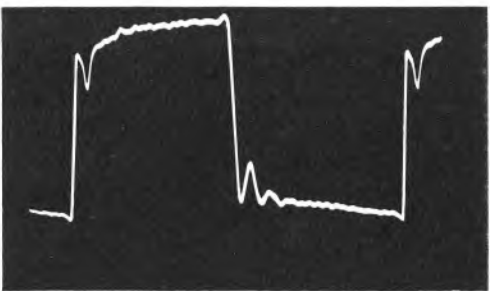
Compatibility

Recommended Loading 47K ohms
 Recommended Loading 100-400pt
 Match up these letters (ABCD/ JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance Rating U
 Damping Rating L
 Low mass arm required but damping unnecessary
 *See text

RECOMMENDED

Stanton 500A

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This robust cartridge is intended to track between 2 and 5g, and accordingly it was tested at 3g. A spherical tip is specified, which on examination was found to have a good 0.7thou tip radius in a naked mount, and while the alignment was satisfactory, the polish could be much improved.

The overall response fitted within $\pm 2\text{dB}$ limits, with the mid-band to within $\pm 1\text{dB}$. Channel balance was excellent with the separation to a good standard, and trackability proved to be fine at the test downforce. Distortion levels were average and the output was 2.5dB above nominal, with excellent hum rejection. The squarewave photograph reflected the slightly drooping response, with the 19kHz tip mass resonance showing good damping.

A compliance of 12cu was measured which makes the 500A compatible with a number of medium to heavy arms of up to 25g effective mass, and although it is probably not justified at the price, some arm damping would be a further advantage.

The subjective tests results were somewhat of a surprise, as this model's pleasant, clean and restrained nature clearly found favour. It was ranked moderately above average; higher than its more expensive brothers, and although the slightly dull balance was commented on, it was not considered to be at all objectionable.

Stylus Data

Stylus Type	shank spherical
Interchangeability	yes
Finish and Alignment of diamond	adequate
HF Resonance	19kHz
Measured Dynamic Compliance at 10Hz	11cu
Replacement Stylus Price ex VAT	£9.75

General Data

Cartridge Mass	5g
Test Tracking Force	3g
LF Resonance in Standard Arm	10.5Hz
Induced Hum Level	-73dB
Sensitivity	1.3mV/cm/sec

Sensitivity referred to 1mV/cm/sec	+ 2.5dB
Subjective Sound Quality	good

Frequency Response and Separation

20Hz-20kHz	$\pm 2\text{dB}$
100Hz-5kHz	$\pm 1\text{dB}$
Channel Separation at 100Hz	22dB
Channel Separation at 1kHz	25dB
Channel Separation at 10kHz	20dB
Channel Balance at 1kHz	0dB
Channel Balance at 10kHz	0.8dB

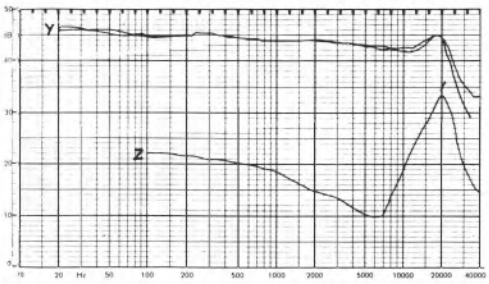
Distortion

HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	0.5%
Vertical Distortion at +6dB 300Hz	3%
Mid-band Intermodulation	3%
HF Intermodulation pulsed 10kHz/24cm/sec peak	0.8%

Trackability

Trackability 300Hz Lateral +14dB	1.25g
Trackability 300Hz Vertical +11dB	1.5g
Supertrackability 300Hz +18dB Lateral passed at	3g
Typical Selling Price ex VAT	£16.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

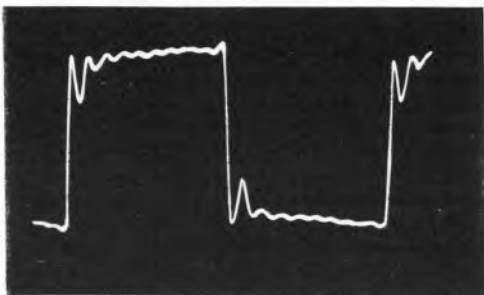


Compatibility

Recommended Loading	47K ohms
Recommended Loading	100-250pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	A
Damping Rating	M
Compatible with medium to high mass arms	

Stanton 680EE

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

While not compromising performance, this recent introduction to the Stanton range is claimed to withstand rough handling, as might be encountered in professional situations.

In common with the more expensive 681EEE, the stylus brush was removed during testing. The maker's specified loading is 47K ohms 275pf, but measurements showed that a moderate increase to 400pf levelled the upper presence band by a dB or so, and suppressed a small peak at 19kHz, while rolling off the response above that level. With 400pf, the 100Hz to 10kHz band fitted within good ± 1 dB limits. A moderate down-tilt was evident but was not as severe as with the 681EEE. Overall, trackability and distortion were both fairly good although the cartridge was not too happy on the 10kHz pulsed test band. The output was a nominal 1mV/cm/sec, with good hum rejection.

The squarewave flat top illustrated the uniform frequency response, the initial tip mass resonance being quickly damped. The measured compliance was 25cu, higher than that of the 681EEE, and its nominal damping suggests the use of a medium effective mass arm (up to 12g), preferably damped for best tracking stability.

Subjective tests placed this model below average, although marginally above the 681EEE. A curious effect was noticed whereby the singers appeared to have their pitch altered by a subtle balance change. Slight hardness was also apparent.

The stylus was found to be a dural shank mounted elliptical of good polish and alignment, but with 0.3×0.6 thou radii, the latter poorly shaped. This aspect could be improved especially in view of the £35.00 odd purchase price.

Stylus Data

Stylus Type shank elliptical
Interchangeability yes

82 Cartridges

Finish and Alignment of diamond adequate
HF Resonance 20kHz
Measured Dynamic Compliance at 10Hz 25cu
Replacement Stylus Price ex VAT £22 95

General Data

Cartridge Mass 5.5g
Test Tracking Force 1.25g
 \angle F Resonance in Standard Arm 7Hz
Induced Hum Level -71dB
Sensitivity 1mV/cm/sec
Sensitivity referred to 1mV/cm/sec 0dB
Subjective Sound Quality average

Frequency Response and Separation

20Hz-20kHz ± 1 5dB
100Hz-5kHz ± 1 dB
Channel Separation at 100Hz 20dB
Channel Separation at 1kHz 22dB
Channel Separation at 10kHz 15dB
Channel Balance at 1kHz 0.5dB
Channel Balance at 10kHz 0.0dB

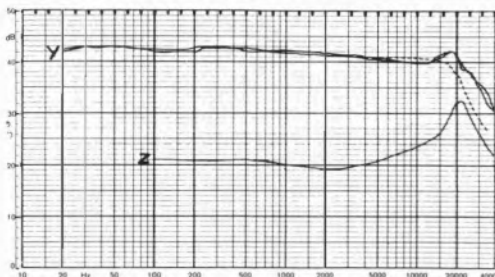
Distortion

HF Wave Form Quality good
Lateral Distortion at +9dB 300Hz 0.65%
Vertical Distortion at +6dB 300Hz 2%
Mid-band Intermodulation 2%
HF Intermodulation pulsed 10kHz 24cm/sec peak 1%

Trackability

Trackability 300Hz Lateral +14dB 0.7g
Trackability 300Hz Vertical +11dB 1g
Supertrackability 300Hz +18dB Lateral passed at 1.75g
Typical Selling Price ex VAT £35 00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

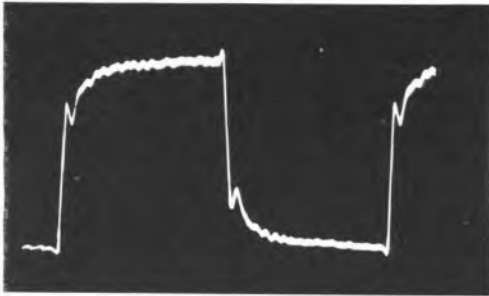


Compatibility

Recommended Loading 47K ohms
Recommended Loading 300-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)
Resonance Rating C
Damping Rating M
Low to medium mass arm ideal, damped if possible

Stanton 681EEE

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This high cost induced magnet cartridge is equipped with a naked elliptical diamond tip. Specified at 0.2×0.7 , the well shaped radii actually measured at 0.3×0.6 . Both finish and polish were only classed as good, and in view of the high purchase price they could have been better. As with the Pickerings, the supplied stylus brush was removed before testing as it could possibly have introduced colouration effects.

The measured compliance was 20cu which was surprisingly low, and offers a useful match with medium weight arms of up to 15g effective mass (preferably those with some damping). However, as this compliance value was lower than that for the more robust 680EEE it is possible that it represents a sample anomaly.

The response was flat to 2kHz with the by now familiar roll-off, continuing to fall to -4dB at 15kHz. However, a touch of pre-amplifier treble lift should provide some correction. Channel balance and separation were both good and trackability fairly so. Tip mass was low, judged by the 25kHz upper resonance which was barely visible on the squarewave due to the rounded leading shoulder, the latter a function of the frequency response. Distortion levels were moderate; the output 1.9dB below nominal, and the hum rejection satisfactory.

The cartridge ranked significantly below average on the listening tests, mainly due to its rather dull balance. Some hardness and nasality were also evident with only fair stereo imaging.

Stylus Data

Stylus Type	naked elliptical
Interchangeability	yes
Finish and Alignment of diamond	good
HF Resonance	25kHz
Measured Dynamic Compliance at 10Hz	20cu
Replacement Stylus Price ex VAT	£27.50

General Data

Cartridge Mass	5.5g
Test Tracking Force	1.25g
LF Resonance in Standard Arm	8Hz
Induced Hum Level	-68dB
Sensitivity	0.8mV/cm/sec
Sensitivity referred to 1mV/cm/sec	-1.9dB
Subjective Sound Quality	acceptable

Frequency Response and Separation

20Hz-20kHz	$\pm 2.5\text{dB}$
100Hz-5kHz	$\pm 1.5\text{dB}$
Channel Separation at 100Hz	17dB
Channel Separation at 1kHz	25dB
Channel Separation at 10kHz	19dB
Channel Balance at 1kHz	0.5dB
Channel Balance at 10kHz	0dB

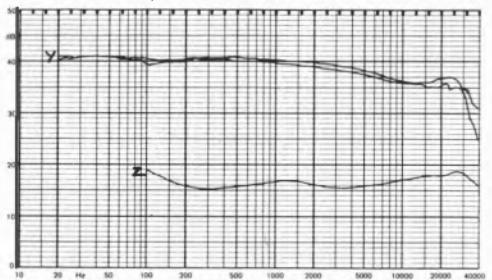
Distortion

HF Wave Form Quality	average
Lateral Distortion at +9dB 300Hz	1.1%
Vertical Distortion at +6dB 300Hz	3%
Mid-band Intermodulation	1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	0.4%

Trackability

Trackability 300Hz Lateral +14dB	1.25g
Trackability 300Hz Vertical +11dB	0.9g
Supertrackability 300Hz +18dB Lateral passed at	1.4g
Typical Selling Price ex VAT	£50.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



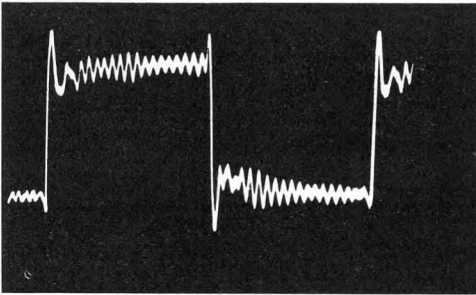
Compatibility

Recommended Loading	47K ohms
Recommended Loading	150-300pF
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	B
Damping Rating	M
If sample typical, then medium mass damped arm suitable	

RECOMMENDED

Supex 900E Super

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This costly Japanese moving coil cartridge is one of the models that require a special input amplifier or transformer. The output was higher than that of the FR1 or MC20, and measured 6.4dB above nominal, using the Denon '3 ohm' transformer setting. The stylus consultant waxed lyrical over the naked diamond tip which was classed as excellent, both in terms of its polish and alignment, with beautifully shaped 0.3 x 0.7 thou elliptical radii.

The compliance measured close to spec at 20cu, although the value for another sample checked by chance was rather lower, at 12.5cu. Medium mass arms in the 5-10g range are suitable, no damping being required, but heavier arms of up to 15g could also be accommodated, especially if the compliance is generally lower than that of the first test sample.

Separation and balance were both excellent, bar a treble-band resonance at 8.5kHz which is just visible on the frequency response. The latter met ± 1.0 dB limits over the 20Hz to 20kHz band with the tip mass resonance apparently above 45kHz. Trackability and distortions were generally pretty good, although the 6.5% recorded on the vertical (L-R) modulation band was about double the average value for the group. The high output helped to produce a satisfactory hum level, while the squarewave showed a basically good shape, overlaid with inaudible supersonic ringing at around 40kHz.

Subjective testing ranked this model as among the top three, and while it was characterised by a slightly dull and rich balance, and the extreme treble was occasionally slightly tizzy and hard, great depth, transparency, fine stereo imaging and perspective were all noted.

Stylus Data

Stylus Type naked elliptical
Interchangeability no
Finish and Alignment of diamond excellent
HF Resonance approx 40kHz

Measured Dynamic Compliance at 10Hz 20cu
Replacement Stylus Price ex VAT £67.50

General Data

Cartridge Mass 8.5g
Test Tracking Force 2g
LF Resonance in Standard Arm 6.5Hz
Induced Hum Level approx. -60dB
Sensitivity 2.1mV/cm/sec
Sensitivity referred to 1mV/cm/sec +6.4dB*
Subjective Sound Quality excellent

Frequency Response and Separation

20Hz-20kHz ± 1 dB
100Hz-5kHz ± 0.75 dB
Channel Separation at 100Hz 22dB
Channel Separation at 1kHz 35dB
Channel Separation at 10kHz 26dB
Channel Balance at 1kHz 0dB
Channel Balance at 10kHz 0.8dB

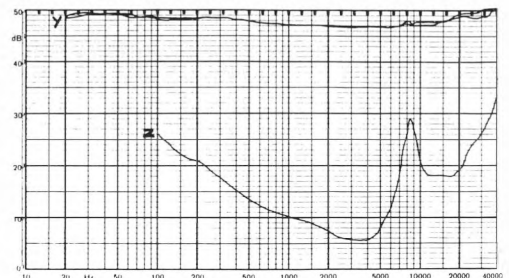
Distortion

HF Wave Form Quality poor
Lateral Distortion at +9dB 300Hz 0.35%
Vertical Distortion at +6dB 300Hz 6.5%
Midband Intermodulation 1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak 0.2%

Trackability

Trackability 300Hz Lateral +14dB 0.9g
Trackability 300Hz Vertical +11dB 0.8g
Supertrackability 300Hz +18dB Lateral passed at 2.5g
Typical Selling Price ex VAT £85.00*

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



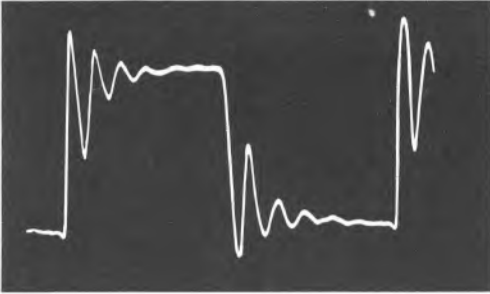
Compatibility

Recommended Loading transformer or pre-amplifier required
Recommended Loading
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)
Resonance Rating B
Damping Rating J
Medium mass arm suitable, damping not required

*see text

Tenorel 2000ED

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

It has been suggested in the past that this model is a possible equivalent to other manufacturers' cartridges, such as the Shure M75ED. Specified as carrying an 0.2×0.7 thou shank mounted elliptical, the stylus examination found a reasonably aligned and polished 0.3×0.6 tip, with a very poor profile on the major radius. This was considered rather disappointing for a hi-fi cartridge, irrespective of price level. The specified downforce range is 1-3g and accordingly it was tested at 1.75g.

While the compliance was specified at 25cu a much lower value of 7.0 was measured, which if typical, requires that high mass arms be used for the best results. The resonance was very poorly damped, indicating the need for additional arm damping, although this is unlikely to be provided at this price level. The squarewave photograph was dominated by the under-damped tip mass resonance in the audible range, at 14kHz, which produced a peak 8dB high on the response trace, even though the 100Hz to 5kHz range met fine ± 1 dB limits. Separation and channel balance were good; trackability average at mid-range but poor at high frequencies. However, distortion levels were above average. Output was 1.6dB above nominal and hum induction very good.

Subjective listening tests ranked the Tenorel in the lowest group, with the sound described as rough, brittle, sibilant and emphasising record surface noise. It is possible that increased load capacitance might tame the 14kHz resonance, but time was not available to try this.

Stylus Data

Stylus Type	shank elliptical
Interchangeability	yes
Finish and Alignment of diamond	poor
HF Resonance	14kHz
Measured Dynamic Compliance at 10Hz	7cu
Replacement Stylus Price ex VAT	£7.95

General Data

Cartridge Mass	7g
Test Tracking Force	1.75g
LF Resonance in Standard Arm	13.5Hz
Induced Hum Level	-72dB
Sensitivity	1.2mV/cm/sec
Sensitivity referred to 1mV/cm/sec	+1.6dB
Subjective Sound Quality	poor

Frequency Response and Separation

20Hz-20kHz	± 4.5 dB
100Hz-5kHz	± 1 dB
Channel Separation at 100Hz	22dB
Channel Separation at 1kHz	27dB
Channel Separation at 10kHz	17dB
Channel Balance at 1kHz	0.8dB
Channel Balance at 10kHz	1.5dB

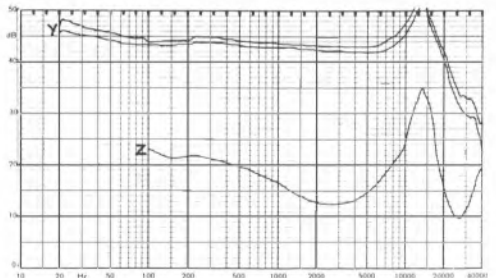
Distortion

HF Wave Form Quality	poor
Lateral Distortion at +9dB 300Hz	1%
Vertical Distortion at +6dB 300Hz	6.5%
Mid-band Intermodulation	2%
HF Intermodulation pulsed 10kHz 24cm/sec peak	9%

Trackability

Trackability 300Hz Lateral +14dB	1.2g
Trackability 300Hz Vertical +11dB	1.1g
Supertrackability 300Hz +18dB Lateral passed at	2.5g
Typical Selling Price ex VAT	£10.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.



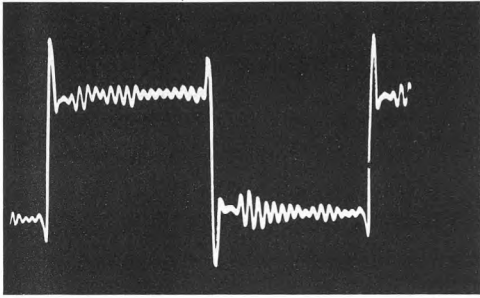
Compatibility

Recommended Loading	47K ohms
Recommended Loading	300-500pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	A
Damping Rating	M
High mass arm preferably with damping	

RECOMMENDED

Ultimo 20A

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



Photograph of squarewave characteristics at 1kHz illustrating transient performance.

This unusual moving coil cartridge has sufficient output to drive a normal pre-amplifier input. Our sample measured 5dB below nominal, which corresponds to a reasonable 2.8mV from a 5cm/sec lateral band and is sufficient for most modern amplifiers.

The body was quite heavy at 9.5g, so it was fortunate that the compliance was moderate at 20cu. The damping was fair and with a low mass arm (5g) extra damping should not be necessary. However, if a higher mass arm (up to 12g) is used it might prove beneficial. On the normal 47K ohms 150pf load the response showed a rise above 5kHz, reaching +5dB at 25kHz. A new loading of 22K ohm, 500pf, tamed the rise considerably, resulting in ± 1 dB limits over the 20Hz to 30kHz range. The mid-band fitted within ± 0.5 dB limits.

The squarewave showed an essentially flat topped wave shape, with a quickly damped, very fast initial overshoot possessing some inaudible supersonic ringing. The trackability was classed as fairly good, channel balance superb and separation as very satisfactory. Despite its moving coil design, hum induction ranked as good, and distortion levels were low throughout the range.

Subjective testing ranked the Ultimo among the top three, with a light, open and detailed balance, excellent vocal clarity and good stereo perspective and imaging. Occasionally a hint of grittiness was detected, possibly due to tracking difficulties.

The stylus report described a naked Shibata tip of excellent polish, very good alignment, fine shape and beautiful setting.

Stylus Data

Stylus Type	..... naked shibata
Interchangeability	..... no
Finish and Alignment of diamond	..... excellent
HF Resonance	..... 33kHz
Measured Dynamic Compliance at 10Hz	..... 20cu
Replacement Stylus Price ex VAT	..... £37.12

86 Cartridges

General Data

Cartridge Mass	..... 9.5g
Test Tracking Force	..... 1.5g
LF Resonance in Standard Arm	..... 7Hz
Induced Hum Level	..... -67dB
Sensitivity	..... 0.56mV/cm/sec
Sensitivity referred to 1mV/cm/sec	..... -5dB
Subjective Sound Quality	..... excellent

Frequency Response and Separation

20Hz-20kHz ± 1 dB*
100Hz-5kHz ± 0.5 dB*
Channel Separation at 100Hz	..... 19dB
Channel Separation at 1kHz	..... 25dB
Channel Separation at 10kHz	..... 18dB
Channel Balance at 1kHz	..... 0dB
Channel Balance at 10kHz	..... 0dB

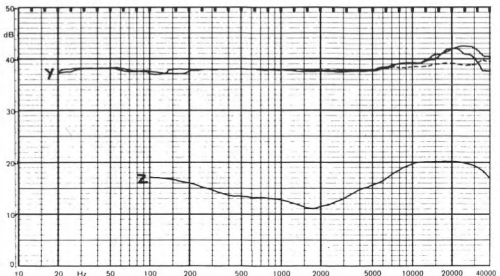
Distortion

HF Wave Form Quality	..... average
Lateral Distortion at +9dB 300Hz	..... 0.3%
Vertical Distortion at +6dB 300Hz	..... 3%
Mid-band Intermodulation	..... 1.5%
HF Intermodulation pulsed 10kHz 24cm/sec peak	..... 0.2%

Trackability

Trackability 300Hz Lateral +14dB	..... 1.5g
Trackability 300Hz Vertical +11dB	..... 1.4g
Supertrackability 300Hz +18dB Lateral passed at	..... 2.2g
Typical Selling Price ex VAT	..... £65.00

Y shows the left and right frequency amplitude responses. Z shows crosstalk. Note: 1dB per division.

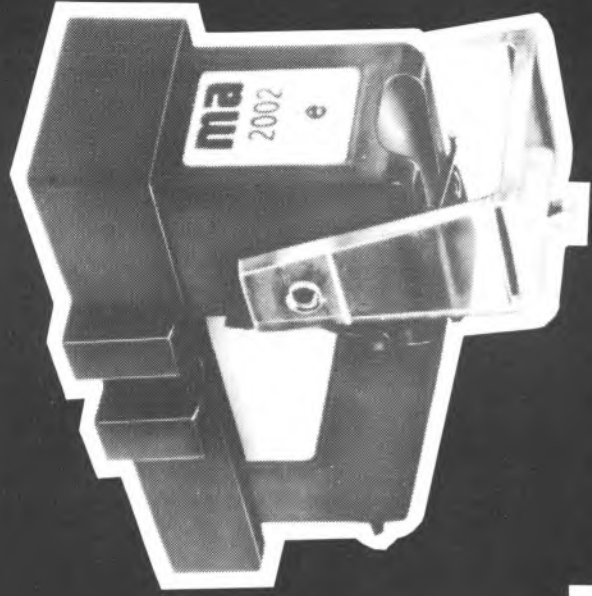


Compatibility

Recommended Loading	..... 22K ohms
Recommended Loading	..... 500-600pf
Match up these letters (ABCD/JKLM) in this section with those in the arm compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance Rating	..... R
Damping Rating	..... L
Compatible with medium mass arms, some damping may be helpful	

* see text

**Because good
tracking
isn't enough.**



Micro- Acoustics

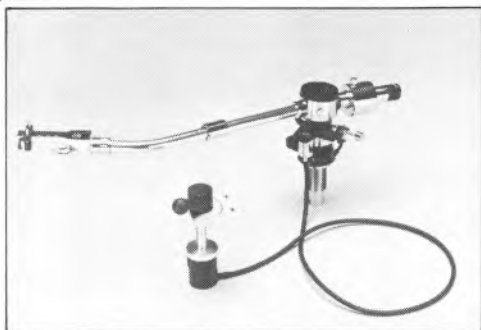
For further details write or phone:

Webland Electronics Ltd, Mirabel House, 117-121 Wandsworth Bridge Road, London SW6. 01-736 0987.

RECOMMENDED

Audio-Technica AT1009

Shiro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



The latest in a line of arm designs from Audio Technica, this model owes something, at least in appearance, to its cheaper brother, the AT1005. A moderate mass die-cast shell is provided in the standard universal fixing, its skeletal form aiding cartridge alignment. The design is essentially rigid with only token counterweight decoupling, the counterweight offset geometry providing lateral balancing without the use of suspect outrigger weight. A remote air pressure operated cue control was provided, which demonstrated a reluctance to effect arm descent after a period of non operation, be it a matter of hours or days. It recovered after a couple of operation cycles however, and the recommendation is to leave the cue in the 'down' position after use, and the problem does not then arise. A generous length of air hose was provided, allowing the cue level to be sited away from the arm sub platform, and hence avoid any tracking disturbance.

On test, the AT1009 proved neutral sounding, complementing a number of low-medium compliance cartridges, including moving coil models. The lab results showed correct bias and downforce readings, with very low friction—a fine example of engineering and performance for its price and mass range.

General data

Type of headshell	universal detachable
Headshell mass	7.5g
Geometrical accuracy	good
Adjustments provided	height, overhang
Finish and engineering	excellent
Ease of assembly	very good
Ease of use	fairly good
Trackability	very good
Hum level	-70dB

Friction

Typical lateral	<10mg
Typical vertical	<10mg

88 Pick-up arms

Bias compensation (set to 1.5g elliptical)

Type of system	thread and lever
Rim	150mg
Centre	175mg

Downforce calibration error

1g	0.95%
2g	1.9%

Cue operation

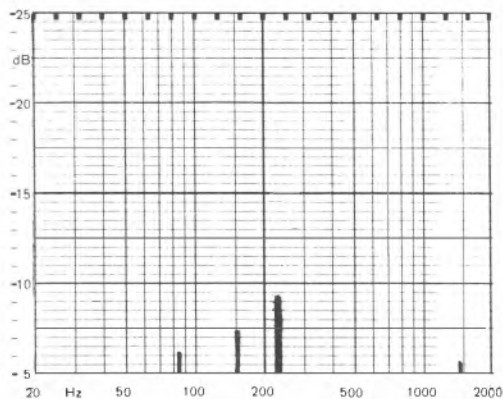
Drift	satisfactory
Ascent (8mm)	1sec
Descent (8mm)	2.5secs*

Subjective sound quality very good

Motor recommended DDX1000, SP10 II, Lux PD131, etc.

Typical selling price ex VAT £52.00

Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 13-15g

Match up these letters (ABCEJ/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating B

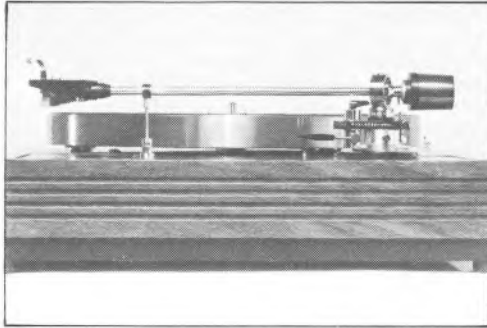
Damping rating J

Recommended tracking weight 1.25-2.5g

Low to medium compliance cartridges recommended (8-15 cu)

Grace G707

Linn Products Ltd., 235 Drakemire Drive, Glasgow. 041 634 3860.



Cue operation	
Drift	satisfactory
Ascent (8mm)	1.5secs
Descent (8mm)	3secs
Subjective sound quality	
Motor recommended	LINN LP12, DDX1000, KD500 etc
Typical selling price ex VAT	£70.00

One of the very few Japanese models possessing low effective mass, this fixed headshell arm compares with the fixed SME 3009 II in this respect. The shell is a rigid acrylic moulding of good acoustic resonant properties, but otherwise the arm is conventional, employing a thread and weighted lever bias compensator, a rotary counterweight with some decoupling via flexible bushing, and an arm lift integrated with the pillar.

On test we found very low friction; somewhat high biasing (reduce the indicated setting by 20%); moderately accurate downforce calibration (25% high); and good geometry. However, considering the price level we felt the overall standard of calibration should have been higher. The effective mass was confirmed as low, suited to cartridges up to 35cu—the only Japanese arm in the report capable of such matching. The arm was also found to be practically free of resonances, and on subjective sound quality was rated as very good.

Indication of magnitude and frequency of arm resonances

No visible resonances

General data

Type of headshell	fixed
Headshell mass	—
Geometrical accuracy	very good
Adjustments provided	height, tilt, overhang
Finish and engineering	excellent
Ease of assembly	very good
Ease of use	good
Trackability	very good
Hum level	— 70dB

Friction

Typical lateral	10mg
Typical vertical	10mg

Bias compensation (set to 1.5g elliptical)

Type of system	thread and lever
Rim	250mg
Centre	250mg

Downforce calibration error

1g	1.25%
2g	2.5%

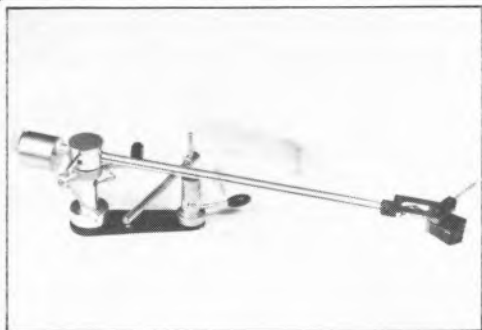
Compatibility

Effective moving mass excluding cartridge	5.6g
Match up these letters (ABCE/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	C
Damping rating	K
Recommended tracking weight	1.25-3g
Medium to high compliance cartridges suitable (15-35 cu)	

RECOMMENDED

Hadcock GH228

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



This UK built arm has the distinction of being one of the few separate arm designs reviewed in this report to gain a recommendation. A prime factor influencing this decision was the high sound quality, with other important aspects such as friction, biasing and general calibration all making an effective contribution.

However, we do have certain reservations, of a practical and engineering nature. While the design undeniably works well, it proved to be very difficult to set up, and could then be easily misaligned. This tends to put it into the enthusiasts' category, as it could prove problematical for the 'non technical' purchaser. The second point concerns the engineering and finish. At this price level, the two Japanese pick-up arms and the SME also reviewed, all offered fine standards of finish and accuracy, but this cannot be said of the Hadcock. We found poor or even rough finish on several components with odd sections just Araldited together; the use of plastic cable clips for the arm rest and a generally poor fit of both threaded and sliding parts. We feel that an improvement to both finish and operational quality could only benefit a pick-up arm possessing this high standard of sound quality.

General data

Type of headshell	fixed
Headshell mass	3.1g
Geometrical accuracy	very good
Adjustments provided	tilt, overhang
Finish and engineering	fair
Ease of assembly	difficult
Ease of use	fair
Trackability	very good
Hum level	-70dB

Friction

Typical lateral	<10mg
Typical vertical	25mg

90 Pick-up arms

Bias compensation (set to 1.5g elliptical)

Type of system	weighted lever
Rim	120mg
Centre	140mg

Downforce calibration error

1g	1.125%
2g	2.1%

Cue operation

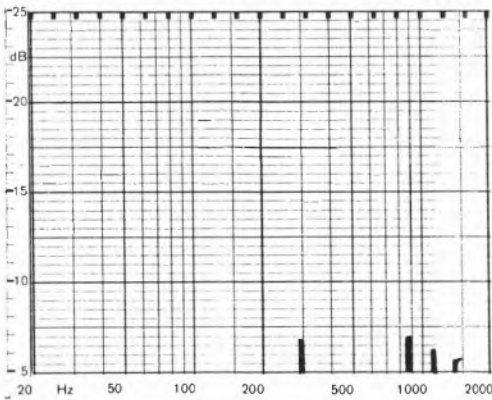
Drift	satisfactory
Ascent (8mm)	0.5secs
Descent (8mm)	2secs

Subjective sound quality very good

Motor recommended LP12, SP 10 II, DDX 1000, TD 12611, etc.

Typical selling price at VAT £40.00

Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 6.8g

Match up these letters (ABCE/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating C

Damping rating J,K,L

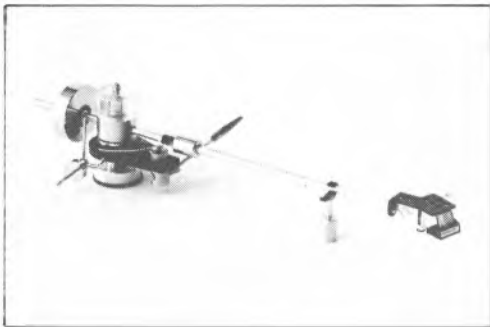
Recommended tracking weight 1.25-3g

Medium to high compliance cartridges recommended (15-30 cu)

RECOMMENDED

Formula 4 PLS4D mk II

Mayware Ltd., 15 Heather Walk, Edgware, Middlesex. 01-958 9421.



Trackability	very good	
Hum level	-70dB	
Friction		
Typical lateral	<10mg	
Typical vertical	<10mg	
Bias compensation (set to 1.5g elliptical)		
Type of system	thread coupled lever	
Rim	180mg	
Centre	170mg	
Downforce calibration error		
1g	1%	
2g	2%	
Cue operation		
Drift	fairly good	
Ascent (8mm)	0.5secs	
Descent (8mm)	2.5secs	
Subjective sound quality		good
Motor recommended		LP12, TD160/TD126, etc
Typical selling price ex VAT		£40.00

Manufactured in Japan for the UK company of Mayware, the Formula 4 arm contains elements of both British and Japanese design expertise. The prime objective was to reduce effective mass to a minimum and this has in fact been largely achieved. For example, using an AKG P8ES cartridge, the total effective mass is of the order of 13g which with a typical compliance of 30cu, gives a subsonic resonance at 8Hz. This is satisfactory for a medium to high compliance model, particularly with the provision of viscous silicone damping which also allows as much resonance control as may be needed, and will help to cope with even higher compliance cartridges such as the ADC XLM.

A thread and weighted lever bias compensation is fitted and the arm lift is integral with the single hole fixing pillar. The Formula 4 proved to be fairly easy to assemble and set up (for a unipivot), but the multiplicity of fine set screw adjustments and delicate alignments means that it is more suited to the experienced enthusiast rather than for family use. It was found to be well engineered and finished, with good lab results, and the subjective performance was rated as good.

It should be noted that this mk II version incorporates a rigid improved headshell structure of low resonance properties. The moderate mass and provision for a range of damping values suggests that this arm will work well with a variety of cartridges with compliance values from 12-40cu.

General data

Type of headshell	fixed
Headshell mass	N/A
Geometrical accuracy	very good
Adjustments provided	tilt, overhang, height
Finish and engineering	very good
Ease of assembly	fair
Ease of use	fairly good

Please note that the cartridge compliance recommendations in the 'best buys' section can be extended to the values quoted above.

Indication of magnitude and frequency of arm resonances

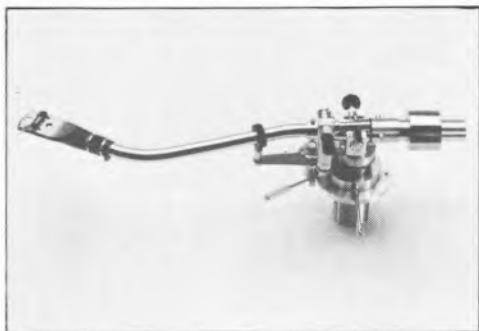
No visible resonances

Compatibility

Effective moving mass excluding cartridge	7-8g
Match up these letters (ABCE/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	C
Damping rating	K,L,M*
Recommended tracking weight	1.25 to 2g
Medium to high compliance cartridges suitable(12-40cu)	

Micro-Seiki MA 505

Tannoy Products Ltd., St Johns Rd., Tyers Green, High Wycombe, Bucks. 049 481 5221.



This visually complex arm is a rigid 'S' tube design with a universal detachable headshell. All the controls are integrated into the pedestal, and thus only one hole is required for fixing. Both tracking force and biasing controls have been arranged so that adjustment is possible while a cartridge is tracking, which facilitates their optimisation and is also ideal for cartridge testing! The engineering and operating quality of all the controls was judged to be excellent and the lateral outrigger was one of the very few examples with a substantial and resonance-free support bar.

The test results showed a fine performance. Biasing was free of friction, but tended to reduce towards the record centre; however, the values attained against the 1.5g dialled setting were quite satisfactory and were much nearer the correct value than for most other arms in the survey. With a 10g headshell, the effective mass was on the high side. This, together with the lack of damping, suggests the use of cartridges in the 8-15cu compliance range, although possibly a little higher if the cartridge itself is well damped. The arm was also essentially free of resonances, and the sound quality was judged to be of a high standard.

General data

Type of headshell	universal detachable
Headshell mass	10g
Geometrical accuracy	very good
Adjustments provided	height, tilt, overhang
Finish and engineering	excellent
Ease of assembly	very good
Ease of use	very good
Trackability	very good
Hum level	-70dB

Friction

Typical lateral	<10mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	lateral tensioner
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92 Pick-up arms

Rim	200mg
Centre	225mg

Downforce calibration error

1g	1%
2g	2%

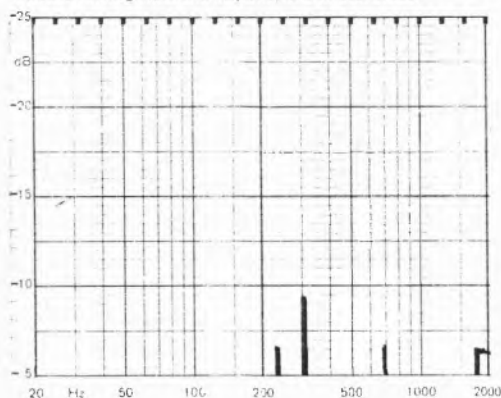
Cue operation

Drift	negligible
Ascent (8mm)	2secs
Descent (8mm)	4secs

Subjective sound quality	very good
Motor recommended	DDX1000, SP10II, Lux 131 etc

Typical selling price ex VAT	£90.00
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Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge	14-16g
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Match up these letters (ABCEJ/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

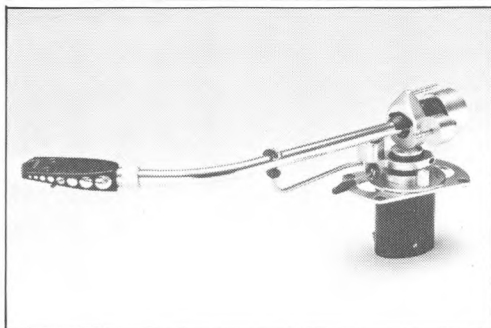
Resonance rating	A
Damping rating	J
Recommended tracking weight	1.25-3g

Low to medium compliance cartridges suitable (8-15 cu)

RECOMMENDED

SME 3009/2 improved

SME Ltd., Steyning, Sussex. 0903 814321.



Ease of assembly	very good
Ease of use	very good
Trackability	very good
Hum level	- 70dB

Friction	
Typical lateral	10mg
Typical vertical	15mg

Bias compensation (set to 1.5g elliptical)	
Type of system	pulley, thread and weight
Rim	300 mg
Centre	300mg

Downforce calibration error	
1g	1%
2g	2%

Cue operation	
Drift	poor
Ascent (8mm)	1sec
Descent (8mm)	7.5secs

Subjective sound quality fairly good
 Motor recommended Lux 131, SR370, TD160, TD126, etc.

Typical selling price ex VAT £35.00

This review covers both the detachable and fixed versions of the renowned SME improved arm; in the table, the results for the former are represented by the bracketed figures. Without doubt, the instructions were exemplary, allowing only moderately 'technical' people to set up and install what is certainly a fairly complex precision design.

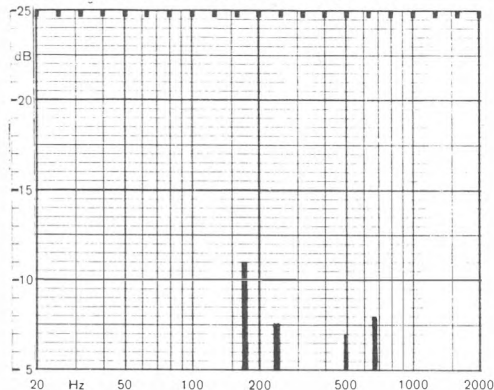
On engineering and finish the SME was judged to be faultless, but during the test programme we developed certain reservations concerning its subjective quality. These criticisms are not severe but are valid in the context of the attainable performance illustrated by other designs. The sound rating was only fairly good, which referred to the incidence of moderate low and mid-frequency colouration, some of which is reflected by the arm resonance graph. We suspect that both the lightweight headshell and the counterweight decoupling system are potential causes, the problem proving to be of significance with low compliance cartridges particularly the moving coil variety, rather than medium to high compliance cartridges.

The cue descent was very slow and exhibited lateral drift, but otherwise most of the measured parameters were excellent, bar biasing, which we regarded as being on the high side, and could be reduced by 40% or so. The fixed shell version offers low effective mass and the detachable model, medium mass, and the addition of an optional silicone filled damper which will shortly become available means that from the viewpoint of trackability this arm will then be compatible with almost any type of cartridge.

General data

Type of headshell	universal detachable (ND)
Headshell mass	5.5 (N, A) g
Geometrical accuracy	very good
Adjustments provided	tilt, height, overhang
Finish and engineering	excellent

Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge	8-10g (5.5-6.5g)
Match up these letters (ABCEJ/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	B(C)
Damping rating	J or L, M*
Recommended tracking weight	1.25 to 1.5g
Medium to high compliance cartridge suitable (10-25 cu) (20-45 cu)	

*D = Detachable shell, (ND = non detachable)

Pick-up arms 93

ADC Accutrac

BSR McDonald Ltd., Monarch Works, Powles Lane, Cradley Heath, Warley, Worcs. 0384 65191.



Vibration and shock resistance were barely adequate.

Considering the low level of performance attained by both test samples we felt that it would be unfair to comment on their subjective quality, and we can only hope that BSR can sort out the many problems we have experienced on their future production.

The first Accutrac sample was not without its problems, and these led to a complete retest of a second deck. Unfortunately, this resulted in continuing reservations concerning its performance.

Special features of this turntable include the use of the standard Matsushita direct drive motor with the usual stroboscope and variable speed facility. A cartridge is fitted—a special version of the ADC XLM with a photo electric sensor built in, and this was used for both the lab and the subjective test programmes. A highly complex and versatile remote control and track selection system is supplied as standard. This worked well, although some inexperienced users found it frustrating, as they were put off by the slowness of the automatic mechanism, interpreting this as their own failure to operate it correctly.

The test problems encountered with the two samples were different, and largely concerned the cartridge. The specification states the arm/cartridge resonance to be 8-10Hz which was attained by the low compliance stylus fitted to the second deck. Also, the second cartridge gave the reasonable wow and flutter and rumble figures shown in the table but unfortunately its trackability was severely impaired; the +15dB 300Hz test band required a 1.1g downforce as compared with the 0.5g measured using the first sample, which had the high compliance stylus. In addition, the second sample showed poor separation—below 20dB—which is a disappointment considering the price level.

With both decks it was found that the sprung plinth section was adjusted to resonate at too high a frequency, namely 6.8Hz, and this further undermined the stability of the record platform. Both samples also exhibited a high level of hum breakthrough, plus induced mains frequency vibration attributed to the power transformer.

MOTOR

General data

Type	Fully automatic direct drive
Platter mass	1.35kg
Platter damping	good
Finish and engineering	good
Type of mains lead	two core
Type of connecting lead	phono + earth

Speed

Speeds offered	33 1/3, 45 rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.06%
Absolute speed accuracy error	<0.1%
Speed drift	<0.1%
Speed variation under load	-0.3%
Start-up time to audible stabilisation	3.5secs

Rumble

DIN B weighted L and R average	-66dB*
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ARM

General data

Type of headshell	fixed
Headshell mass	—
Geometrical accuracy	good
Adjustments provided	overhang*
Finish and engineering	good
Ease of assembly	very good
Trackability	—*

Friction

Typical lateral	<15mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	—
Centre	—

Downforce calibration error

1g	1.05g
2g	2.1g

Cue operation

Drift	negligible
Ascent (8mm)	1.0secs
Descent (8mm)	1.0secs

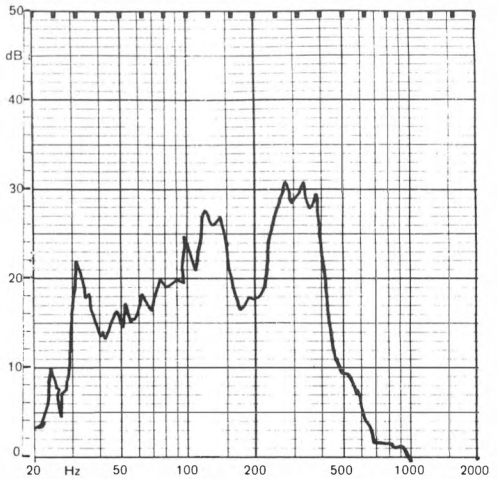
MOTOR AND ARM DATA

Size	474W x 435D x 147Hmm
Clearance for lid	x 86mm
Overall weight	9kg
Ease of use	good*

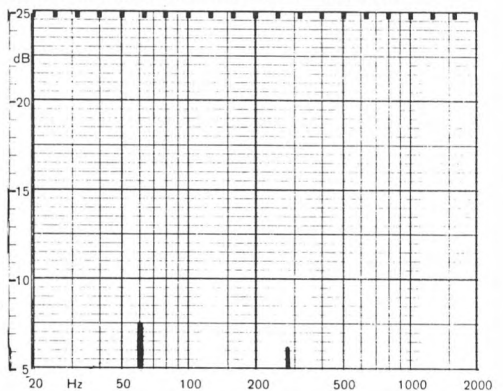
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	—*
Hum level	-55dB
Acoustic feedback	good
Vibration sensitivity	adequate

Arm obtainable separately	no
Typical selling price ex VAT	£230.00 inc cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge fixed
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating	—
Damping rating	—
Recommended tracking weight	1.5-3.0g

*see text

Akai AP001

Rank Audio Products Ltd., P O Box 70, Great West Rd., Brentford, Middlesex. 01-568 9222.



Akai are best known for their cassette and reel to reel tape machines, but in recent years their range has been extended to include receivers, amplifiers, tuners and record decks. The AP-001 is a modestly priced example, incorporating a belt drive system and an automatic arm lift at the end of the record side. A spring suspension system is fitted, which isolates the lower deck from the upper moulded plastic plinth section, but this model does not fully exploit the floating sub-chassis technique.

The instructions were rather sparse and did not mention the bias setting. This was a lever operated mechanism with no provision for adjustment. The values provided were judged to be suitable for tracking downforces in their range 1.5 to 2.0g, and the matching cartridge should be chosen with this in mind. The effective mass is compatible with cartridge compliance values in the 10-20cu range.

On test, the Akai was found to run fast by some 1.2%, and while this is unlikely to trouble most users, it could so easily be better. Load stability was good, indicating a powerful drive system, which was confirmed by the fast start-up time. The wow and flutter reading was exceptionally good and in fact rivalled the best of the direct drive models in the report.

The rumble reading was satisfactory at -64dB and some mild motor hum was audible at very high listening levels. The arm gave a fairly reasonable performance with moderate friction, and the cue control was effective. One point which caused concern was the dynamic balance or 'outrigger' weight which was quite sizeable and suspended on a thin bar. These assemblies are inclined to resonate if poorly designed; at best they may introduce colouration and at worst they may cause the cartridge to mistrack at certain frequencies. Some of the arm resonances plotted are more than likely due

to the effect of this outrigger.

Acoustic breakthrough was fairly good, feedback resistance reasonable and vibration or shock susceptibility adequate. However, listening tests did not favour this model, the main problems believed to be associated with resonances in the plastic deck and pick-up arm.

In common with a number of other basically well engineered turntables in the report, the Akai lacks the small but important design points which make the difference between an ordinary sounding deck and one which offers a much cleaner and more satisfying subjective quality. As other models illustrate, these details need not be costly.

MOTOR**General data**

Type	Belt drive, manually operated with auto-stop
Platter mass	1.05kg
Platter damping	good
Finish and engineering	good
Type of mains lead	three core
Type of connecting lead	phono plus earth wire

Speed

Speeds offered	33 $\frac{1}{3}$, 45 rpm
Fine speed control	no
Wow and flutter (DIN peak weighted)	0.03%
Absolute speed accuracy error	+1.2%
Speed drift	none
Speed variation under load	-0.2%
Start-up time to audible stabilisation	1secs

Rumble

DIN B weighted L and R average	-64dB
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ARM**General data**

Type of headshell	Universal Detachable
Headshell mass	8.0g
Geometrical accuracy	good
Adjustments provided	height and overhang
Finish and engineering	good
Ease of assembly	fairly good*
Trackability	fairly good

Friction

Typical lateral	50mg
Typical vertical	50mg

Bias compensation (set to 1.5g elliptical)

Type of system	weighted lever*
Rim	200mg
Centre	200mg

Downforce calibration error

1g	1.05g
2g	2.15g

Cue operation

Drift	negligible
Ascent (8mm)	1sec
Descent (8mm)	3secs

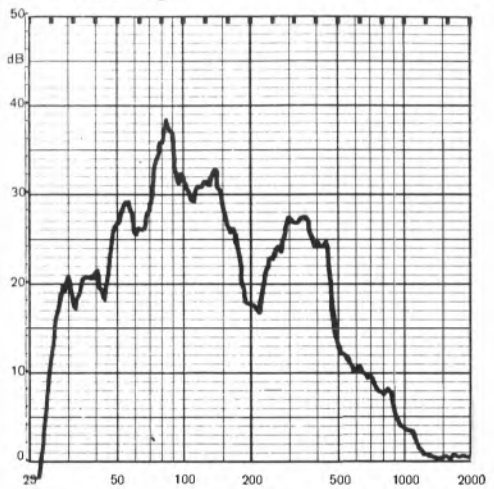
MOTOR AND ARM DATA

Size	440W x 350D x 140Hmm
Clearance for lid	45mm
Overall weight	6.3kg
Ease of use	good

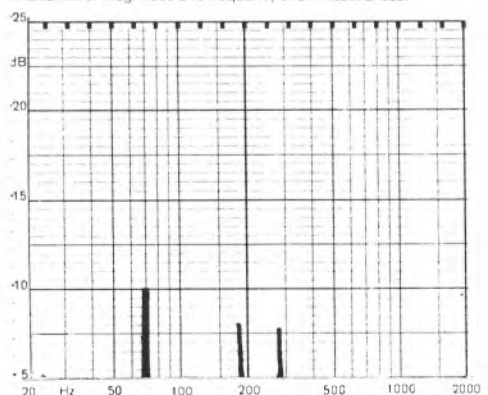
Typical acoustic breakthrough and resonances	fair
Subjective sound quality of complete system	below average
Hum level	-70dB
Acoustic feedback	good
Vibration sensitivity	adequate

Arm obtainable separately	no
Typical selling price ex VAT	£60.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.

**Compatibility**

Effective moving mass excluding cartridge	11-12g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	B
Damping rating	J
Recommended tracking force range	1.5-2.0g

Low to medium compliance cartridges suitable.

*see text

Amstrad TP12D

Amstrad Ltd., 89 Ridley Rd., Dalston, London E8. 01-249 5237.



An inexpensive turntable using a UK motor section and a Japanese arm, power is provided by a small 16 pole synchronous motor driving the three lobe vestigial platter via a rubber cord. I presume that the platter was chosen on visual rather than acoustic grounds, as it is distinctly disadvantageous from a sound quality point of view in comparison with a conventional flat platter. Speed change is by hand, shifting the drive cord from one section of the pulley to another.

The arm, which is quite versatile, comes with a fairly heavy 10g detachable headshell, (although specified as lightweight) and has a range of bias settings on a thread and weight system. The instructions were clear and helpful.

A few minor problems were encountered. The arm was not mounted at the correct distance from the platter so that the alignment of a standard cartridge was not possible, even using the full overhang adjustment provided on the headshell. We were unable to obtain very low hum levels despite trying out various earthing arrangements. More seriously, when first measured, the TP12D returned a high (0.3%) DIN peak weighted wow and flutter result. This was poorer than the 0.1% specified, even allowing for the rms unweighted reading technique used by the manufacturer. The unweighted rumble figure at -35dB was also worse than spec, the latter quoting -47dB . Accordingly, we contacted Amstrad about our findings. The main bearing was assumed to be the cause of the trouble, as a grinding noise could be heard coming from it as the platter was rotated, and we were eventually supplied with a new platter and main bearing unit which we fitted to the deck. Unfortunately, the results were similar to those obtained from the original unit. Moderate loading slowed the motor significantly, (-1.53%) and wow could be heard

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during the listening tests. Once the optional accessory foam rubber feet (2 per leg) were fitted, then the sound quality (bar rumble) was considered fairly good for the price.

On test, the arm gave quite reasonable friction levels, accurate downforce calibration and rather high bias; we suggest that cartridges in the 8-15cu range are suitable, tracking at between 1.5-3.0g.

Although the supplied TP12D was unsatisfactory, if a little more care was taken with the design and manufacture of the motor side, a much better performance could be obtained.

MOTOR

General data

Type	Belt drive, manual
Platter mass	0.75kg
Platter damping	poor
Finish and engineering	fairly good
Type of mains lead	2 core
Type of connecting lead	DIN

Speed

Speeds offered	33 $\frac{1}{3}$, 45 rpm
Fine speed control	no
Wow and flutter (DIN peak weighted)	0.3%
Absolute speed accuracy error	+1.2%
Speed drift	none
Speed variation under load	-1.53%
Start-up time to audible stabilisation	1.5secs

Rumble

DIN B weighted L and R average	-48dB
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ARM

General data

Type of headshell	Universal Detachable
Headshell mass	10g
Geometrical accuracy	poor*
Adjustments provided	overhang
Finish and engineering	fairly good
Ease of assembly	good
Trackability	fairly good

Friction

Typical lateral	50mg
Typical vertical	35mg

Bias compensation (set to 1.5g elliptical)

Type of system	thread and weight*
Rim	200mg
Centre	300mg

Downforce calibration error

1g	0.925g
2g	1.85g

Cue operation

Drift	satisfactory
Ascent (8mm)	1.5secs
Descent (8mm)	<1secs

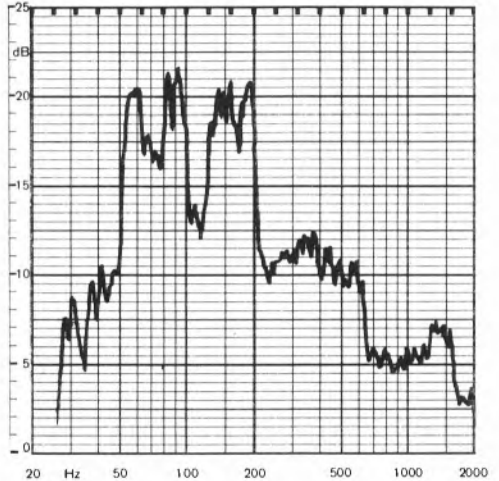
MOTOR AND ARM DATA

Size	444W x 366D x 125Hmm
Clearance for lid	70mm
Overall weight	5.0kg
Ease of use	fairly good

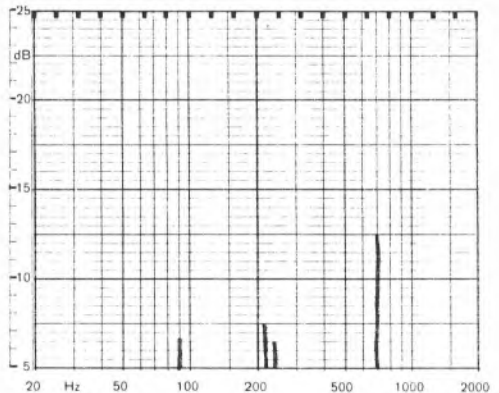
Typical acoustic breakthrough and resonance	average*
Subjective sound quality of complete system	average*
Hum level	-50dB
Acoustic feedback	fairly good
Vibration sensitivity	adequate*

Arm obtainable separately	no
Typical selling price ex VAT	£40.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge	16.18g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	

Resonance rating	A
Damping rating	J
Recommended tracking weight	1.5-3g

Low to medium compliance cartridges suitable (8-15cu)

*see text

Ariston RD11E

Ariston Audio Ltd., P O Box 13, Irvine, Ayrshire, Scotland. 0294 75211.



The Ariston brand name possesses a chequered history which has not been helped by the recent placing in receivership of its parent company, Dunlop Westayr. However, at the time of going to press, it is rumoured that a backer is contemplating the purchase of the Ariston division and will continue the line.

A one-piece platter is employed which carried a vestigial type mat; two thin circular rubber ribs are all that are provided to support the record. In consequence, neither the platter nor record can be effectively 'deadened' in acoustic terms, and I would strongly recommend the manufacturer to substitute a conventional rubber mat. Drive power is provided by a small DC motor with two speeds and fine variable control. A mirror type stroboscope is incorporated, the markings applied to the underside of the platter. The turntable is also available without arm at a reduced cost, the 'E' suffix denoting the incorporation of a conventional Japanese tone arm made by Jelco, to which Ariston have added a special photo electric motor stop feature at the end of the record side. The arm however does not automatically lift off.

On unpacking the deck, we were disappointed to find traces of rust on the bearing spindle, which could adversely affect both the rumble figures and bearing life. Under test, the motor returned only a reasonable performance. The start up was slow, the speed loss under moderate loading significant and the wow and flutter acceptable. Over 0.3% of speed drift was noted in the first hour, which although not excessive, is poorer than most electronic turntables.

The arm proved quite respectable on test, with low friction values, reasonably accurate downforce calibration and approximately correct bias forces. The cue rate was fine, but the arm tended to drift laterally on descent.

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Judged to be fairly good on acoustic breakthrough and resonances, the hum level was fine and the feedback rejection very good. The suspension was however considered to be overdamped, this endowing the unit with a poor resistance to external shock and low frequency vibration.

Using the reference cartridge, subjective testing ranked this model as reasonable for the price, but overall, we felt that the design was capable of better results if some attention were paid to a few details, notably the platter and the main bearing finish.

MOTOR

General data

Type belt drive with auto-stop
 Platter mass 2.0kg
 Platter damping poor
 Finish and engineering good*
 Type of mains lead two core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.11%
 Absolute speed accuracy error <0.1%
 Speed drift +0.33%
 Speed variation under load -0.41
 Start-up time to audible stabilisation 4secs

Rumble

DIN B weighted L and R average -66dB

ARM

General data

Type of headshell Universal Detachable
 Headshell mass 8g
 Geometrical accuracy fairly good*
 Adjustments provided overhang
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 20mg
 Typical vertical 10mg

Bias compensation (set to 1.5g elliptical)

Type of system thread and weight
 Rim 200mg
 Centre 200mg

Downforce calibration error

1g 0.925g
 2g 1.85g

Cue operation

Drift poor
 Ascent (8mm) 1secs
 Descent (8mm) 2secs

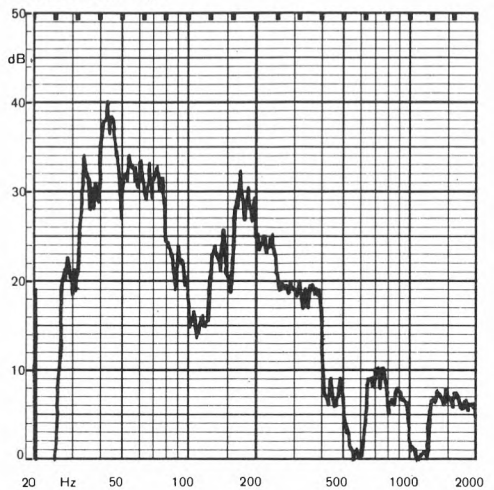
MOTOR AND ARM DATA

Size 450 W x 355 D x 170 H mm
 Clearance for lid approx 80mm
 Overall weight —
 Ease of use good

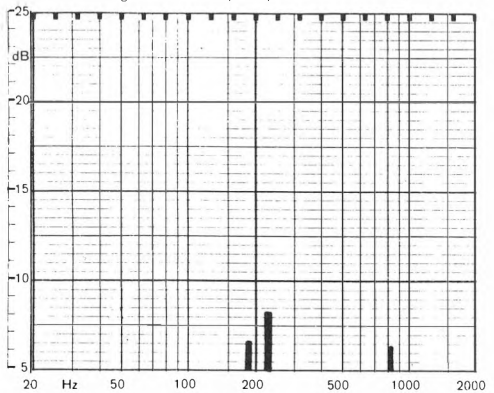
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system average
 Hum level -68dB
 Acoustic feedback very good
 Vibration sensitivity adequate

Arm obtainable separately no*
 Typical selling price ex VAT £110.00 inc arm

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



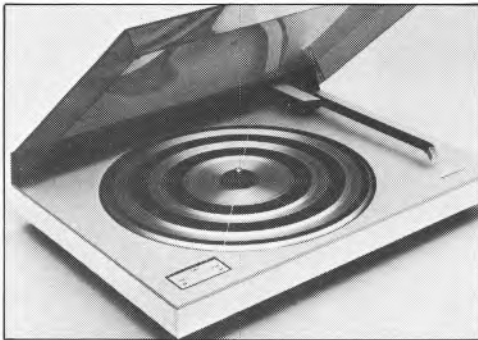
Compatibility

Effective moving mass excluding cartridge 16-18g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A
 Damping rating J
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges required (8-15cu)

*See text

Beogram 1902

Bang and Olufsen (UK) Ltd., Eastbrook Rd., Gloucester, GL4 7DE. 0452 21591.



Instantly recognisable as B&O, this superbly styled turntable possesses a very low profile only 86mm high, with the lid hinges contained within the plinth dimension. Thus no rear overhang is required for lid elevation. It features an integrated arm/cartridge design where the customary headshell has been eliminated, leaving the MMC4000 cartridge supplied to plug directly into the reduced mass arm. Despite the latter's fairly high compliance, the resonance of the combination was placed at an ideal 12.0Hz, which makes the essential moving mass inclusive of cartridge a remarkably low 6.5g. This was undoubtedly the lowest value for the whole turntable group, bar that for the 1902's big brother, the 4002.

A single press control is responsible for all functions including cue, pause, speed selection, reject and start, the mode engaged depending on which part of the plate is depressed and what mode was previously engaged. The automatics were rapid and positive in action, a complete record engagement from 'rest' being possible in a matter of seconds.

Inspection of the construction showed it to be to a high standard although some parts looked rather frail. On test, good results were obtained from the motor section; rumble was low, as was wow and flutter, and although the running speed was fast, it was not unduly so. The deck exhibited moderate slowing under load which was considered to be inconsequential, since only low drag, low tracking force cartridges may be fitted to the arm. Start-up time was rapid at under 1 second.

The arm had higher friction values than we would have liked, but they were still quite satisfactory for the supplied cartridge, tracking at around 1.25g. The downforce calibration was spot on. No drift was detectable on the cue, and the cue rate was

commendably swift although it retained full control.

Two minor problems were encountered. These concerned the small stick-on felt pads for the feet which tended to become detached, and the fact that although electrical hum was low, vibrational hum could be heard from the mains transformer. On acoustic breakthrough and resonances, however, the 1902 was classed as good. It possessed very good immunity to external shock and vibration, and good resistance to acoustic feedback. The pressed alloy platter was minimally damped and although it did provide some protection for an inadvertently lowered stylus, we felt that a conventional rubber mat would further improve the sound quality.

In the listening tests, this model was classed as above average using the MMC4000 cartridge and considering the unique combination of features offered, the total package must therefore be classed as good value for money.

MOTOR

General data

Type automatic belt drive, integrated cartridge/arm
 Platter mass 0.8kg
 Platter damping fairly poor
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead DIN

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.04%
 Absolute speed accuracy error +0.67%
 Speed drift - %
 Speed variation under load -0.33%
 Start-up time to audible stabilisation 0.8secs

Rumble

DIN B weighted L and R average -69dB

ARM

General data

Type of headshell interchangeable cartridge
 Headshell mass -
 Geometrical accuracy good
 Adjustments provided none
 Finish and engineering very good
 Ease of assembly fairly good
 Trackability good

Friction

Typical lateral 80mg
 Typical vertical 40mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 200mg
 Centre 200mg

Downforce calibration error

1g 1.0g
 2g 2.0g

Cue operation

Drift negligible
 Ascent (8mm) 0.5secs
 Descent (8mm) 1sec

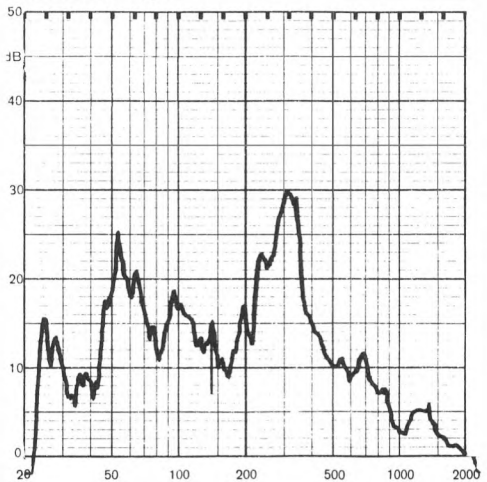
MOTOR AND ARM DATA

Size 438 W x 327 D x 86 H mm
 Clearance for lid none
 Overall weight -
 Ease of use excellent

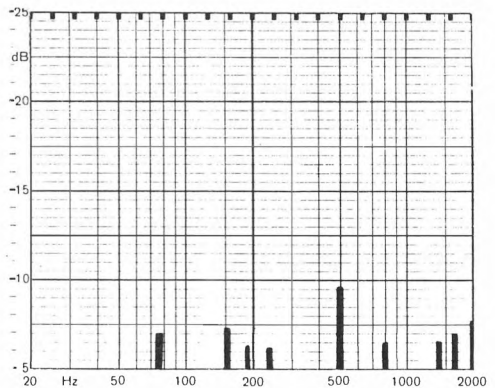
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system above average
 Hum level -70dB
 Acoustic feedback good
 Vibration sensitivity very good

Arm obtainable separately no
 Typical selling price ex VAT £125.00 inc MMC4000 cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 2-3g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating D
 Damping rating K
 Recommended tracking weight 1.25-2g
 Medium to high compliance cartridges suitable (25-40cu)

Beogram 4002

Bang and Olufsen (UK) Ltd., Eastbrook Rd., Gloucester, GL4 7DE. 0452 21591.



The B&O 4002 represents a highly complex turntable with a top class, parallel tracking, integrated pick-up arm. The system provides various automatic facilities including record size and presence detection, two speed traverse, power operated cueing, plus auto return and stop. When a disc is placed on the platter, a photo electric sensor in the arm detects its presence due to the obstruction of the radial bars on the platter surface.

All these facilities worked flawlessly in our sample, and B&O are also to be congratulated for not neglecting other vital aspects such as a fully floating sub-chassis system, and the optimisation of the cartridge/arm interface. The total moving mass of the arm worked out at 5.5g inclusive of cartridge, leaving the contribution of the arm itself at a mere 1.5g or so.

The same MMC4000 cartridge is fitted to both this and the other B&O model in the report, and this allowed a ready comparison to be made of the two models. We could find very little to distinguish between the 4002 and its cheaper brother the 1902, and hence purchasers must consider very carefully the true worth of the extra 4002 features—a particularly pertinent point, since the 1902 is in any case fully automatic at almost one third the cost of the 4002.

On test, the deck ran 1% slow, which would probably go unnoticed by most users, but is excessive considering the price level. Wow and flutter was very low but the rumble level was poorer than that of the 1902 at -67dB, and proved to be just audible when used with a wide dynamic range system at high levels.

The arm was found to have astonishingly low mass and yet showed no sign of impaired rigidity. Friction was very low and the downforce calibration

accurate. The cue device operated flawlessly, with speed and precision.

The 4002 was one of the few decks in the report to achieve 'very good' ratings for acoustic breakthrough and resonances, plus vibration resistance, shock rejection and acoustic feedback. As with the 1902, the subjective sound was rated above average for the group. However, we felt the sound quality could be further improved if a good quality rubber mat of high vibration absorption qualities were fitted, instead of the hard plastic bars currently used; the photo electric sensing pattern could continue in the form of a printed pattern, or possibly by arranging the mat in the form of radial lobes.

MOTOR

General data

Type	belt drive automatic with integrated cartridge
Platter mass	1.4kg
Platter damping	poor
Finish and engineering	very good
Type of mains lead	two core
Type of connecting lead	DIN

Speed

Speeds offered	33½, 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.035%
Absolute speed accuracy error	-1%
Speed drift	-½%
Speed variation under load	-0.1%
Start-up time to audible stabilisation	1secs

Rumble

DIN B weighted L and R average	-67dB
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ARM

General data

Type of headshell	integrated cartridge
Headshell mass	-g
Geometrical accuracy	very good
Adjustments provided	none required
Finish and engineering	very good
Ease of assembly	fairly good
Trackability	very good

Friction

Typical lateral	<20mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	none required
Rim	-mg
Centre	-mg

Downforce calibration error

1g	1.0g
2g	-g

Cue operation

Drift	negligible
Ascent (8mm)	<0.2secs
Descent (8mm)	0.5secs

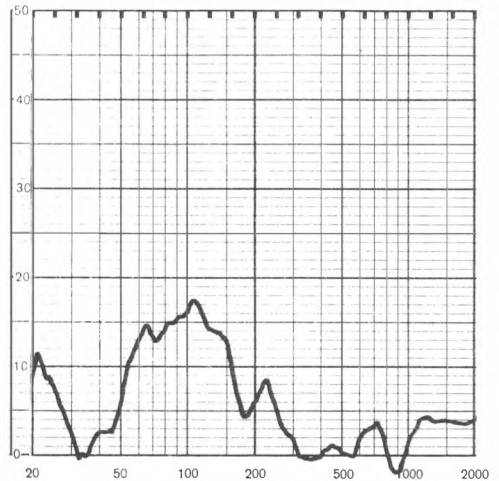
MOTOR AND ARM DATA

Size	486 W × 380 D × 97 H mm
Clearance for lid	zero
Overall weight	11kg
Ease of use	excellent

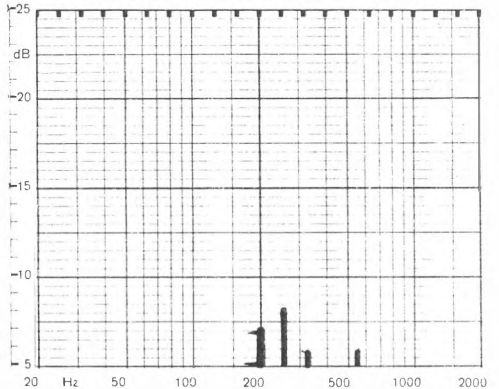
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	above average
Hum level	-70dB
Acoustic feedback	very good
Vibration sensitivity	very good

Arm obtainable separately	no
Typical selling price ex VAT	£320.00 inc MMC4000 cart

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 1.5g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating D

Damping rating K

Recommended tracking weight 1.1-1.5g

Suitable for high and very high cartridge compliance (25-50cu)

BSR BDS80

BSR McDonald Ltd., Monarch Works, Powles Lane, Cradley Heath, Warley, Worcs. 0384 65191.



One of the least expensive turntables in the report, the BDS80 is normally supplied with an ADC K7E cartridge, and may be obtained with phono or DIN leads. Ours had phonos, and no separate earth wire was provided. Mains supply is via a two core cable, indicating a double insulated construction, and because the chassis earth was joined to one of the signal earths, it was not found possible to obtain low hum levels. This problem was common to the other decks employing the same type of wiring, including several of the European turntables and the other BSR model, the BDS95. The operation of the control levers was rather stiff but it must be stated that they operated correctly, and the presence of an auto mechanism in a belt drive deck at this price level is an achievement in itself.

Start-up on the motor section was rapid; wow and flutter was quite low, with speed accuracy very good and moderate slowing under load. The rumble level was reasonable considering the price level, but strictly speaking was not quite to a hi-fi standard, since both motor vibration and background hum were audible at fairly high listening levels.

The arm gave accurate downforce values with fairly high friction, and was judged to be compatible with cartridges tracking in the 2-4g range. Bias was rather high; values of about half those measured are suitable and could be obtained by undersetting the dial by some 50%. The cueing device showed negligible lateral drift and the ascent and descent rates were quite rapid, without running out of control. The headshell on this deck was fixed, and a push fit, plastic slider attaches the cartridge to the headshell. No provision for alignment is made so that any other cartridge which might be fitted must conform to the standard stylus tip-to-fixing centre spacing; fortunately, this includes the models from such manufacturers as ADC, Audio Technica,

Ortofon, Philips and Shure.

Breakthrough and resonances were classed as fairly good and susceptibility to shock and vibration were both reasonable. The performance of the supplied cartridge is believed to be broadly similar to the ADC QLM series, (represented by the QLM 36 II in the cartridge section) and using the K7E, subjective testing rated the sound quality as average, which is undoubtedly a good result considering the price level.

MOTOR**General data**

Type	belt drive automatic and manual
Platter mass	1.425kg
Platter damping	fair
Finish and engineering	fairly good
Type of mains lead	two core
Type of connecting lead	phonos or DIN

Speed

Speeds offered	33 1/3 & 45rpm
Fine speed control	no
Wow and flutter (DIN peak weighted)	0.07%
Absolute speed accuracy error	+0.13%
Speed drift	none
Speed variation under load	-0.37%
Start-up time to audible stabilisation	1sec

Rumble

DIN B weighted L and R average	-55dB
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ARM**General data**

Type of headshell	BSR slide carrier
Headshell mass	—
Geometrical accuracy	good
Adjustments provided	none*
Finish and engineering	good
Ease of assembly	good
Trackability	fairly good

Friction

Typical lateral	150mg
Typical vertical	25mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	210mg
Centre	420mg

Downforce calibration error

1g	1.05g
2g	2.1g

Cue operation

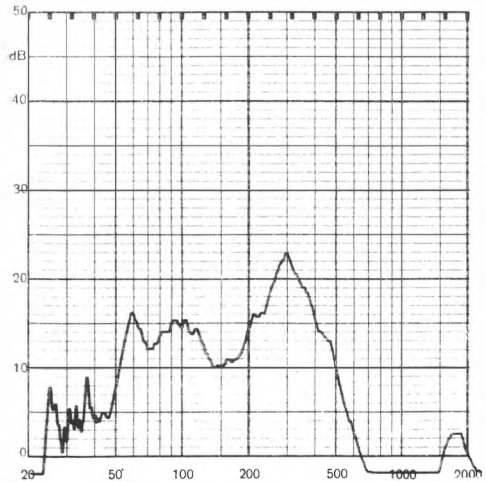
Drift	negligible
Ascent (8mm)	0.4secs
Descent (8mm)	0.6secs

MOTOR AND ARM DATA

Size	451 W x 383 D x 170 H mm
Clearance for lid	92mm
Overall weight	—
Ease of use	good

Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	average
Hum level	-56dB
Acoustic feedback	good
Vibration sensitivity	good

Arm obtainable separately	no
Typical selling price ex VAT	£27.00 inc cartridge K7E

Acoustic breakthrough.

Indication of magnitude and frequency of arm resonances.

No visible resonances**Compatibility**

Effective moving mass excluding cartridge	12-16g*
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	B
Damping rating	J
Recommended tracking weight	2.4g
Low to medium compliance cartridges suitable (10-20cu)	

*See text

BSR BDS95

BSR McDonald Ltd., Monarch Works, Powles Lane, Cradley Heath, Warley, Worcs. 0384 65191.



Our sample of the BDS95 was not without its problems, and although we felt that they could have been spotted by basic quality control tests we have good reason to assume that they were atypical. One problem concerned the audio connecting leads which had an open circuit earth wire on one channel, with the left/right colour coding also reversed. The second difficulty concerned the platter which was slightly off-centre and gave a wow and flutter figure higher than its cheaper brother, the BDS80, although it should be stressed that the result was still acceptable.

In theory, the BDS95 offers a more luxurious presentation and improved performance by comparison with the BDS80. It is supplied with an ADC K5E cartridge fitted in the tubular arm which has a rotating cylindrical type counterweight with some decoupling. Rumble was in fact 5dB better than with the BDS80 at about the average level for this price range; wow and flutter has already been mentioned and was satisfactory at 0.13% DIN peak weighted, but was just audible on listening tests. The motor ran close to the correct speed but the platter slowed a significant 0.5% under the test loading.

Fairly high friction levels were noted on the arm in both planes, suggesting minimum tracking forces around 2g, and the level of bias compensation was judged to be excessive at 450-500mg, this being three times the ideal value. Setting the scale at $\frac{1}{3}$ of the required value would thus achieve the correct result, but most bias compensators do not work properly on dialled settings below 1g and so this subterfuge may not be effective. On the plus side, the downforce calibration proved accurate and the cue action was well controlled, fast and free of drift. Using the supplied cartridge the ADC K5E, the arm resonance was poorly defined and centred around 108 Integrated turntables

12Hz, giving an estimated effective mass in the medium range, 8-10g.

Due to the earthing arrangements, we found it impossible to obtain satisfactorily low hum levels. Acoustic breakthrough and resonance levels were classed as good, subjective sound quality (using the reference cartridge) a fraction below average and hence reasonable at the price. However, acoustic feedback and vibration resistance levels were only classed as adequate—in fact, poorer than for the cheaper BDS80.

MOTOR**General data**

Type bell drive automatic and manual
 Platter mass 1.6kg
 Platter damping fairly good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead phonos, no earth wire

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.13%
 Absolute speed accuracy error -0.2%
 Speed drift none
 Speed variation under load -0.5%
 Start-up time to audible stabilisation 1.5secs

Rumble

DIN B weighted L and R average -60dB

ARM**General data**

Type of headshell BSR special slide carrier
 Headshell mass
 Geometrical accuracy fair*
 Adjustments provided none
 Finish and engineering good
 Ease of assembly good
 Trackability fairly good

Friction

Typical lateral 200mg
 Typical vertical 110mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 500mg
 Centre 450mg

Downforce calibration error

1g 1.05g
 2g 2.1g

Cue operation

Drift negligible
 Ascent (8mm) 0.5secs
 Descent (8mm) 0.75secs

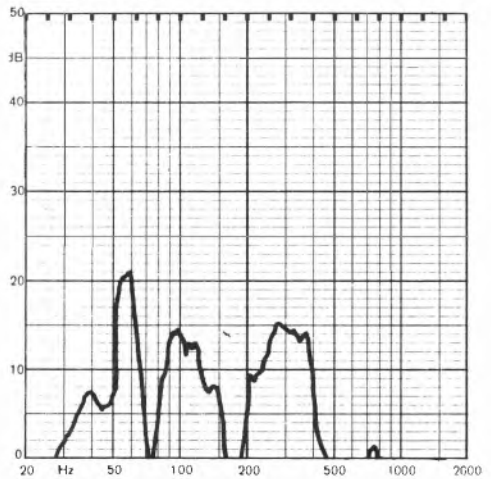
MOTOR AND ARM DATA

Size 448 W x 380 D x 168 H mm
 Clearance for lid 92mm
 Overall weight
 Ease of use good

Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system average*
 Hum level -52dB
 Acoustic feedback adequate
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £35.00 inc K5E cartridge

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances

No visible resonances**Compatibility**

Effective moving mass excluding cartridge 8-10g*
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating C
 Damping rating K
 Recommended tracking weight 2-4g
 Medium compliance cartridges recommended (15-25cu)

*See text

Connoisseur BD2A

A R Sugden Ltd., Market Street, Brighouse, Yorks. 0484 71 2142.



Connoisseur express their philosophy as 'simplicity at a reasonable cost' and the BD2A amply bears this out. This long established design has been available for some years now and has undergone continuous improvement. For example, the speed change used to be finger operated, transferry the rubber drive cord from one pulley step to another, but it is now under push button control. The 'A' suffix denotes the use of a magnetic reed switch operated solenoid, which provides automatic lift off and stop at the end of a record side. (Both the motor section and the arm are available separately as the BD1 and SAU2, and the BD2 may also be obtained as a chassis unit without plinth or cover.)

On test, the wow and flutter was classed as acceptable, with good absolute speed, accuracy and tolerance to loading. The start-up time was fairly quick at 1.5 seconds, aided no doubt by the unique 'flick start' lever. A satisfactory weighted rumble figure was obtained and the induced hum level was in practice reasonable, although poorer than average, and it tended to increase towards the inner grooves. The arm showed some friction which Connoisseur suggest is not typical; it could in any case be readily adjusted by a dealer. However, the test sample values did make it more difficult to assess both the bias and the downforce calibration accuracy, especially since this arm employs inclined bearing gimbals. With the large bias weight the bias values were rather high, and the smaller alternative gave figures nearer the norm. Tracking below 1.5g is not recommended. The supplied downforce scales were apparently inaccurate, for we obtained values about 17% low, and if this sample is typical, then the user should set the downforce on the high side to compensate.

The cue was found to be effective with a reasonable descent rate for our 8mm test cue drop.

The effective arm mass was estimated at 7.9g despite the fairly heavy 7g plastic headshell. Clearly, the counterweight decoupling has some effect, and the arm will work with fairly compliant cartridges.

Acoustic breakthrough levels were fairly good, particularly above 400Hz, and the arm did not exhibit any significant resonances on test. The rubber feet are, however, only mildly effective in suppressing internal vibration.

Subjective testing placed the sound quality of this model around the average level, with no unpleasant characteristics. Considering that its price was about one third that of the average for the group, this is a very fine result.

Note: This turntable is also available without the automatic lift-off for about £5 less and is thus even better value for money.

MOTOR

General data

Type manual belt-drive with end of side lift off
 Platter mass 1.25kg
 Platter damping fairly good
 Finish and engineering fairly good
 Type of mains lead two core
 Type of connecting lead 'phono' plus earth or DIN optional

Speed

Speeds offered 33 $\frac{1}{3}$, 45 rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.14%
 Absolute speed accuracy error -0.2%
 Speed drift none
 Speed variation under load -0.3%
 Start-up time to audible stabilisation 1.5secs

Rumble

DIN B weighted L and R average -65dB

ARM

General data

Type of headshell none standard, interchangeable
 Headshell mass 7.0g
 Geometrical accuracy good
 Adjustments provided Height, but not vertical angle
 Finish and engineering fair
 Ease of assembly fair
 Trackability fairly good

Friction

Typical lateral 75mg
 Typical vertical 100mg

Bias compensation (set to 1.5g elliptical)

Type of system offset weight on gimbal
 Rim 300mg
 Centre 300mg*

Downforce calibration error

1g 0.825g
 2g 1.8g

Cue operation

Drift negligible
 Ascent (8mm) 0.5secs
 Descent (8mm) 3.0secs

MOTOR AND ARM DATA

Size 458W x 381D x 142Hmm
 Clearance for lid 42mm
 Overall weight
 Ease of use fairly good

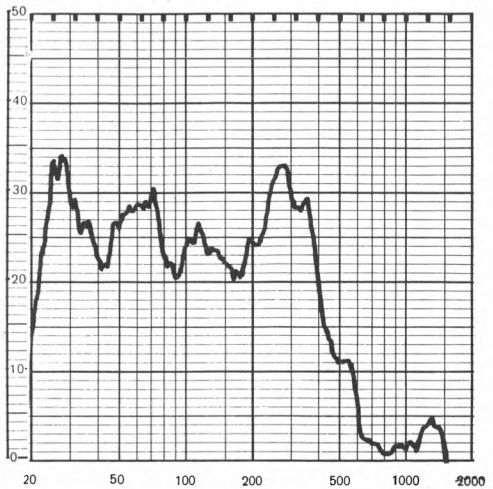
Typical acoustic breakthrough and resonances

Subjective sound quality of complete system good
 Hum level -62dB
 Acoustic feedback adequate
 Vibration sensitivity adequate

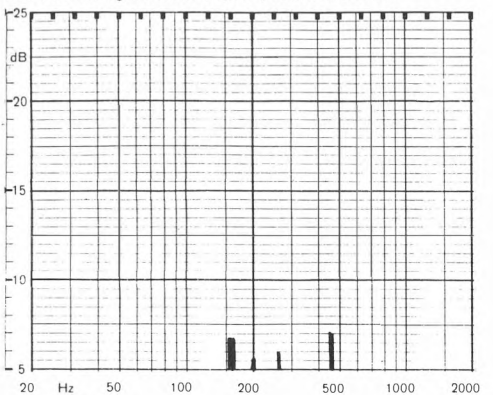
Arm obtainable separately

..... yes, SAUZ without auto-lift
 Typical selling price ex VAT £45.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

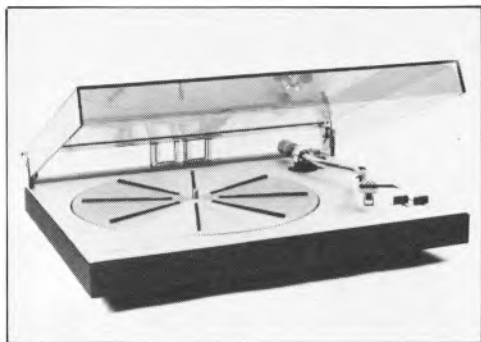
Effective moving mass excluding cartridge 6.8g decoupled
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating C
 Damping rating L
 Recommended tracking weight 1.5-3.0g

Suitable for medium compliance cartridges

* see text

Dansk SD 1702

Plustronics Ltd., Hempstalls Lane, Newcastle, Staffs. 0782 615131.



This manual, belt drive turntable is unusual in that variable speed control is provided at $33\frac{1}{2}$ rpm with a matching mains frequency driven stroboscope. The styling is typically 'Scandinavian' with a low profile and an uncluttered, brushed metal deck plate.

Instead of a rubber mat, the platter is provided with radial plastic bars, which I do not favour on two counts. Firstly, without a record on the platter the unintentional lowering of a stylus will probably result in its destruction, and secondly, neither the platter nor the record can be well damped, and will thus be subject to resonances. Significant wobble was also noted with the platter, which is an indication that it was not particularly flat.

Two major problems were encountered early on during testing and although the importers were duly notified of these difficulties, no reply has so far been forthcoming. One concerned the downforce calibration which was found to be 50% too high at the 1g setting. The other comprised the earth wiring, as the unit was supplied with a three core mains lead and a 5 pin DIN audio lead connector. No combination of connections on test were able to improve the hum level to beyond the poor -53 dB figure noted.

Lab tests were conducted using the Ortofon F150 cartridge as it was factory fitted to the fixed headshell arm. As supplied, the cartridge lateral alignment was significantly in error by $2-3^\circ$ but was easily reset. However as the arm pillar was slightly high the headshell vertical alignment was also not quite right and with no obvious means of adjustment. Concerning the arm, friction values were good, although the bias force demonstrated a reverse variation ie: it was low at the centre and high at the record edge.

While the wow and flutter results were fine, with good speed accuracy, stability and resistance to

loading, the rumble level was only just adequate, and the hum background really unacceptable with our test set up.

Subjective results were more promising. The sound quality was considered to be above average despite the lack of an effective record mat, and acoustic feedback and vibration resistance were both classed as more than satisfactory.

As supplied, the Dansk cannot be recommended. Potentially, it is capable of a good performance considering its price, but it is necessary to first resolve the problems of the hum and rumble levels, bias and downforce calibration and finally the platter damping.

MOTOR

General data

Type Belt drive, auto stop
 Platter mass 1.825kg
 Platter damping poor
 Finish and engineering adequate
 Type of mains lead three core
 Type of connecting lead DIN

Speed

Speeds offer 33 1/3, 45 rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.04%
 Absolute speed accuracy error +0.2%
 Speed drift +0.2%
 Speed variation under load -0.13%
 Start-up time to audible stabilisation 3.0secs

Rumble

DIN B weighted L and R average -62dB

ARM

General data

Type of headshell fixed
 Headshell mass —
 Geometrical accuracy poor*
 Adjustments provided overhang only
 Finish and engineer good
 Ease of assembly very good
 Trackability good

Friction

Typical lateral 20mg
 Typical vertical 30mg

Bias compensation (set to 1.5g elliptical)

Type of system magnetic
 Rim 300mg
 Centre 150mg

Downforce calibration error

1g 1.5g
 2g 2.5g

Cue operation

Drift satisfactory
 Ascent (8mm) 1.5secs
 Descent (8mm) 2.0secs

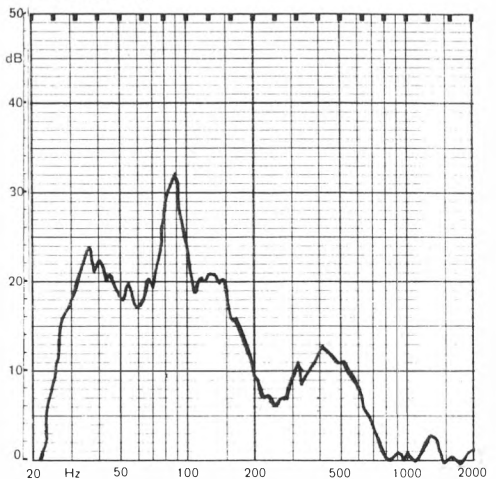
MOTOR AND ARM DATA

Size 450W x 360D x 100H-mm
 Clearance for lid none required
 Overall weight —
 Ease of use very good

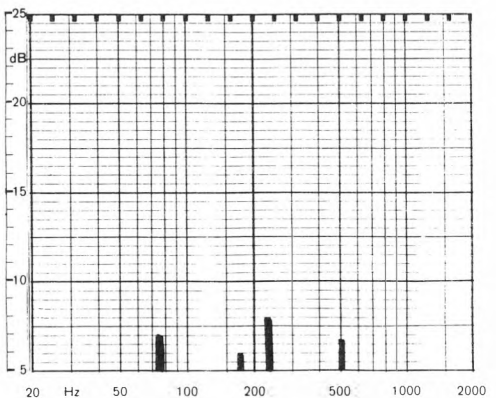
Typical acoustic breakthrough and resonances very good
 Subjective sound quality of complete system good
 Hum level -53dB*
 Acoustic feedback good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £115.00 inc cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge —
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.5-3g

Cartridge supplied is a reasonable match

*see text

Eagle D2006A

Eagle Int. Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex. 01-902 8832.



This Japanese built turntable chassis comes supplied with an unusual plinth system built in the UK. Its acrylic cover hinges back and needs only 28mm of rear clearance. The height attained when lifted is also lower than average at 360mm; (most decks require 500mm or so of vertical clearance for full lid elevation.)

On first appearance, the turntable would seem to be a direct drive model, as it uses the usual die cast platter with machined strobe markings on the rim. No illumination is provided, and closer investigation reveals that it is in fact a belt drive design, with an arm traverse coupled motor switch and automatic lift off and return. The motor is servo controlled and has a fine speed adjustment facility.

As with the Akai AP-001, the lever bias mechanism on the Eagle has a fixed setting, in this case producing 130mg of correction, which would suit tracking forces of around 1g. Unfortunately this level is unlikely to be possible using this arm, as the effective mass suggests a cartridge compliance in the 10-20cu range, tracking at between 1.5 and 3.0g. While the bias deficiency is not particularly serious, it will prevent the turntable from exploiting the trackability of a given cartridge to the full. Arm friction was satisfactory and geometrical alignment was good, although the arm pillar was set quite high and substantial packing was required between the cartridge body and the headshell to level the arm.

Motor tests gave a good rumble measurement and although the wow and flutter was rather high the spectral analysis did not reveal any particularly dominant component frequencies. Eagle were informed of our findings but so far have not found the cause. Speed accuracy was fine, drift low and tolerance of loading very good. We felt the platter and record damping could be improved by the use of a more substantial mat

114 Integrated turntables

The analysis of acoustic breakthrough and arm resonances showed some problems and the unit did not fare well on the listening tests. While the D2006A was fairly resistant to acoustic feedback, mechanical shock caused the unit chassis to bounce severely with harmonic modes overlapping the arm/cartridge resonance vibration. A substantial and rigid shelf is thus recommended.

Despite the incorporation of certain favourable features, the subjective quality and high wow and flutter figures preclude any recommendation of this model. The fixed bias is of course a further problematical area.

MOTOR

General data

Type Bell drive with auto lift off and return
 Platter mass 0.8kg
 Platter damping fairly poor
 Finish and engineering good
 Type of mains lead three core
 Type of connecting lead DIN

Speed

Speeds offered 33 1/3, 45 rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.25%
 Absolute speed accuracy error +0.23%
 Speed drift +0.1%
 Speed variation under load <0.1%
 Start-up time to audible stabilisation 0.75secs

Rumble

DIN B weighted L and R average -67dB

ARM

General data

Type of headshell Universal detachable
 Headshell mass 7.5g
 Geometrical accuracy good, arm quite high
 Adjustments provided overhang
 Finish and engineering good
 Ease of assembly fairly good
 Trackability fair

Friction

Typical lateral 60mg
 Typical vertical 15mg

Bias compensation (set to 1.5g elliptical)

Type of system lever*
 Rim 100mg
 Centre 160mg

Downforce calibration error

1g 0.96g
 2g 1.9g

Cue operation

Drift —
 Ascent (8mm) 0.5secs
 Descent (8mm) 4secs

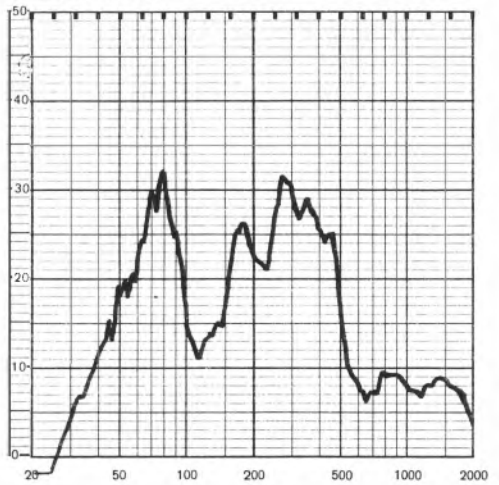
MOTOR AND ARM DATA

Size 497 W × 380 D × 190 H mm
 Clearance for lid 28mm
 Overall weight —
 Ease of use good

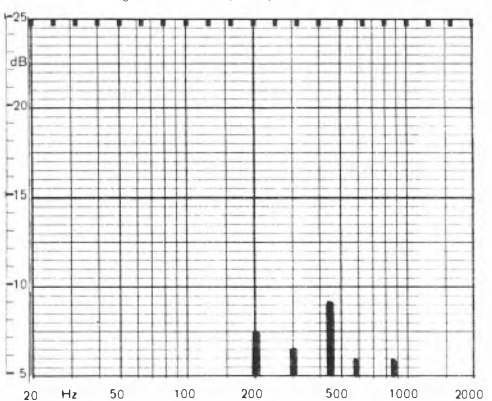
Typical acoustic breakthrough and resonances fair
 Subjective sound quality of complete system below average
 Hum level -67dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £80.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 10.5-11.5g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.5-3.0g
 Low to medium compliance cartridges recommended (10-20cu)

*See text

Empire 698

Hayden Labs. Ltd., Hayden House, Churchfield Rd., Chalfont St Peter, Bucks. 02813 88447.



This costly American turntable is virtually handmade, featuring a belt drive system with a fully suspended die-cast sub-chassis and a well finished arm of moderate mass, with a detachable headshell. However, it incorporated one surprisingly primitive aspect which concerned the method of speed change from 33 1/3 to 45rpm. A cover plate must be removed via a thumbscrew and the belt flicked from one pulley section to another by hand. In addition, with this plate removed, a further thumbscrew becomes accessible, which provides fine speed control. This offers a limited range of adjustment, mainly to correct drift, by canting the entire motor with respect to the belt axis, so that the belt rides on a smaller or larger diameter section of the pulley crown.

As with the Philips models, the strobe on the 698 is printed on a trim ring on the platter top surface, and normally cannot be seen. The mat is one of the low disc contact area types, with a couple of raised ribs providing support, but little record damping. No cover is provided for the plinth undersurface, the wiring and mechanics being fully accessible. Inspection showed that all wiring and terminals had been double insulated and were thus well protected, and the mechanical accessibility allows ready adjustment of the suspension springs to level the turntable when it is installed.

One small problem which the importers believe was confined to our particular sample, concerned the downforce calibration on the arm, which gave values about 20% below those dialed. Empire claim arm friction to be of the order of 1mg, but do not state the reference point. Our measured values at the stylus tip are much higher than this, although still reasonable. There were also problems on compatibility grounds. Empire's own 2000Z top line cartridge is unsuitable for this deck, since the

combination resonance is of the order of 5Hz, and is thus susceptible to record warps, etc. A much lower compliance model in the 20 to 25cu range would be sensible, judging by our measurements. A word of warning about the headshell; the clearance is rather limited and may not allow the use of the longer cartridges such as the Supex 900 Super.

The motor section demonstrated good rumble and wow and flutter results and during the listening tests, not a trace of wow was audible. In fact, the main bearing was one of the largest I have ever seen and would look more at home in a lift motor than in a turntable, which augurs well for the unit's longevity. The subjective testing overall showed the 698 to be a fine sounding turntable, with very good immunity to vibration and shock, and a high resistance to feedback.

MOTOR

General data

Type manual belt drive with auto arm lift
 Platter mass 3.02kg
 Platter damping poor
 Finish and engineering excellent
 Type of mains lead two core
 Type of connecting lead phono plus earth wire

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control no*
 Wow and flutter (DIN peak weighted) 0.05%
 Absolute speed accuracy error +0.2%
 Speed drift none
 Speed variation under load <0.1%
 Start-up time to audible stabilisation 1.5secs

Rumble

DIN B weighted L and R average -68dB

ARM

General data

Type of headshell Empire special detachable
 Headshell mass 5.0g
 Geometrical accuracy good
 Adjustments provided height and overhang
 Finish and engineering very good
 Ease of assembly fairly good
 Trackability very good

Friction

Typical lateral 15mg
 Typical vertical 40mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 200mg
 Centre 200mg

Downforce calibration error

1g 0.8g
 2g 1.6g

Cue operation

Drift negligible
 Ascent (8mm) 3secs
 Descent (8mm) 2secs

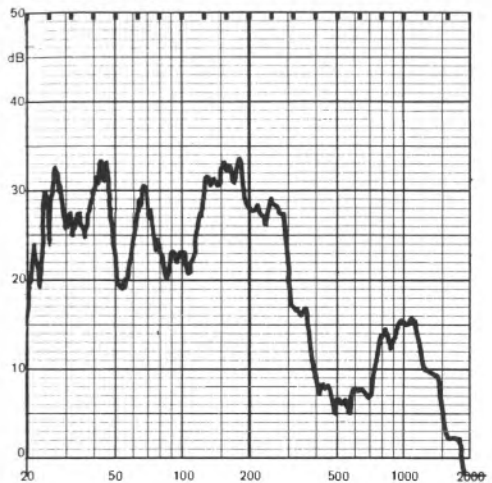
MOTOR AND ARM DATA

Size 446 W x 384 D x 214 H mm
 Clearance for lid 16mm
 Overall weight 13kg approx
 Ease of use good*

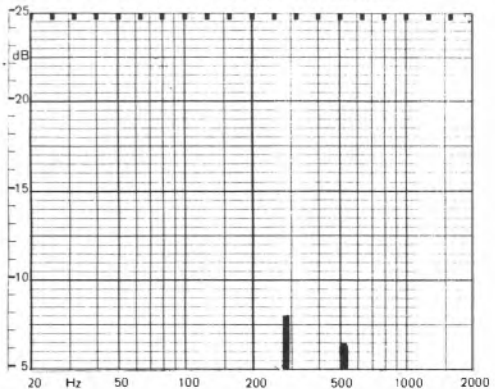
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system very good
 Hum level -70dB
 Acoustic feedback good
 Vibration sensitivity very good

Arm obtainable separately no
 Typical selling price ex VAT £270.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 11-13g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3.0g
 Low to medium compliance cartridges recommended (20-25cu)

*See text

Garrard 125SB

Garrard Engineering Ltd., Newcastle Str., Swindon, Wilts. 0793 35381.



this result lies in the arm resonance plot which shows problems in the 300Hz region close to the tracking test frequency. Tracking forces of between 1.5 and 3.0g are recommended, with cartridges compliance values of 8 to 25 μ c.

The vibration sensitivity, acoustic feedback and breakthrough were all ranked as good, while listening tests gave the deck an average rating which is commendable at the price.

This deck provides for fully automatic or manual operation and is one of the cheapest in the report. Hence it should not be judged too harshly on the basis of its performance.

Garrard's excellent instruction manual clearly explained how to set up the turntable; release of transit screws, adjustment of pick-up arm, etc. It also provided sufficient information on service and internal adjustment for any competent engineer to maintain or repair the unit.

Overall, the finish and engineering were to a high standard, although the friction locks in the lid hinges began to loosen up after a few days use, finally allowing the lid to flop backwards when elevated. On the plus side, the lid was a remarkably 'dead' acrylic type, much better in acoustic terms than the noisy polystyrene usually provided in this price range.

Lab testing confirmed a reasonable wow and flutter figure, slightly better than specified, although on audition, the wow was just audible, as was rumble. However, as the system likely to accompany this deck will probably not possess sufficient dynamic range to expose this rumble noise level, it must therefore be judged as satisfactory. Speed accuracy was relatively good, with variation under load classed as fair. Start-up was rapid at 1.0 seconds. The arm was surprisingly good in some respects, demonstrating low friction, good geometry, and reasonable downforce accuracy, the error being on the preferred high side. The bias correctly showed an increase towards the record centre but was set rather low; a moderate increase of 50% on the dial would bring it up to a reasonable level.

For some reason, the arm did not exploit the potential trackability of the test cartridge and must be rated as below average in this respect. A clue to

MOTOR

General data

Type belt drive, fully auto and manual
 Platter mass 0.7kg
 Platter damping adequate
 Finish and engineering fairly good
 Type of mains lead 2 core
 Type of connecting lead DIN with integral earth

Speed

Speeds offered 33 1/3, 45
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.15%
 Absolute speed accuracy error -0.6%
 Speed drift none
 Speed variation under load -0.4%
 Start-up time to audible stabilisation 1.0secs

Rumble

DIN B weighted L and R average -62dB

ARM

General data

Type of headshell special interchangeable slide
 Headshell mass -g
 Geometrical accuracy good
 Adjustments provided for overhang
 Finish and engineering good
 Ease of assembly balance slightly ambiguous
 Trackability below average

Friction

Typical lateral 20mg
 Typical vertical 25mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 50mg
 Centre 100mg

Downforce calibration error

1g 1.15g
 2g 2.25g

Cue operation

Drift negligible
 Ascent (8mm) 0.5secs
 Descent (8mm) 2secs

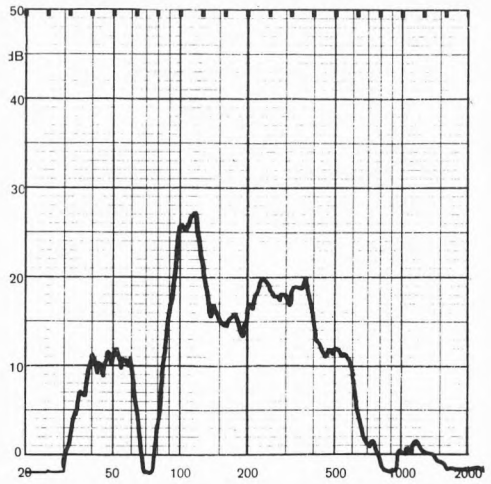
MOTOR AND ARM DATA

Size 425 W x 363 D x 163 H mm
 Clearance for lid 52mm
 Overall weight
 Ease of use good

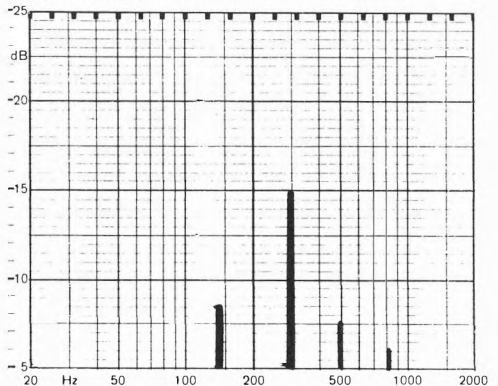
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system average
 Hum level -60 approx dB
 Acoustic feedback good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £42.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 7-10g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating K
 Recommended tracking weight 1.5-3.0g
 Low to medium compliance cartridges recommended (8-25cu)

*See text

Garrard GT55P

Garrard Engineering Ltd., Newcastle Str., Swindon, Wilts. 0793 35381.



An unusual belt drive turntable, the GT55P is the successor to the famous Zero 100 deck, and carries the same type of low tracking error, pivoted headshell arm. The original model achieved a reasonable standard but suffered somewhat on arm mass, rumble and horizontal arm friction. The GT55P is designed to overcome these problems, and great pains have been taken to reduce pivot friction, with the arm section being a die casting in magnesium alloy in order to lower the mass.

The motor is a DC type, under servo control, and offers adjustment to the nominal $33\frac{1}{2}$ and 45rpm settings using the single thumbwheel provided. Other facilities include magnetic and hence frictionless bias compensation, plus an array of operating slide levers controlling cueing, record size selection and manual or automatic modes. The start lever was not sufficiently positive in the manual position and it proved all too easy to swing it through to the auto setting. In contrast, the cue lever was rather stiff and in use one could easily jar the sprung, pressed steel chassis and possibly dislodge the stylus from the groove. The mat did not damp the platter resonances effectively and its hard consistency also resulted in relatively poor damping of the record resonances.

On test, the motor section delivered a fine wow and flutter level and although the speed loss on load was significant, it was not excessive. The -68 dB DIN weighted rumble level was very good, but appeared less satisfactory on audition, possibly because of the poor resistance to vibration and acoustic feedback. Around 100Hz, the breakthrough level was considerable, and dominated the feedback characteristic.

The arm gave quite low friction values particularly in the vertical plane. Alignment with the supplied cartridge was spot on, the bias slightly high but well

within tolerance, with the downforce reasonable, the error being on the high side. Both cue rate and accuracy were fine.

On the compatibility side, the arm mass was lower than average and while not a true low mass type, it would suit cartridges with compliances of up to 30cu, tracking as low as 1.25g.

Subjectively, the GT55P was not outstanding but it was considered better than the DD75, and rates an average qualification for sound quality.

MOTOR

General data

Type	belt drive, auto and manual
Platter mass	1.9kg
Platter damping	poor
Finish and engineering	good
Type of mains lead	2 core
Type of connecting lead	DIN + earth*

Speed

Speeds offered	33 $\frac{1}{3}$, 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.05%
Absolute speed accuracy error	-0.33%
Speed drift	+0.1%
Speed variation under load	-0.43%
Start-up time to audible stabilisation	2.5secs

Rumble

DIN B weighted L and R average	-68dB
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ARM

General data

Type of headshell	special cartridge slide
Headshell mass	1g
Geometrical accuracy	very good
Adjustments provided	overhang only
Finish and engineering	good
Ease of assembly	good
Trackability	fairly good*

Friction

Typical lateral	30mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	magnetic
Rim	200mg
Centre	210mg

Downforce calibration error

1g	1.15g
2g	2.20g

Cue operation

Drift	negligible
Ascent (8mm)	1sec
Descent (8mm)	3secs

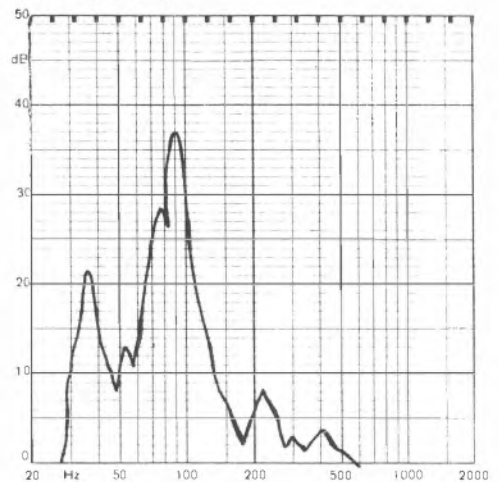
MOTOR AND ARM DATA

Size	430 W x 387 D x 186 H mm
Clearance for lid	83mm
Overall weight	
Ease of use	fairly good

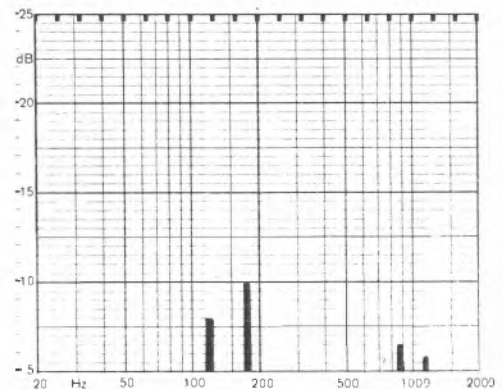
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	average
Hum level	-67dB
Acoustic feedback	adequate
Vibration sensitivity	adequate

Arm obtainable separately	no
Typical selling price ex VAT	£90.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances



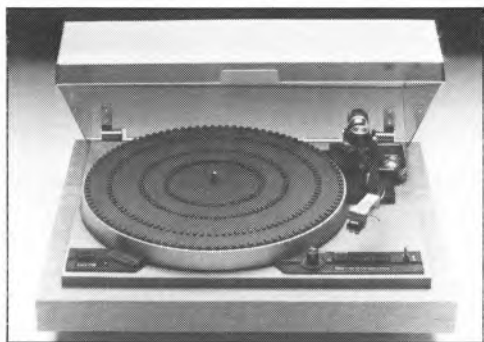
Compatibility

Effective moving mass excluding cartridge	8.09.0g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	C
Damping rating	K
Recommended tracking weight	1.25-3.0g
Medium to high compliance cartridges compatible (15-30cu)	

*See text

Garrard DD75

Garrard Engineering Ltd., Newcastle Str., Swindon, Wilts. 0793 36381.



This unit is Garrard's first venture into the field of modern direct drive turntables and employs the ubiquitous Japanese Matsushita motor combined with an arm, piinth and electronics all manufactured in the UK.

A photo-electric sensor provides frictionless control of end of side detection and subsequent arm lift. A strobe is fitted to the underside of the platter and is viewed through a mirror system and an inspection window. One variable speed knob is provided, operative on both 33½ and 45rpm, which may be selected by soft-action push buttons. These were found to be rather close to the pick-up stylus when the latter was in the rest position. The solid veneered piinth was supported on rubber feet and overall, the finish and engineering were both to a high standard.

Lab testing revealed that the arm friction was moderate if not as low as the specification suggests. In contrast to the 125SB the bias levels were slightly high but downforce calibration was exactly correct. An interchangeable plastic cartridge carrier is used which also fits the 125 SB, but not the GT55P. The geometrical alignment was fine, although the supplied cartridge was slightly out by 1°.

The deck proved to be easy to set up, but as with the 125 SB, some reservations were felt concerning trackability, and some resonances in the test frequency range were also observed. The cue control was generally satisfactory bar a rather stiff lever action, but the descent time was considered too slow at 6.5 seconds, 2 seconds being a reasonable compromise between speed and stability. We found the arm to be suited to cartridges of 10 to 20cu, tracking from 1.5 to 3.0g.

On test, the motor returned a typically good -69dB rumble level but showed higher than average wow and flutter for a direct drive,

predominantly in the 7Hz range. The speed accuracy was fine, but drifted moderately during a one hour test session. It slowed by nearly 0.3% under a 5g dust bug load, and showed the overshoot recovery characteristic that is typical of this motor.

On listening tests using the reference cartridge, the DD75 did not fare well, and was ranked as below average. In addition to the audible colouration and lack of clarity, slight wow could be heard on critical programme sections; and the high breakthrough levels and poor resistance to vibration must be relevant factors in the overall subjective assessment.

MOTOR

General data

Type	manual direct drive with auto-lift off
Platter mass	1.6kg
Platter damping	fairly good
Finish and engineering	good
Type of mains lead	two core
Type of connecting lead	DIN plus earth wire

Speed

Speeds offered	33 1/3, 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.06%
Absolute speed accuracy error	<0.1%
Speed drift	+0.3%
Speed variation under load	-0.27%
Start-up time to audible stabilisation	4.0secs

Rumble

DIN B weighted L and R average	-69dB
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ARM

General data

Type of headshell	special slide holder
Headshell mass	g
Geometrical accuracy	good
Adjustments provided	overhang only
Finish and engineering	very good
Ease of assembly	good
Trackability	fairly good

Friction

Typical lateral	20mg
Typical vertical	45mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	200mg
Centre	220mg

Downforce calibration error

1g	1.0g
2g	2.0g

Cue operation

Drift	satisfactory
Ascent (8mm)	0.5secs
Descent (8mm)	6.5secs

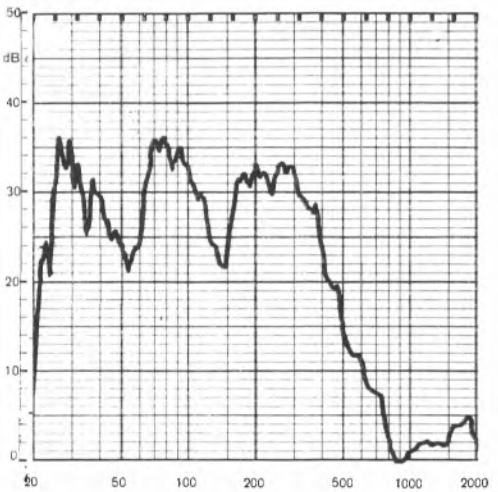
MOTOR AND ARM DATA

Size	437 W x 375 D x 165 H mm
Clearance for lid	63mm
Overall weight	7.3kg
Ease of use	very good

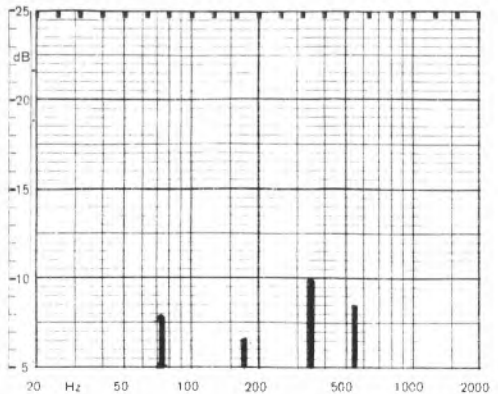
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	fair
Hum level	-70dB
Acoustic feedback	good
Vibration sensitivity	adequate

Arm obtainable separately	no
Typical selling price ex VAT	£90.00

Acoustic breakthrough:



Indication of magnitude and frequency of arm resonances:



Compatibility

Effective moving mass excluding cartridge	11-12g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	B
Damping rating	K
Recommended tracking weight	1.5-3.0g
Low to medium compliance cartridges compatible (10-20cu)	

Harman Kardon ST7

Tannoy Products Ltd., St Johns Rd., Tylers Green, High Wycombe, Bucks. 049 481 5221.



This unusual belt drive turntable has a brushed alloy plinth and a clear acrylic cover. The arm is made by Rabco, a small American company who have specialised in parallel tracking designs, the nearest European equivalent in the report being the B&O 4002. As with the Strathearn SMA2 and Thorens TP160II, the complete headshell/arm tube is detachable with the locking section located near the pivots in order to reduce mass. The deck incorporates photo-electric sensing for end of side switch off, and offers fine variable speed control with a matching strobe

At this elevated price level (£320.00) one might expect a design to be free of problems, but this was not the case with the ST-7. While a good wow and flutter result was obtained in the lab, with fine speed accuracy, the motor slowed significantly (by 0.63%) under moderate 5g downforce dust bug loading. This is an indication that wow might be audible on programme with a medium tracking weight cartridge, and in fact, was just discernible with the test moving coil cartridge (FRI Mk II) using our selected music band, (see introduction).

Rumble was fine and measured close to specification, but proved to be just audible on a wide dynamic range system. We believe its effect was magnified by the resonant qualities of the plinth system. Some problems were also noted in connection with the arm, possibly associated with the offset friction wheel techniques employed to obtain the lateral tracking drive. The subsonic resonance was ill defined, with the well damped test cartridge showing signs of instability. Tracking tests were undertaken which revealed that the cartridge's potential was not fully exploited, in consequence, models tracking at the 1.5-3.0g range are indicated, despite the low mass characteristics of the arm.

Cartridges were with a mass of 9g and over will require an optional heavier counterweight.

The 'fairly good' sound quality ranking is inadequate at this price level, and curves for both acoustic breakthrough and arm resonance revealed an unsatisfactory performance. The unit was found to be very sensitive to external shock and vibration and a solid shelf, preferably mounted on a structural wall, is recommended. A good resistance to acoustic feedback was shown but the deck's position could prove to be critical in this respect, and as the thin rubber platter mat was of the minimal record support type, it was of no help in improving the sound quality.

MOTOR

General data

Type	Belt drive, auto stop
Platter mass	1.2kg
Platter damping	poor
Finish and engineering	fairly good
Type of mains lead	three core
Type of connecting lead	phonos + earth

Speed

Speeds offered	33 1/3, 45 rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.05%
Absolute speed accuracy error	<0.1%
Speed drift	+0.2%
Speed variation under load	-0.63%
Start-up time to audible stabilisation	0.5secs

Rumble

DIN B weighted L and R average	-67dB
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ARM

General data

Type of headshell	special detachable
Headshell mass	not valid
Geometrical accuracy	very good
Adjustments provided	overhang
Finish and engineering	good
Ease of assembly	good
Trackability	fair

Friction

Typical lateral	40mg*
Typical vertical	60mg

Bias compensation (set to 1.5g elliptical)

Type of system	not required
Rim	-
Centre	-

Downforce calibration error

1g	1.0g
2g	2.05g

Cue operation

Drift	poor
Ascent (8mm)	<0.2secs
Descent (8mm)	3.0secs

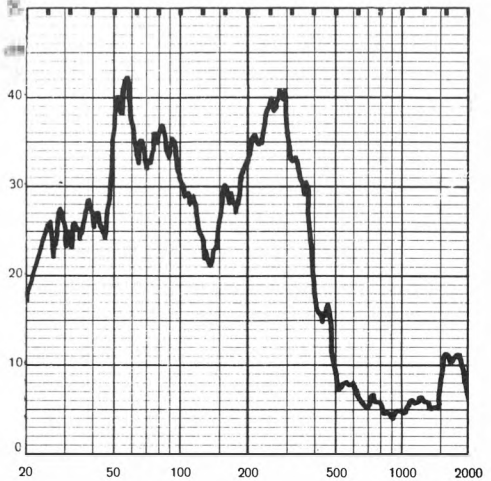
MOTOR AND ARM DATA

Size	419W x 413D x 157Hmm
Clearance for lid	70mm
Overall weight	10kg
Ease of use	good

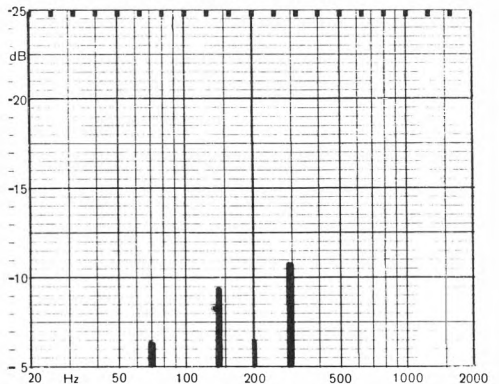
Typical acoustic breakthrough and resonances	poor
Subjective sound quality of complete system	fairly good
Hum level	-70dB
Acoustic feedback	good
Vibration sensitivity	poor

Arm obtainable separately	no
Typical selling price ex VAT	£320.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge	5.6g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	C
Damping rating	L
Recommended tracking weight	1.5-3.0g

Suitable for medium to high compliance cartridges (15-30cu)

*see text

Hitachi PS-38

Hitachi Sales (UK) Ltd., Hitachi House, Station Rd., Hayes, Middlesex. 01-848 8787.



In common with several other players in the report, some of them costing considerably more than this low priced deck, the PS-38 employs the by now ubiquitous Matsushita motor. The Hitachi price also includes a modest cartridge which was replaced by our reference models for the purposes of testing.

Overall, the quality of finish and workmanship was to a good standard, and was surprising considering the price. The usual engraved stroboscope markings were machined on the platter rim; neon illuminated, and both 33½ and 45rpm speeds were adjustable.

Although the simply laid out controls meant that the PS-38 was easy to use, we found the instructions rather poor with inadequate information concerning cartridge alignment, and no guage was provided. The headshell in the test sample was rotated 2.3° vertically from the correct axis with no obvious means of correction, this error likely to somewhat reduce the channel separation of any matching cartridge.

Lab testing provided the usual information concerning this popular motor. Rumble and wow were both very good at -69dB and 0.035% respectively, but the significant slowing under moderate load and the prolonged start-up time at around 4 seconds were less satisfactory, as was the accompanying overshoot as the correct speed was attained.

Arm measurements revealed ideal bias correction values, fairly good friction levels and medium/high effective mass. Downforce calibration was also highly accurate. Cartridges tracking at 1.5-2.5g are suitable, with compliance values of between 10 and 20cu. A generally satisfactory performance was demonstrated in the areas of feedback susceptibility and response to unwanted vibration.

Subjective testing ranked the PS-38 a little below

average which is a fair result for the price. Slight wow was audible under demanding programme conditions but this was obviously not judged to be as serious with this model, as a similar effect noted with the same motor in a deck costing over twice as much as the PS-38.

Overall, we found that Hitachi's modest specification was comfortably bettered on test and we felt that the supply of a well finished direct drive turntable complete with cartridge at a price well below £100 was no mean feat in itself.

MOTOR

General data

Type	direct drive manual
Platter mass	1.5kg
Platter damping	good
Finish and engineering	very good
Type of mains lead	three core
Type of connecting lead	phono plus earth

Speed

Speeds offered	33 1/3 & 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.035%
Absolute speed accuracy error	<0.1%
Speed drift	+0.23%
Speed variation under load	-0.46%
Start-up time to audible stabilisation	4.0secs

Rumble

DIN B weighted L and R average	-69dB
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ARM

General data

Type of headshell	universal, detachable
Headshell mass	7.5g
Geometrical accuracy	fair
Adjustments provided	overhang only
Finish and engineering	good
Ease of assembly	good
Trackability	fairly good

Friction

Typical lateral	.70mg
Typical vertical	.20mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	150mg
Centre	200mg

Downforce calibration error

1g	1.05g
2g	2.05g

Cue operation

Drift	satisfactory
Ascent (8mm)	0.5secs
Descent (8mm)	3.0secs

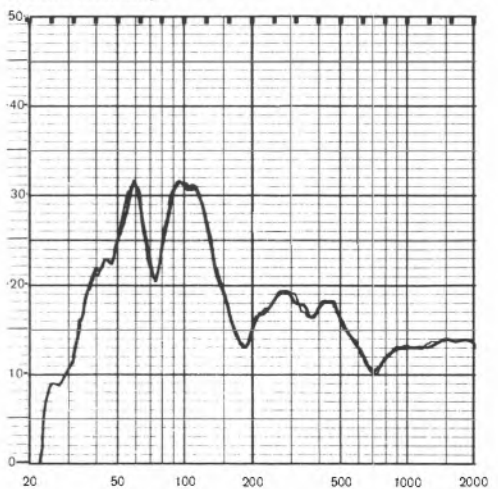
MOTOR AND ARM DATA

Size	476 W x 352 D x 61 H mm
Clearance for lid	73mm
Overall weight	7.5
Ease of use	good

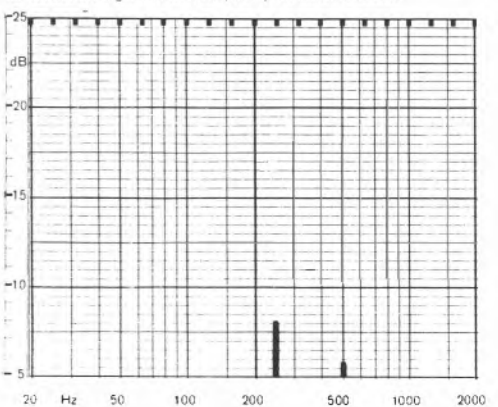
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	average
Hum level	-69dB
Acoustic feedback	good
Vibration sensitivity	good

Arm obtainable separately	no
Typical selling price ex VAT	£90.00 inc cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 10-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating	B
Damping rating	J
Recommended tracking weight	1.5-2.5g
Low to medium compliance cartridges recommended	(10-20cu)

JVC JLA-15

JVC (UK) Ltd., Eldonwall Trd. Est., Staples Corner, 6/8 Priestly Way, London NW2. 01-450 2621.



JVC's new quartz turntable was not available in time for this survey, and the JL-A15 is the only deck to be included from this manufacturer. An attractively styled and moderately priced unit, its features include automatic arm return and switch off at the end of a record side. The pick-up arm is unusually heavy with the headshell alone weighing 12g, and a low compliance cartridge is definitely recommended. Models with compliance values in the 6-12cu range would be suitable; this rules out JVC's own Z1 (see cartridge reports) whose measured compliance at 27cu would place the estimated resonance for the combination at 6Hz. However, substitution of another headshell could improve matters; for example, the use of an SME shell would allow cartridges with compliance values of up to 20cu to be fitted, though the counterweight may then be too heavy.

This belt drive design offers 33 $\frac{1}{3}$ and 45rpm. A two core mains lead is fitted, indicative of a double insulated construction, with the phono type audio leads combined with the normally separate chassis earth wire. As noted with similar wiring practice on other models, this technique is likely to result in impaired hum levels, and while the -60dB recorded for the JL-A15 is satisfactory, it could have been much better with a separate earth lead.

On test, the arm was found to have fairly high lateral friction which would preclude the use of cartridges tracking below 2g or so. Downforce calibration was reasonable with biasing close to the expected value, but the latter was difficult to measure to any degree of accuracy due to the interference effect of the arm friction on the lateral plane.

The motor section proved excellent, with the fine wow and flutter and rumble figures much better than specified. The turntable slowed very little under 128 Integrated turntables

load, was close to correct speed and started up quickly. The light 500g platter shows that for low wow and flutter figures a heavy platter is not essential; but that good overall engineering is required.

Vibration isolation was classed as barely adequate. As with many of the other decks, the rubber feet proved to be ineffective. The acoustic breakthrough levels and feedback were fairly good and the subjective sound quality about average, which is fair enough at the price.

With softer feet, better control of arm friction, a low mass headshell and a separate chassis earth wire, JVC would have quite a competitive turntable in the JL-A15. As it stands, however, it cannot be recommended.

MOTOR

General data

Type manual belt drive with auto arm return
 Platter mass 0.5kg
 Platter damping good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead phono, no earth wire

Speed

Speeds offered 33 $\frac{1}{3}$, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.04%
 Absolute speed accuracy error -0.33%
 Speed drift none
 Speed variation under load -0.16%
 Start-up time to audible stabilisation <1sec

Rumble

DIN B weighted L and R average -68dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 12.0g
 Geometrical accuracy good
 Adjustments provided tilt, overhang
 Finish and engineering very good
 Ease of assembly good
 Trackability fairly good

Friction

Typical lateral 150mg
 Typical vertical 50mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 150mg
 Centre 150mg

Downforce calibration error

1g 0.95g
 2g 1.8g

Cue operation

Drift negligible
 Ascent (8mm) 1sec
 Descent (8mm) 1.5secs

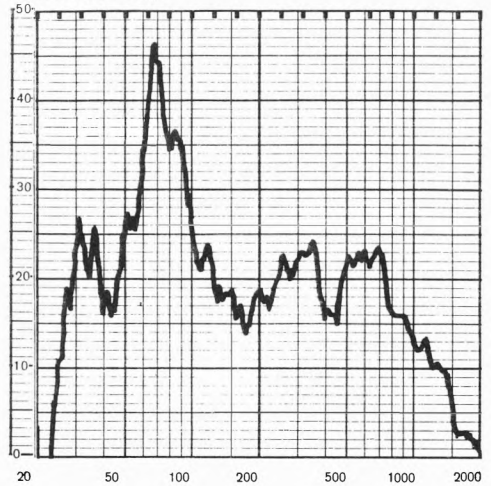
MOTOR AND ARM DATA

Size 460 W x 354 D x 130 H mm
 Clearance for lid 45mm
 Overall weight 5.0kg
 Ease of use good

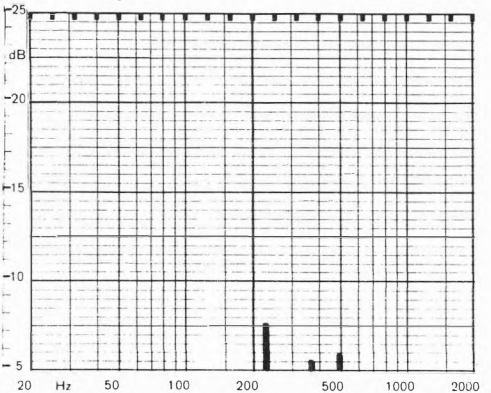
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system average
 Hum level -60dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £57.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 21-23g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A
 Damping rating J
 Recommended tracking weight 2.0-3.0g
 Low compliance cartridges suitable (6-12cu)

Leak 3001

Rank Audio Products Ltd., P O Box 70, Great West Rd., Brentford, Middlesex. 01-568 9222.



Subjective testing did not give favourable results relative to price, largely due to the vibration and resonance qualities described. As it stands, we feel the 3001 has some significant weaknesses, but it would not take much work to upgrade its performance; a little attention to the feet, deck resonances and motor mounting would put this deck into a good value rating.

This turntable which carries the UK brand name of Leak is manufactured in Japan, and is attractively finished in brushed alloy, with a clear acrylic lid. A belt drive, manually operated deck, the 3001 offers a fine variable speed control independently adjustable on $33\frac{1}{3}$ and 45rpm settings, this facilitated by the strobe markings machined into the platter rim. The platter itself carries a sensible mat which confers good damping.

This turntable is a rigid structure mounted on fairly stiff adjustable rubber feet, which gave barely adequate resistance to vibration. These feet proved to be nothing like as effective as the liquid filled sphero-dynamic suspension which was employed on Leak's earlier 2001 deck. On test, we found quite severe acoustic breakthrough in the 50Hz to 250Hz region apparently due to resonance in the alloy top plate. These magnified an otherwise moderate vibration level from the motor, giving a weighted rumble figure around -60dB , (average of two test samples) which could only be classed as acceptable. However, wow and flutter was very low for a belt drive, speed accuracy good and drift over one hour acceptable. Only moderate slowing was noted under load.

Although the manual states the 3001 to have a low effective mass arm, we measured it as 11-12g M_e , which places it in the medium mass bracket. However, despite this discrepancy, it rated quite highly on test. Low friction values were obtained, the biasing was exactly as recommended by this survey and the downforce calibration was accurate. The cue rates were sensible, with only moderate drift. The arm proved capable of exploiting the tracking potential of a suitably matched cartridge; models of compliance 10-20cu are indicated, tracking down to 1.5g.

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MOTOR

General data

Type	Belt drive, manual
Platter mass	0.95kg
Platter damping	very good
Finish and engineering	good
Type of mains lead	two core
Type of connecting lead	DIN, integral earthing

Speed

Speeds offered	33 1/3, 45 rpm
Fine speed	YES
Wow and flutter (DIN peak weighted)	0.035%
Absolute speed accuracy error	+0.2%
Speed drift	-0.4%
Speed variation under load	-0.33%
Start-up time to audible stabilisation	1.5secs

Rumble

DIN B weighted L and R average	-60dB*
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ARM

General data

Type of headshell	Universal Detachable
Headshell mass	7.0g
Geometrical accuracy	very good
Adjustments provided	overhang and pillar height
Finish and engineering	very good
Ease of assembly	good
Trackability	very good

Friction

Typical lateral	20mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	150mg
Centre	200mg

Downforce calibration error

1g	1.05g
2g	2.1g

Cue operation

Drift	satisfactory
Ascent (8mm)	0.5secs
Descent (8mm)	2secs

MOTOR AND ARM DATA

Size	436W x 346D x 145Hmm
Clearance for lid	65mm
Overall weight	8.0kg
Ease of use	good

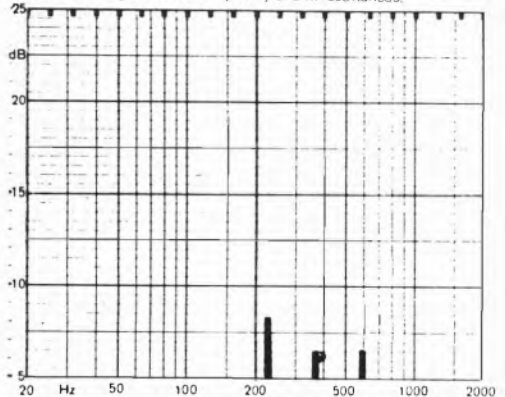
Typical acoustic breakthrough and resonance	poor
Subjective sound quality of complete system	below average
Hum level	-60dB
Acoustic feedback	fairly good
Vibration sensitivity	adequate

Arm obtainable separately	no
Typical selling price ex VAT	£85.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge	11-12g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	B
Damping rating	J
Recommended tracking weight	1.5-3.0g

Compatible with low to medium compliance cartridges (10-20cu)

*see text

Lenco L84

C E Hammond & Co. Ltd., 111 Chertsey Rd., Byfleet, Surrey KT14 7LA. Byfleet 41131.



The Lenco turntables were commissioned for review before the recently announced receivership of Goldring, their UK importers. However, new agents have since been appointed, and the L84 together with other models in the range will continue to be available. The price is, however, indeterminate at present, but it is hoped that the figure quoted will prove to be fairly typical.

The unit comprises a conventional pressed steel chassis mounted on damped coil springs. The drive is from a 16 pole slow-speed synchronous motor coupled by a precision belt to the platter, and both automatic and manual operation is provided. The finish was, however, poor in some respects; for example the remaining moulding flash on the polystyrene lid was razor sharp and drew blood from my assistant!

On test, the motor section met the manufacturer's figure of 0.08% DIN peak weighted wow and flutter, and bettered the spec with a satisfactory -66DIN B weighted rumble level. The platter ran almost 1% fast, which is excessive from an engineering point of view, although unlikely to be noticed by most users. Speed variation under load was reasonable and during auditioning wow was not found to be a problem, though some rumble could be heard at high listening levels.

The 'S' shaped arm carries a moulded plastic detachable headshell – the geometry and method of connection being unique to Lenco. A very soft bushing was incorporated in the counterweight to provide some damping at the subsonic arm resonance, and the appropriate response trace shows that it is quite effective and also offers some degree of additional reduction in effective mass. The result is that the L84 arm will be compatible with a number of medium compliance cartridges up to 30cu, at tracking forces of between 1.5 and 3.0g.

The bias correction was fairly good, although somewhat on the high side and the downforce calibration reasonably accurate but tending to read low. The cue operation was without drift, although the ascent time was slow at 3 seconds.

While listening tests indicated an average rating on subjective quality grounds, the resistance to acoustic breakthrough, resonances and shock or vibration were all considered barely adequate. Resistance to acoustic feedback was, however, thought to be quite good. As with the other Goldring deck in the report, a sturdy shelf is also recommended for this turntable, under which circumstances the overall performance and subjective quality would be classed as reasonable for the price. Two other plus points are also relevant, namely the moderate arm mass, and the smooth acting automatic facilities.

MOTOR

General data

Type	belt drive, automatic
Platter mass	1.3kg
Platter damping	good
Finish and engineering	good
Type of mains lead	3 core
Type of connecting lead	DIN

Speed

Speeds offered	33 1/3, 45rpm
Fine speed control	no
Wow and flutter (DIN peak weighted)	0.08%
Absolute speed accuracy error	+ 0.93%
Speed drift	none
Speed variation under load	-0.33%
Start-up time to audible stabilisation	2secs

Rumble

DIN B weighted L and R average	- 66dB
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ARM

General data

Type of headshell	special detachable
Headshell mass	.6g
Geometrical accuracy	very good
Adjustments provided	overhang, height via spacers
Finish and engineering	good
Ease of assembly	good
Trackability	good

Friction

Typical lateral	100mg
Typical vertical	75mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	180mg
Centre	250mg

Downforce calibration error

1g	0.95g
2g	1.8g

Cue operation

Drift	negligible
Ascent (8mm)	3secs
Descent (8mm)	3secs

MOTOR AND ARM DATA

Size	.470W x 370Q x 165H mm
Clearance for lid	90mm
Overall weight	7.9kg
Ease of use	very good

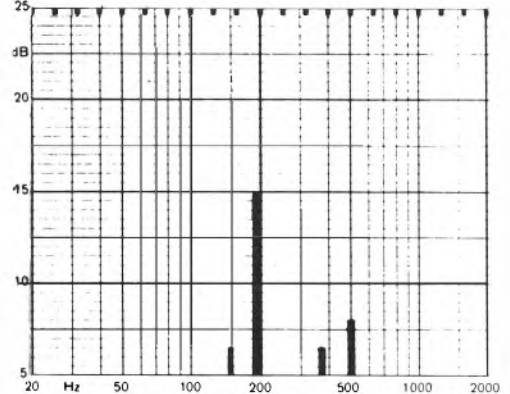
Typical acoustic breakthrough and resonances	fairly poor
Subjective sound quality of complete system	average
Hum level	- 68dB
Acoustic feedback	good
Vibration sensitivity	adequate

Arm obtainable separately	no
Typical selling price ex VAT	£60.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge	8-10g*
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	C
Damping rating	L
Recommended tracking weight	1.5-3g
Medium to high compliance cartridges recommended (15-25cu)	

*See text

Lenco L833

C E Hammond & Co. Ltd., 111 Chertsey Rd., Byfleet, Surrey KT14 7LA. Byfleet 41131.



good, but the shock and external vibration resistance was poor. We considered that the feet fitted to this model were far too rigid, and effectively transmitted a large proportion of floor and shelf propagated vibration to the cartridge stylus. The true purpose of resilient feet is to decouple the plinth structure from the shelf, hopefully at frequencies from 5Hz upwards. A firm, heavy and rigid shelf is thus recommended for positioning this deck.

Once again, we find the Matsushita direct drive motor, this time in a Swiss made turntable fitted with an elegant Matsushita platter, its bevelled rim carrying the machined strobe markings. Mains powered neon illumination lights the strobe pattern, with fine variable speed controls for both $33\frac{1}{3}$ and 45rpm. Two versions of this basic platter/motor combination are available; one is the L830DD which is a manually operated deck and the other is the model reviewed here, which incorporates an end of side arm lift and stop facility. This detection is accomplished without adding to the arm friction, by using a high frequency sensing coil.

Lab testing confirmed the general performance level of the motor although it is interesting to note that variations in platter mass and possibly power supply from manufacturer to manufacturer seem to affect the wow and flutter readings. Likewise, differences in plinth construction and type of isolating feet would seem to affect the rumble figure. In fact, although both wow and flutter and rumble were satisfactory with the L-833DD, they were below the standard attained by examples of this motor as used in other plinth systems in the report.

The arm exhibited fairly accurate downforce calibration, very low friction in both planes and sensible bias compensation, although the actual values were on the high side and could be reduced to advantage by almost 30%. Some lateral drift was noticed on the cue control but the ascent and descent rates were fine.

Subjective listening tests ranked this model of average quality for the group as a whole; this includes subjective assessment of audible wow, a trace of which was present with this design. Acoustic breakthrough and resonances were classed as fair, resistance to acoustic feedback

MOTOR

General data

Type	direct drive with auto lift off
Platter mass	1.55kg
Platter damping	adequate
Finish and engineering	good
Type of mains lead	3 core
Type of connecting lead	DIN

Speed

Speeds offered	33 $\frac{1}{3}$, 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.06%
Absolute speed accuracy error	<0.1%
Speed drift	<0.1%
Speed variation under load	0.4%
Start-up time to audible stabilisation	4.0 secs

Rumble

DIN B weighted L and R average	-66dB
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ARM

General data

Type of headshell	special Lenco detachable
Headshell mass	9.0g
Geometrical accuracy	good
Adjustments provided	overhang, height via spacers
Finish and engineering	good
Ease of assembly	good
Trackability	very good

Friction

Typical lateral	5mg
Typical vertical	10mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	200mg
Centre	275mg

Downforce calibration error

1g	0.95g
2g	1.9g

Cue operation

Drift	satisfactory
Ascent (8mm)	1sec
Descent (8mm)	3secs

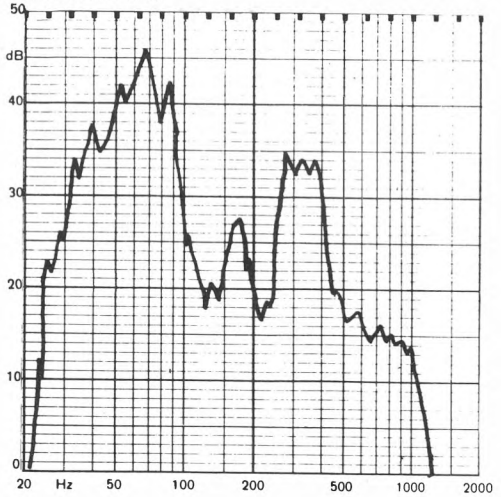
MOTOR AND ARM DATA

Size	365D x 460W x 140H mm
Clearance for lid	80mm
Overall weight	
Ease of use	good

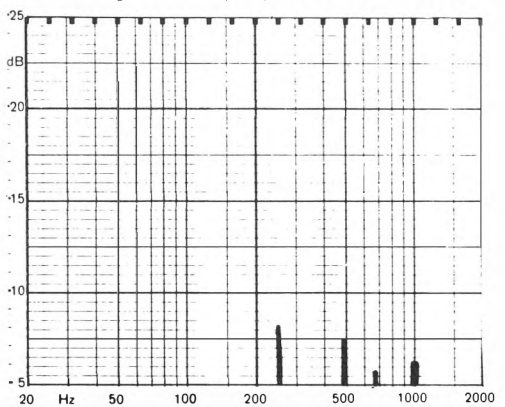
Typical acoustic breakthrough and resonances	fair
Subjective sound quality of complete system	average
Hum level	-65dB
Acoustic feedback	good
Vibration sensitivity	poor

Arm obtainable separately	no
Typical selling price ex VAT	£150.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 11-13g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating	B
Damping rating	K
Recommended tracking weight	1.25-3g
Low to medium compliance cartridges suitable (10-20cu)	

Lux PD282

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



Lux has the reputation for finely finished products and this is certainly borne out by the appearance of the PD282. Its direct drive motor is a so-called condenser type made by Fujia rather than the more usual Matshushita model, and on test, a reasonable 0.07% wow and flutter was recorded, together with good speed accuracy and stability, a moderate start-up time and a fair tolerance of loading. Wow was inaudible and the satisfactory rumble level at -66dB was only just detectable on audition.

The arm was a conventional 'S' design with a detachable headshell and a weighted level bias compensator. A balancer or outrigger weight was incorporated, comprising a fairly heavy cylinder suspended on a thin bar. Its purpose is to balance the arm in the lateral plane so that it is less sensitive to any tilt of the turntable plinth. Two side effects can ensue from this, which are by no means restricted to the Lux; they are frequently encountered with many of the other arms incorporating similar devices. Firstly, the effective moving mass is different in the vertical and horizontal planes, which may impart a double resonance to the subsonic arm/mass resonant frequency, and this could in turn induce a rather complex and undesirable vibration of the cantilever. Secondly, these assemblies can develop resonances in the audio band which may colour the reproduced sound. If such problems are suspected, it is best to simply remove the weight, and then ensure that the plinth is satisfactorily level. However, this was not found necessary with the Lux deck. This model also possesses rubber feet that can be height adjusted.

The arm demonstrated low friction, accurate downforce calibration and sensible bias levels. Cue drift was negligible and the ascent and descent rates were fine. Overall, the arm was quite impressive and realised the full tracking capabilities of a compatible

cartridge. The latter may be of 10-20cu, tracking from 1.25 to 3.0g downforce.

While the immunity to shock and vibration was uninspiring, in common with many similar models, the acoustic feedback resistance was fine, with the acoustic breakthrough and resonances classed as fairly good. The subjective sound quality was definitely above average which is fair enough at the price, if not quite in the 'recommended value' class.

MOTOR

General data

Type direct drive manual
 Platter mass 1.05kg
 Platter damping adequate
 Finish and engineering excellent
 Type of mains lead two core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 $\frac{1}{3}$, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.07%
 Absolute speed accuracy error <0.1%
 Speed drift +0.1%
 Speed variation under load -0.17%
 Start-up time to audible stabilisation 2.5secs

Rumble

DIN B weighted L and R average -66dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 7g
 Geometrical accuracy very good
 Adjustments provided height and overhang
 Finish and engineering excellent
 Ease of assembly good
 Trackability very good

Friction

Typical lateral 15mg
 Typical vertical 15mg

Bias compensation (set to 1.5g elliptical)

Type of system weighted lever
 Rim 150mg
 Centre 150mg

Downforce calibration error

1g 1.03g
 2g 2g

Cue operation

Drift negligible
 Ascent (8mm) 0.5secs
 Descent (8mm) 2.5secs

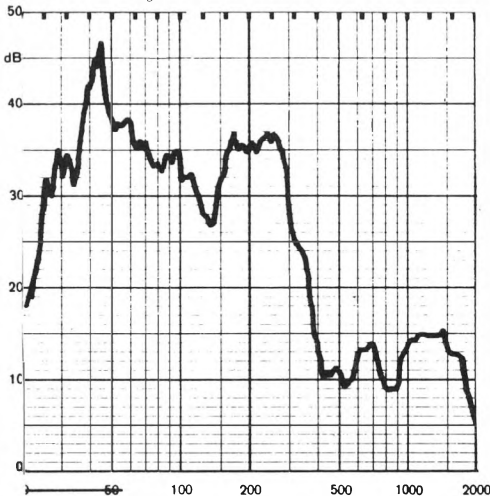
MOTOR AND ARM DATA

Size 471 W x 351 D x 175 H mm
 Clearance for lid 85mm
 Overall weight 10kg
 Ease of use very good

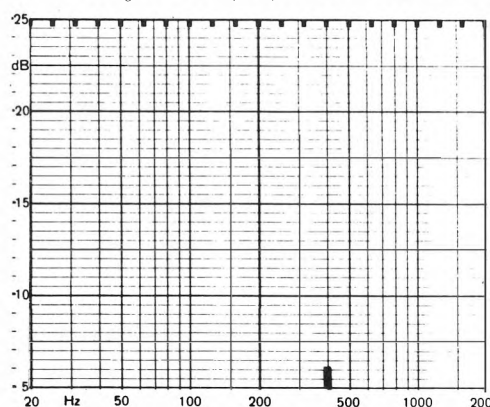
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system above average
 Hum level -70dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £150.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 12-13g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating K
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges recommended (10-20cu)

Marantz G6100

Marantz Audio (UK) Ltd., 203 London Rd., Staines, Middlesex. Staines 50132.



immunity to shock and vibration were barely adequate. On listening tests, the model was rated as about average which is a reasonable result at this price level, although the rumble level should be improved.

The Marantz product range is extensive and includes four turntables, three of which are assessed in this report. The cheapest is the 6100 which exhibits a high standard of external finish for the price. An auto-return and stop feature is incorporated, and the design includes a two speed belt drive motor section with a detachable headshell arm, the latter fitted with a massive, satin-gold finished headshell. The internal mechanics bear a strong resemblance to the Yamaha YP211, and both appear to have originated from the same factory.

On test, the turntable section delivered good wow and flutter, a slightly fast absolute speed, and a low variation under loading. Run-up time was pretty fast at 1.5 seconds. Unfortunately, the rumble level was only just adequate at -60dB , and motor vibration was audible at high listening levels.

The arm geometry was basically good although if the instructions are followed and the accessory masker used as directed, an error of $1^\circ\text{-}2^\circ$ results, which is not excessive, but does just about double the intrinsic tracking error of the arm itself. Lateral and vertical friction were moderate and the bias and downforce calibration correct. The cue action exhibited negligible drift and had close to ideal ascent and descent rates. The headshell is common to all four models in the Marantz range and weighs 13.5g. Unavoidably, this places the pickup arms in the heavyweight class, suitable for cartridges with compliances of 20cu or less, preferably in the range 8-15cu. Considering the high mass of the supplied headshell, the Marantz decks would benefit from the substitution of a lighter model, this would bring the effective mass into the 'medium' range, but the counterweight supplied might then prove too heavy.

The acoustic breakthrough, arm resonances and resistance to acoustic feedback were all classed as good, with the hum level acceptable, but the 138 Integrated turntables

MOTOR

General data

Type Belt drive with auto-return and stop
 Platter mass 1kg
 Platter damping adequate
 Finish and engineering good
 Type of mains lead three core
 Type of connecting lead phone + earth

Speed

Speeds offered 33 1/3, 45 rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.04%
 Absolute speed accuracy error +0.57%
 Speed drift none
 Speed variation under load -0.2%
 Start-up time to audible stabilisation 1.5secs

Rumble

DIN B weighted L and R average -60dB

ARM

General data

Type of headshell Universal detachable
 Headshell mass 13.5g
 Geometrical accuracy good*
 Adjustments provided height and overhang
 Finish and engineering good
 Ease of assembly good
 Trackability fairly good

Friction

Typical lateral 50mg
 Typical vertical 60mg

Bias compensation (set to 1.5g elliptical)

Type of system thread and weight
 Rim 185mg
 Centre 200mg

Downforce calibration error

1g 1.05g
 2g 2.0g

Cue operation

Drift negligible
 Ascent (8mm) 0.5secs
 Descent (8mm) 3secs

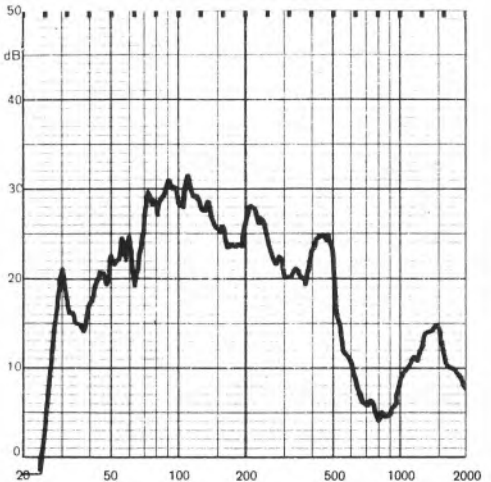
MOTOR AND ARM DATA

Size 440W x 350D x 167Hmm
 Clearance for lid 73mm
 Overall weight 6.6
 Ease of use very good

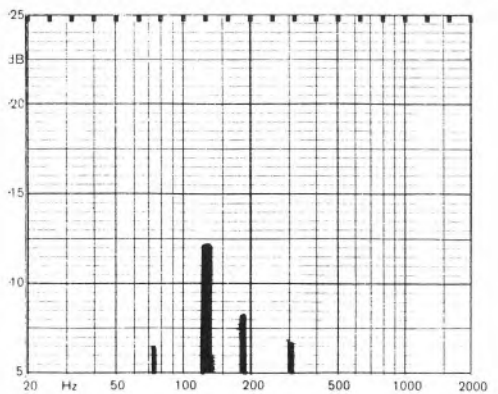
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system about average
 Hum level -65dB
 Acoustic feedback good
 Vibration sensitivity just adequate

Arm obtainable separately no
 Typical selling price ex VAT £65.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility
 Effective moving mass excluding cartridge 16-17g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A
 Damping rating J
 Recommended tracking weight 1.5-3g
 Low to medium compliance cartridges suitable 8-15cu

*see text

Marantz G6200

Marantz Audio (UK) Ltd., 203 London Rd., Staines, Middlesex. Staines 50132.



level was satisfactorily low but acoustic feedback susceptibility together with shock and vibration resistance were only just adequate.

It is thus difficult to recommend the 6200 and by comparison, the 6100 appears better value for money.

Numerically, the 6200 is the next model up from the 6100, and its purchase price is almost double. The cost difference is reflected by the numerous additional operating facilities offered by the 6200, but sad to say, its performance was no better, and in some cases was worse than that of the cheaper model.

The deck offers automatic operation for the setting-down cycle of stylus from rest to the groove, and also for return and stop. A record size selector is provided which also allows automatic cueing of 7", 10" and 12" records. Perhaps it is only fair to point out that this same automatic cueing facility (with the exception of the unusual 10" size) is available on the least costly model in the group, namely the BSR BDS80, costing about one quarter the price of the 6200.

While the deck met the manufacturer's specification on test, the results were nonetheless disappointing considering the higher price level. Wow and flutter was satisfactory at 0.1%, with a moderate +0.4% absolute speed error, and the drift was low, with resistance to loading good. The rumble level was only just adequate at -60dB and was audible on the listening tests.

The high arm mass has already been discussed in the 6100 review and once again indicates the need for careful choice of a compatible cartridge. While vertical friction was moderate the lateral component was rather high, although we suspect that our sample may be an exception in this respect. The downforce calibration was accurate but biasing was on the low side and was, in any case, disturbed by the high lateral friction.

While the acoustic breakthrough and arm resonance levels were considered fairly good, the subjective sound quality only ranked as average, which is not inspiring considering the price. Hum

MOTOR

General data

Type	Fully automatic, belt drive
Platter mass	1.05kg
Platter damping	adequate
Finish and engineering	good
Type of mains lead	three core
Type of connecting lead	phono + earth

Speed

Speeds offered	33 1/3, 45 rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.1%*
Absolute speed accuracy error	+0.4%
Speed drift	<0.1%
Speed variation under load	-0.2%
Start-up time to audible stabilisation	1sec

Rumble

DIN B weighted L and R average	-60dB
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ARM

General data

Type of headshell	Universal detachable
Headshell mass	13.5g
Geometrical accuracy	good*
Adjustments provided	overhang
Finish and engineering	good
Ease of assembly	good
Trackability	fairly good

Friction

Typical lateral	150mg
Typical vertical	35mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	100mg
Centre	100mg

Downforce calibration error

1g	1.05g
2g	2.0g

Cue operation

Drift	negligible
Ascent (8mm)	0.5secs
Descent (8mm)	1.0secs

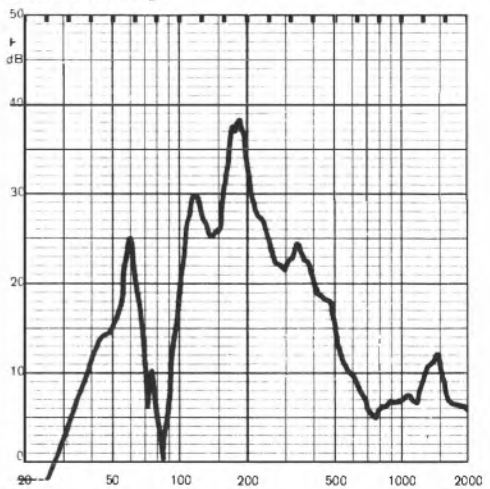
MOTOR AND ARM DATA

Size	440W x 350D x 170Hmm
Clearance for lid	72mm
Overall weight	7.6kg
Ease of use	very good

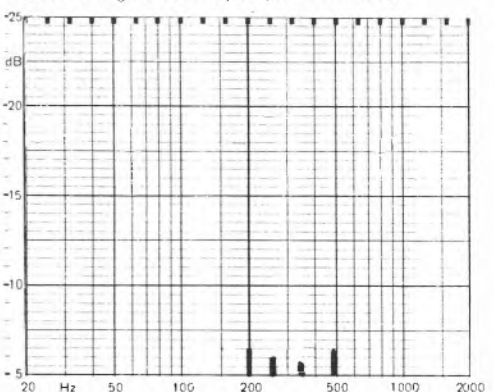
Typical acoustic breakthrough and resonances	fairly good
Subjective sound quality of complete system	average
Hum level	-70dB
Acoustic feedback	adequate
Vibration sensitivity	adequate

Arm obtainable separately	no
Typical selling price ex VAT	£120.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 16-17g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating	A
Damping rating	J
Recommended tracking weight	1.5-3g

Low to medium compliance cartridges suitable 8-15cu

*see text

Marantz G6300

Marantz Audio (UK) Ltd., 203 London Rd., Staines, Middlesex. Staines 50132.



The 6300 is one of the Marantz top line turntables, and incorporates the popular Matshushita direct drive motor with the usual strobe markings machined on the platter rim. Neon mains frequency illumination is provided as well as fine variable speed control for 33 1/3 and 45rpm. The cueing is under power control, energised by light push buttons and as the automatic facility only refers to arm return and stop, it is still necessary to place the pick-up over the desired groove on the disc.

On test, the Matshushita motor produced fairly typical results and although wow and flutter and rumble were both a little worse than average for this type of motor, they were nonetheless satisfactory. The speed stability and resistance to loading were however better than average, perhaps due to a special power supply section.

In contrast to the other two Marantz arms, the overhang alignment method proved to be exactly correct. Lateral arm friction was adequate, vertical, moderate and the downforce calibration accurate. The bias values were a little on the high side but quite reasonable. No drift was shown on the cue control, but the ascent was notably slow at 5 seconds. The instruction manual contains the statement that 'any high quality stereo phono cartridge will provide excellent results with the Marantz 6300', the example illustrated in the handbook being the Shure V15. I beg to disagree, as such a combination results in an arm/cartridge response at 4.9Hz, (M_e total 26g, compliance 40cu) which is unacceptably low by the standards of this report. To take an even worse case of mismatching, an Empire 2000Z might be chosen, which would produce a 3.9Hz resonance, far below the 10Hz range required for optimum tracking performance and stability. Cartridge compliance values of greater than 15 cu will inevitably result in degraded

performance and excessive unwanted subsonic energy in the overall reproducing system.

The 6300 was rated as just adequate on vibration and shock immunity, fairly good as regards acoustic breakthrough and general resonances, and good on acoustic feedback. The hum level was satisfactory and the general subjective sound quality was rated as average. As with the other turntables using this motor, a trace of wow was discernible on revealing programme material, although the effect was less than with some of the other decks in the survey. As has been explained, the purchaser should take due note of our recommendations concerning a compatible cartridge; while a mismatch can be made to track records, it certainly cannot produce optimal results.

MOTOR

General data

Type direct drive automatic and manual
 Platter mass 1.78kg
 Platter damping good
 Finish and engineering very good
 Type of mains lead three core
 Type of connecting lead phono and earth

Speed

Speeds offered 33 1/3 and 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.06%
 Absolute speed accuracy error <0.1%
 Speed drift <0.1%
 Speed variation under load 0.2%
 Start-up time to audible stabilisation 4secs

Rumble

DIN B weighted L and R average -66dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 13.5g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 80mg
 Typical vertical 30mg

Bias compensation (set to 1.5g elliptical)

Type of system weighted lever
 Rim 230mg
 Centre 220mg

Downforce calibration error

1g 1g
 2g 1.95g

Cue operation

Drift negligible
 Ascent (8mm) 5secs
 Descent (8mm) 5secs

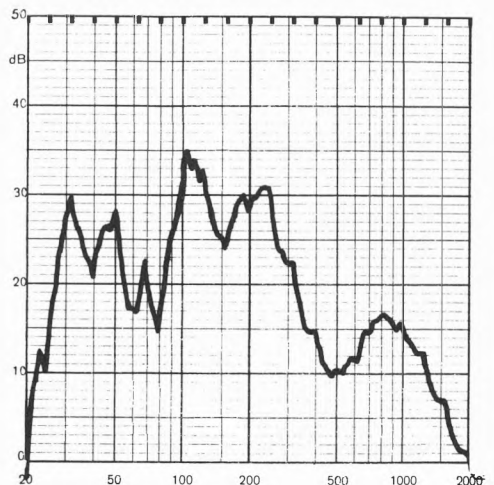
MOTOR AND ARM DATA

Size 434 W x 375 D x 186 H mm
 Clearance for lid 77mm
 Overall weight approx 10kg
 Ease of use good

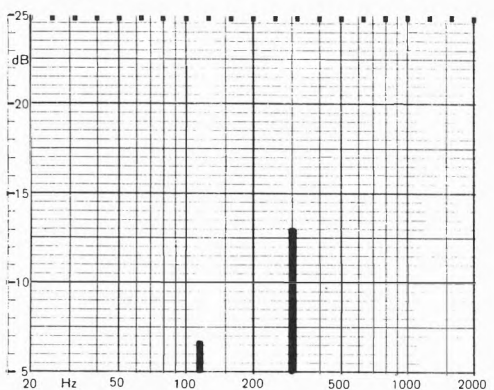
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system average
 Hum level -68dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £185.00

Acoustic break through.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 19-21g

Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating A

Damping rating J

Recommended tracking weight 1.5-3g

Low to medium compliance cartridges recommended (6-12cu)

Micro Seiki MB10

Tannoy Products Ltd., St Johns Rd., Tylers Green, High Wycombe, Bucks. 049 481 5221.



This Micro-Seiki budget turntable presents a great contrast to its big brother, the DDX 1000 unit also reviewed in this report, the latter costing nearly six times as much, when equipped with an arm. The MB10 is a manual belt drive player powered by a four pole synchronous motor. Two speeds are offered, selected by a rotary lever.

As with the JVC JL-A15, the platter mass is quite low, at 0.6kg. Nevertheless, a very creditable 0.04% DIN peak weighted wow and flutter figure was recorded. Absolute speed was reasonably accurate and drift negligible, since the motor is locked to the mains supply which is usually very stable. Variation under 5g dust bug loading was fine, and the start up rapid. The rumble level, if not quite meeting the same low levels attained by one or two similarly priced Japanese decks, was nonetheless fairly good at -64dB.

The arm sports an unusually styled die cast headshell which is on the heavy side at 9g. Geometry and alignment were to a good standard, the friction satisfactorily low and bias force almost ideal. Downforce calibration was on the low side but still reasonable. The cue action showed moderate lateral drift, and the descent time was rather slow at 7 seconds to complete the review standard stylus drop of 8mm. Tests showed the effective arm mass to be in the 10-11g range which indicates the use of cartridges with compliance values of 15-25cu, tracking from 1.25g to 3.0g.

The acoustic breakthrough and resonance were considered to be good, but the vibration was only just adequate, despite the Micro's famous shock absorber feet. A sturdy, well founded shelf would be a good idea for mounting the deck and could well help to improve the sound quality which was judged to be average on the listening tests, which is fair enough at the price.



MOTOR

General data

Type manual belt drive
 Platter mass 0.6kg
 Platter damping good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33%, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.04%
 Absolute speed accuracy error +0.4%
 Speed drift none
 Speed variation under load -0.2%
 Start-up time to audible stabilisation 1sec

Rumble

DIN B weighted L and R average -64dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 9g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering very good
 Ease of assembly very good*
 Trackability very good

Friction

Typical lateral 30mg
 Typical vertical 15mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 180mg
 Centre 200mg

Downforce calibration error

1g 0.9g
 2g 1.75g

Cue operation

Drift satisfactory
 Ascent (8mm) 1sec
 Descent (8mm) 7secs

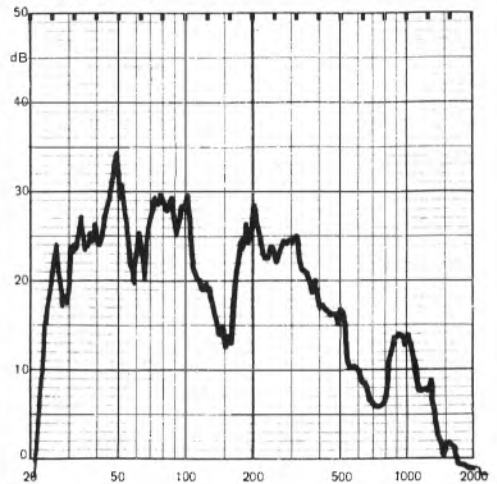
MOTOR AND ARM DATA

Size 456 W x 366 D x 140 H mm
 Clearance for lid 70mm
 Overall weight 5.0kg
 Ease of use very good

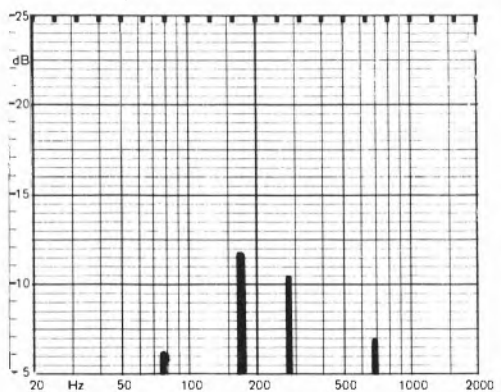
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system average
 Hum level -60dB
 Acoustic feedback adequate
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £55.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 10-11g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3g
 Medium compliance cartridges compatible (15-25cu)

*See text

Philips GA222

Philips Electrical Ltd., Century House, Shatesbury Av., London WC2H 8AS. 01-689 2166.



Philips most expensive model is the GA222, which carries over the electronic touch buttons of the GA312 but with further styling and operational refinements. Both automatic and manual play modes are possible and a GP412 Mk 11 cartridge is normally ready fitted. Judged by the compatibility standards set in this report, this is a poor choice; not on grounds of subjective quality but simply because the arm/cartridge resonance is too low, at less than 6Hz. This is well under the ideal 10-12Hz suggested for optimum tracking. In addition, as with the other Philips decks, the sub-chassis resonance at approximately 4-5Hz was higher than our suggested figure of 2-3Hz, and is therefore suspect as it falls so close to the already low arm resonance.

Nevertheless, a high level of success has been achieved in other directions, notably the suspension design, as the vibration immunity was good. In common with the other suspended decks in the report, listening tests using the reference cartridge ranked this model well above average although only on a par with the cheaper GA437. The deck is clearly capable of a very good all round performance if fitted with a suitably low compliance cartridge, (10-20cu). Backing up the favourable subjective results are the curves for acoustic breakthrough and arm resonance, both of which are classed as better than average.

Lab tests revealed moderate, but poorer than spec arm friction values, together with rather high biasing. This pattern was common to all three Philips models despite their different arm design. Downforce calibration was on the low side; 17.5% too low, to be exact at the 1g nominal setting. This could be improved, particularly since the error should sensibly be on the high rather than the low side to ensure safe tracking. No cue lift drift was shown but the descent was at times erratic and the

ascent at 4 seconds was too slow. Ideally, the stylus should lift quickly out of the groove, in 0.5 of a second or less, to minimise groove damage.

On the motor side wow and flutter was fine and rumble more than adequate – only just audible at the highest volume levels with a wide dynamic range system. The speed drift of 0.4% over the one hour test was a trifle excessive, and it is not known whether it continued to deteriorate. However, excellent immunity to acoustic feedback was demonstrated which may be an advantage in known difficult locations, and it will certainly allow high volume levels to be employed almost regardless of turntable placement.

Philips' practice of using DIN audio leads is not favourable to low hum levels since in most cases, the joining of the chassis earth to the DIN shell and/or one of the signal earths usually results in a hum inducing loop. The level recorded was satisfactory, but could be much better. I would favour optional phono lead versions for the UK market, even though this might cause problems with other DIN equipped ancillary electronics produced by Philips.

MOTOR

General data

Type..... belt drive automatic/manual deck
 Platter mass 1.16kg
 Platter damping fairly good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead DIN with integral earth

Speed

Speeds offered 33%, 45rpm
 Fine speed control..... yes
 Wow and flutter (DIN peak weighted) 0.05%
 Absolute speed accuracy error -0.2%
 Speed drift +0.4%
 Speed variation under load -0.33%
 Start-up time to audible stabilisation 1.5 secs

Rumble

DIN B weighted L and R average..... -66dB

ARM

General data

Type of headshell..... Philips slide carrier
 Headshell mass
 Geometrical accuracy..... good
 Adjustments provided overhang, height via spacers
 Finish and engineering good
 Ease of assembly..... very good
 Trackability..... good

Friction

Typical lateral..... 60mg
 Typical vertical..... 40mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 280mg
 Centre 350mg

Downforce calibration error

1g 0.825g
 2g 1.825g

Cue operation

Drift..... negligible
 Ascent (8mm) 4 secs
 Descent (8mm) 2.5 secs

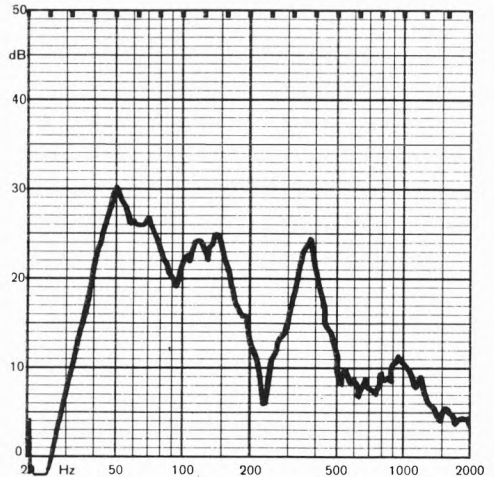
MOTOR AND ARM DATA

Size..... 385 W x 325 D x 145 H mm
 Clearance for lid 92mm
 Overall weight 7.0kg
 Ease of use very good

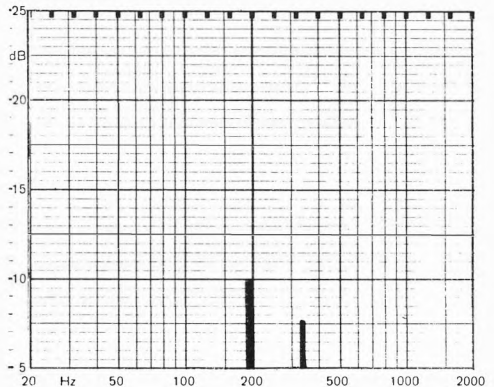
Typical acoustic breakthrough and resonances..... good
 Subjective sound quality of complete system good
 Hum level -63dB*
 Acoustic feedback very good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £110.00 inc cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge..... 12-14g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating..... B
 Damping rating..... J
 Recommended tracking weight..... 1.25-3g
 Low to medium compliance cartridges required (10-20cu)

*See text

Philips GA 312

Philips Electrical Ltd., Century House, Shaftesbury Av., London WC2H 8AS. 01-689 2166.



The Philips GA312 is an updated version of their established GA212 model. It features a servo controlled DC motor with belt drive, a fully suspended sub-chassis and electronic touch controls for start and stop. A fine variable speed adjustment is available for both 33½ and 45rpm, with the stroboscope markings printed on the platter upper surface where they are normally hidden by a record. It could be argued that this is a good thing, since stroboscopes are rarely used and cause more worry and confusion than they are worth! The unit is generally supplied with a Philips GP401 MkII cartridge which possesses a compliance of typically 35cu, and in conjunction with the GA312 arm will give a combined resonance at 6.5Hz. This is in fact too low and comes dangerously near the sub-chassis resonance which has various modes from 4-6Hz. Using the GP401 MkII cartridge the deck was classed as having poor resistance to vibration or shock, although matters improved greatly with the use of the test 20cu cartridge. It is a pity that the deck and supplied cartridge are not adequately compatible, especially as both are supplied by the same manufacturer!

The first sample of the GA312 that we tested showed rather high wow and flutter figures, and accordingly a second deck was obtained. The latter gave a satisfactory figure of 0.1% DIN peak weighted, with rumble at -65dB. Overall speed accuracy, stability and tolerance of loading were classed as good. Arm friction was reasonable but nowhere near the specification of 15mg in both planes. Bias levels were somewhat high and a reduction of some 30% would be beneficial.

In common with the GA437, a steel platter was used in this deck. In practice, this means that the use of moving coil cartridges is not to be recommended and the deck may also prove

unsuitable for some of the 'induced' types with exposed magnets, such as the ADC QLM or VLM.

On acoustic breakthrough and resonance the GA312 fared well; resistance to acoustic feedback was classed as high. Subjective sound quality belied the low price and was of a genuinely high standard, well above the average level.

With such a good performance on certain points, one would like to recommend the GA312, but on balance, such approval must be withheld until Philips improve the matching compatibility of the supplied arm and cartridge, and can resolve the high bias and hum levels and the above spec friction. 'Phono' audio leads would also be an advantage for the UK market.

MOTOR

General data

Type manual belt drive, auto lift and stop
 Platter mass 1.1kg
 Platter damping adequate
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead DIN integral earthing

Speed

Speeds offered 33 $\frac{1}{3}$, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.1%*
 Absolute speed accuracy error <0.1%
 Speed drift <0.1%
 Speed variation under load -0.23%
 Start-up time to audible stabilisation 2.0sec

Rumble

DIN B weighted L and R average -65dB

ARM

General data

Type of headshell Philips slide carrier
 Headshell mass —
 Geometrical accuracy good
 Adjustments provided overhang only
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 50mg
 Typical vertical 50mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 220mg
 Centre 300mg

Downforce calibration error

1g 0.95g
 2g 1.95g

Cue operation

Drift —
 Ascent (8mm) —
 Descent (8mm) —

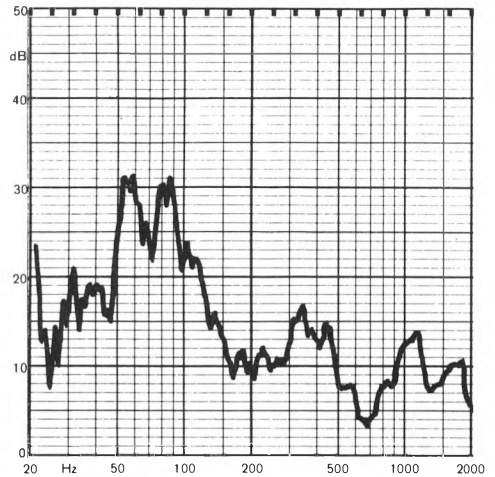
MOTOR AND ARM DATA

Size 388 W x 333 D x 154 H mm
 Clearance for lid 102mm
 Overall weight 7.5kg
 Ease of use good

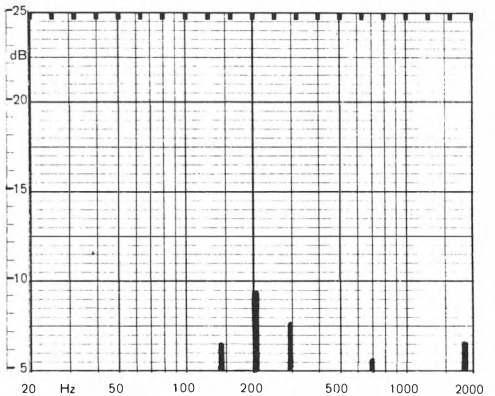
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system very good
 Hum level -63dB
 Acoustic feedback very good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £95.00 inc cartridge

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 10-11g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3.0g
 Low to medium compliance cartridges required (10-20cu)

*See text

Philips GA 437

Philips Electrical Ltd., Century House, Shaftesbury Av., London WC2H 8AS. 01-689 2166.



The GA437 is Philips latest low cost integrated turntable and is normally supplied with a GP400 Mk II cartridge (see cartridge section.). A belt drive manual player with automatic arm lift at the end of a side, this unit also incorporates the floating sub-chassis common to the other Philips models, as well as to certain decks from other manufacturers, notably Thorens and B&O. An ingenious balance is incorporated into the arm rest which reads the stylus downforce directly, and thus simplifies the setting up procedure.

While the construction comprised light alloy panels and plastic moulding, the standard of engineering and finish were both to a high standard, especially in the areas where this is important. The GA437 is one of the lowest cost decks to incorporate a floating sub chassis, and the results gained during the compilation of this report indicate this to be a definite plus feature, with regard to both resistance to shock and colouration.

On test, wow and flutter was very good at 0.06%, and rumble satisfactory at -65dB. The speed was quite accurate and not unduly affected by loading. The arm possessed fairly high friction in the lateral plane and this fact, together with the tracking results and effective mass, suggests the use of a 1.5 to 3.0g tracking cartridge with a compliance of between 10 and 20cu. This surprisingly enough rules out the cartridge supplied with the deck, whose mass of 6g and compliance of 30cu results in an arm resonance at 6.8Hz when used in the GA437. Since the sub-chassis suspension resonances are in the 4-6Hz range, the arm/cartridge resonance is too close for optimum vibration resistance and cartridge trackability. Perhaps Philips should consider reducing the compliance of the GP 400 Mk II to suit?

Downforce calibration was pretty accurate but the bias values were high, roughly double that required.

The cue control operated satisfactorily but surprisingly enough, the time for the ascent was over double that for the descent, the latter a trifle fast but not unduly so.

Subjective testing ranked this turntable as very good, significantly better than a number of costly direct drive decks, and this aspect gains the GA437 high marks considering its price. The Ultimo 20A worked quite satisfactorily in this deck although in general the use of moving coil cartridges is not recommended due to the magnetic attraction between the cartridge and the pressed steel platter. Great care was taken to set the correct downforce with the test cartridge, but this would be difficult for the average purchaser to effect, since a sensitive spring balance was used.

MOTOR

General data

Type belt drive manual with auto stop and lift
 Platter mass 0.8kg
 Platter damping good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead DIN, integral earth

Speed

Speeds offered 33 $\frac{1}{3}$, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.06%
 Absolute speed accuracy error -0.2%
 Speed drift none
 Speed variation under load -0.3%
 Start-up time to audible stabilisation -

Rumble

DIN B weighted L and R average -65dB

ARM

General data

Type of headshell Philips slide carrier
 Headshell mass -
 Geometrical accuracy good
 Adjustments provided overhang only
 Finish and engineering very good
 Ease of assembly good
 Trackability fairly good

Friction

Typical lateral 80mg
 Typical vertical <20mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 300mg
 Centre 400mg

Downforce calibration error

1g 1.1g
 2g 2.1g

Cue operation

Drift satisfactory
 Ascent (8mm) 2secs
 Descent (8mm) 0.8secs

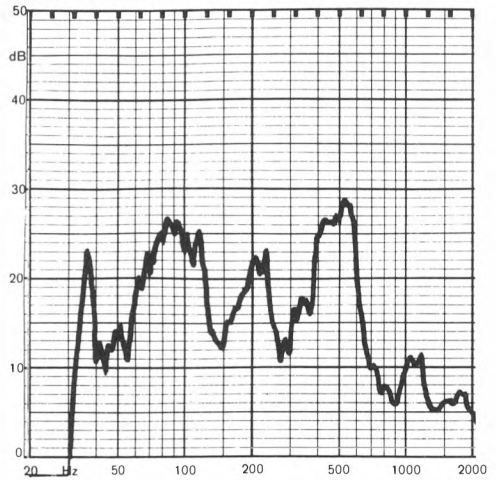
MOTOR AND ARM DATA

Size 416 W x 345 D x 140 H mm
 Clearance for lid 90mm
 Overall weight 6.3kg
 Ease of use very good

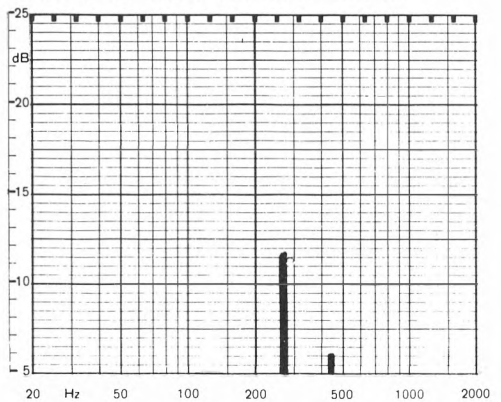
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system very good
 Hum level -67dB
 Acoustic feedback very good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £60.00 inc cartridge*

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 11-13g
 Resonance rating B
 Damping rating L
 Recommended tracking weight 1.5-3.0g
 Low to medium compliance cartridges compatible (10-20cu)

*See text

Pickering FA 104, 112, 145

Highgate Acoustic Ltd., 38 Jamestown Rd., London NW1. 01-267 4937.



The array of model numbers for this American turntable refers to the various types of cartridge with which it comes ready supplied. We have been informed that later this year the range will be updated, and the new decks will probably include the option to fit two of the Pickering cartridges reviewed in this report, namely the XSV3000 and the XV15 625E. In the light of this information, the present review must be regarded as interim information only and as an indication of Pickering's expertise at this price level.

The cartridges supplied are special cut-down bracket versions, which plug directly into the headshell of the FA1. The one supplied would retail at around £16, which provides us with some idea of the real price of the turntable alone, at around £70.00. However, in view of the proposed changes to the product, this cartridge was discarded and replaced by a XV15 625E stylus for the purpose of the lab and subjective testing. It should however be noted that with the factory fitted cartridge an alignment problem was immediately apparent, namely that a considerable lateral error of 4-5° existed. Checking with the importers and the manufacturer revealed that on our sample the arm pivot-to-platter spindle distance was incorrect, and others recently checked at the importers were free of this defect. (No user re-alignment is possible with this arm.)

On test, the motor section gave good wow and flutter and rumble figures, but the latter could probably have been improved in the absence of a sub-chassis resonance in the 200Hz region. The moving speed was highly accurate and was little affected by loading.

The arm demonstrated acceptable friction levels but these were insufficiently low to accommodate the most expensive Pickering cartridge, the XSV 152 Integrated turntables

3000, which tracks comfortably at 1.25g. Excessive force was also developed by the bias compensator, which should have produced less than half those values measured at a 1.5g dialed setting. The cue control worked well, and the downforce calibration proved satisfactorily accurate.

Using the FA1 we were unable to obtain a low hum background and this aspect could certainly be improved. The XV15 625E cartridge was found to be an excellent match for this arm, resulting in a 10.5Hz subsonic resonance which conferred good tracking stability and a resistance to shock and vibration. The floating sub-chassis was also a major advantage in this respect. A rating of 'good' was applied to the acoustic breakthrough, feedback, and subjective sound quality, the latter result favourable at the price. The breakthrough and feedback characteristics were controlled by moderate resonances at 70 and 200Hz, the latter apparently occurring in the sub-chassis.

While this sample of the FA1 did not do particularly well overall, the price is fairly reasonable and there were strong indications that with a little more design work, Pickering could have a competitive turntable.

MOTOR

General data

Type Belt drive, manually operated
 Platter mass 1.3kg
 Platter damping good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead phono + earth

Speed

Speeds offered 33 1/3, 45 rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.07%
 Absolute speed accuracy error <0.1%
 Speed drift none
 Speed variation under load -0.13%
 Start-up time to audible stabilisation 2.5secs

Rumble

DIN B weighted L and R average -67dB

ARM

General data

Type of headshell Fixed / cartridge plugs in
 Headshell mass —
 Geometrical accuracy poor*
 Adjustments provided none
 Finish and engineering fairly good
 Easy of assembly very good
 Trackability good

Friction

Typical lateral 60mg
 Typical vertical 80mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 400mg
 Centre 350mg

Downforce calibration error

1g 1.0g
 2g 2.2g

Cue operation

Drift satisfactory
 Ascent (8mm) 1sec
 Descent (8mm) 3secs

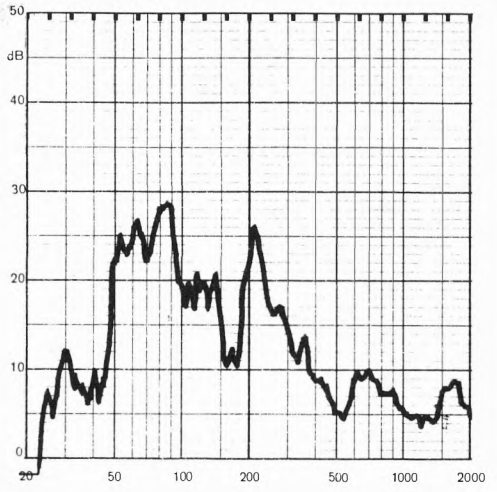
MOTOR AND ARM DATA

Size 375W x 330D x 178Hmm
 Clearance for lid 90mm
 Overall weight 5.7kg
 Ease of use good

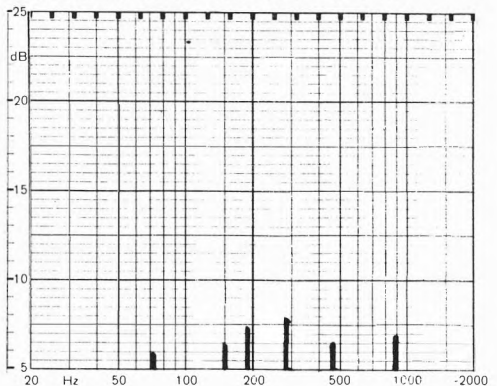
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system good
 Hum level -56dB
 Acoustic feedback good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £90.00 inc XV15/G25E cartridge

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 7-8g
 Resonance rating C
 Damping rating K
 Recommended tracking weight 1.5-3.0g

Medium compliance cartridges compatible (15-25cu)

*see text

Pioneer PL-112D

Shriro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



This result is commendable in view of its price level, and together with the inaudible wow and rumble levels, means that the deck offers very good value for money. However, a firm and rigid shelf is recommended to assist in reducing the effects of room vibrations.

This model is the successor to the popular PL-12D and offers the same two speed, belt drive, manually operated format. The styling has been updated, and most people find it attractive and well finished, considering the price. Performance has been improved, and Pioneer have looked into the problem of acoustic feedback – their solution involving the use of floating sub-chassis of a rather high natural frequency in the 10Hz range, together with a substantial plinth structure utilising mineral loaded plastic moulding.

Under lab testing, the motor section was found to have low wow and flutter, fine speed accuracy plus tolerance of loading, and a very good rumble level. Without reservation, this is a true hi-fi performance despite the modest price level.

The arm was found to be well made, had accurate downforce calibration, low friction and sensible biasing. The cue worked well although the 2sec ascent rate was rather slow, 0.5 seconds being the target figure. The arm effective mass was quite high and hence fairly low compliance cartridges in the 8-15cu range are recommended for optimum results, despite the fact that the overall arm performance is compatible with tracking weights down to 1.25g. The arm also incorporates one of the 'outrigger weights' of which Pioneer appear particularly fond. The resonance at 150Hz on the arm trace was attributed to this device, as was the 'fair' trackability rating. In our view, it is best removed altogether.

The high suspension resonant frequency has already been mentioned, and was largely responsible for the 'adequate' rating on resistance to external shock or vibration. Conversely, the PL-112D rated 'very good' on acoustic feedback. As regards acoustic breakthrough and arm resonances, and its subjective quality, the deck was classed as good.

MOTOR

General data

Type belt drive, manual
 Platter mass 800kg
 Platter damping very good
 Finish and engineering very good
 Type of mains lead three core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.05%
 Absolute speed accuracy error +0.13%
 Speed drift none
 Speed variation under load -0.1%
 Start-up time to audible stabilisation 1sec

Rumble

DIN B weighted L and R average -69dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 8.5g
 Geometrical accuracy good
 Adjustments provided overhang only
 Finish and engineering very good
 Ease of assembly good
 Trackability fair*

Friction

Typical lateral 20mg
 Typical vertical 20mg

Bias compensation (set to 15g elliptical)

Type of system Spring
 Rim 150mg
 Centre 180mg

Downforce calibration error

1g 1.025g
 2g 1.95g

Cue operation

Drift negligible
 Ascent (8mm) 2secs
 Descent (8mm) 3.5secs

MOTOR AND ARM DATA

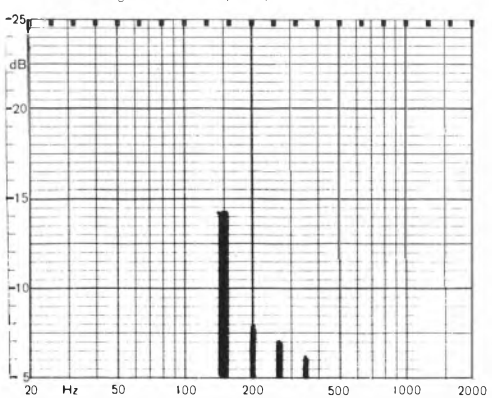
Size 440 W x 352 D x 159 H mm
 Clearance for lid 64mm
 Overall weight 6.0kg
 Ease of use very good
 Typical acoustic breakthrough and resonances good*
 Subjective sound quality of complete system good
 Hum level -70dB*
 Acoustic feedback very good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £50.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 13-15g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A/B
 Damping rating J
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges suitable (8-15cu)

*See text

Pioneer PL-510A

Shriro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



the 3 core cable was connected, greater hum levels resulted. Subjective sound quality was still considered to be above average with inaudible wow and rumble, but unless the variable speed facility was an essential feature, the PL-510A seems to offer little if any advantage to the prospective purchaser over the cheaper PL-112D.

A fairly inexpensive direct drive model, the PL-510A uses one of Pioneer's own motor designs. The unit is manually operated with all the control functions neatly grouped together on the right hand side of the deck plate, and including variable speed control for both 33 $\frac{1}{3}$ and 45rpm. As with the PL-112D, a sprung sub-chassis is incorporated but it was found to be rather stiff and would appear to be directed more towards suppressing acoustic feedback than to blocking the subsonic shock and vibration energy which is also detrimental to sound quality.

The motor achieved very good wow and flutter and rumble results on test. Absolute speed accuracy was fine, while the drift was moderate, as was the speed variation under load.

The arm downforce calibration was found to be perfectly accurate and bias levels were reasonable, but the vertical friction on this sample was high, indicative of an overtight bearing adjustment. The cue action was fine. As with the PL-112D, the arm was fitted with a lateral outrigger which impaired tracking at mid frequencies and is best removed altogether.

The effective mass placed the arm virtually in the heavy weight division. This means that for effective tracking stability and in order that unwanted subsonic energy is not transferred to the amplifier and loudspeakers, cartridges with compliance values in the 8-15cu range should be chosen. The friction levels on this particular sample indicated tracking forces from 1.5-3.0g to be appropriate.

On acoustic feedback the PL-510A rated as good but with vibration and shock resistance only adequate, and the deck did not fare as well as the PL-112D as regards acoustic breakthrough and resonances. With all the Pioneer decks, no hum problems were experienced using the earth tag adjoining the signal cables, but if the earth lead on

156 Integrated turntables

MOTOR

General data

Type direct drive manual
 Platter mass 1.4kg
 Platter damping very good
 Finish and engineering very good
 Type of mains lead three core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33⅓, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.035%
 Absolute speed accuracy error <0.1%
 Speed drift -0.2%
 Speed variation under load -0.23%
 Start-up time to audible stabilisation 3.5secs

Rumble

DIN B weighted L and R average -69dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 8g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering very good
 Ease of assembly good
 Trackability fairly good

Friction

Typical lateral 15mg
 Typical vertical 100mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 200mg
 Centre 200mg

Downforce calibration error

1g 1g
 2g 1g

Cue operation

Drift negligible
 Ascent (8mm) 1sec
 Descent (8mm) 3secs

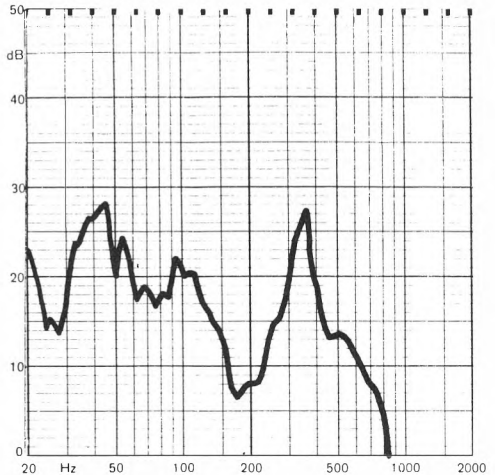
MOTOR AND ARM DATA

Size 440 W × 349 D × 159 H mm
 Clearance for lid 64mm
 Overall weight 8kg
 Ease of use very good

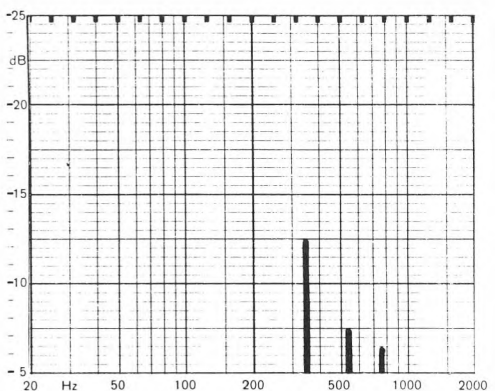
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system above average
 Hum level -70dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £100.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 14-16g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A
 Damping rating J
 Recommended tracking weight 1.5-3.0g
 Low to medium compliance cartridges recommended (8-15cu)

Pioneer PL-530

Shiro (UK) Ltd., Unit 5B, The Ridgeway, Iver, Bucks. 0753 65 2222.



In several respects, the PL-530 parallels the design of the PL-510A by using a similar Pioneer direct drive motor and pick-up arm. However, to actuate the fully automatic start and stop facilities, with selection from the lead-in sections of three record sizes, a second motor is incorporated, but manual control is also possible.

As with the PL-510A and the PL-112D, a rather stiffly suspended sub-chassis technique is employed in an attempt to isolate the platter/arm structure from the main part of the plinth and hence the room environment.

With this sample, the rumble reading was very good, although a couple of dBs below expectation. Analysis revealed a vibration component at mains frequency which we attributed to inadequate damping of the mains transformer, as the rumble due to the main bearing alone was certainly less than -70dB , DIN B weighted. Wow and flutter was excellent at 0.03% and the 2 second motor start-up was quite rapid, with a good tolerance of loading. The speed drift of 0.6% over one hour was considered to be rather high, but its total effect would depend on whether this trend continued or began to stabilise.

On test, the arm provided the low friction values which we believe to be typical of this Pioneer series, thus indicating that the higher value recorded for the PL-510A was a sample fault. Downforce scaling was accurate, bias values near perfect, and the cue action free of drift, although the arm lift rate was rather slow. Once again, a lateral outrigger was fitted, which is best left off altogether, as the same detrimental effects observed with the PL-112D and PL-510A were also noted here. For example, the resonances recorded on the arm analysis were mainly attributable to the action of this device and disappeared on its removal, and the fairly good

trackability rating would likewise improve if the outrigger were omitted.

Once again, the arm mass places it virtually in the heavy weight category with cartridges possessing compliances in the 8-15cu range recommended for the best results.

Finally, on aspects of acoustic feedback, sound quality and vibration sensitivity the PL-530 was judged as being very similar to the PL-510A, which is hardly surprising considering the similarity in their mechanics and construction.

MOTOR

General data

Type direct drive automatic and manual
 Platter mass 1.4kg
 Platter damping very good
 Finish and engineering excellent
 Type of mains lead 3 core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.03%
 Absolute speed accuracy error <0.1%
 Speed drift -0.6%
 Speed variation under load -0.17%
 Start-up time to audible stabilisation 2secs

Rumble

DIN B weighted L and R average -68dB*

ARM

General data

Type of headshell universal detachable
 Headshell mass 8g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering very good
 Ease of assembly very good
 Trackability fairly good

Friction

Typical lateral 25mg
 Typical vertical 10mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 150mg
 Centre 175mg

Downforce calibration error

1g 0.98g
 2g 2g

Cue operation

Drift negligible
 Ascent (8mm) 3secs
 Descent (8mm) 3secs

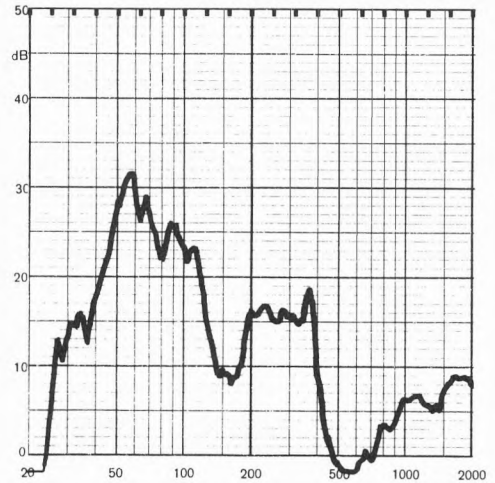
MOTOR AND ARM DATA

Size 480W x 390D x 170H mm
 Clearance for lid 80mm
 Overall weight 10kg
 Ease of use very good

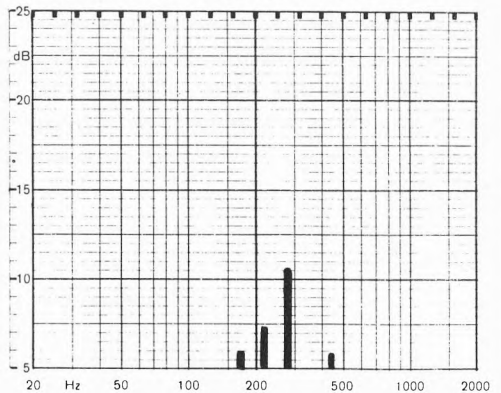
Typical acoustic breakthrough and resonances fairly good*
 Subjective sound quality of complete system above average
 Hum level -73dB
 Acoustic feedback good
 Vibration sensitivity just adequate

Arm obtainable separately no
 Typical selling price ex VAT £150.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 12-14g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A
 Damping rating J
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges compatible (8-15cu)

*See text

Pioneer PL-550

Shriro (UK) Ltd., Unit 5B, The Ridgway, Iver, Bucks. 0753 65 2222.



The PL-550's claim to fame lies in its use of a quartz crystal oscillator as an accurate timing reference, endowing the deck with a superlative speed accuracy that is practically unaffected by aging, temperature, loading or any similar influence. The oscillator uses a timing circuit akin to those employed for quartz wristwatches and bearing in mind the price of the latter devices and the absence of gimmickry on the PL-550, the quartz feature should not in itself add unduly to the turntable's cost.

In fact, it must be said at the outset that the PL-550 is probably the cheapest quartz turntable on the market today, but the value of the quartz feature is itself debateable, as the orders of accuracy it offers can have only a marginal effect on the subjective sound quality. However, a second version of the deck has already been announced by Pioneer; whereas the PL-550 is a manual deck, the new model offers similar automatic facilities to those described for the PL-530, although obviously at an additional cost.

On test, the motor provided predictably low wow and flutter with superb speed accuracy, stability and tolerance of loading. Start-up was moderate at 2.5 seconds, and rumble proved to be inaudible at a measured -70dB . Also in comparison with the other turntables, we perceived a greater stability of pitch with both this and the other quartz model in the report, the Technics SP10.

The pick-up arm proved similar to that used for the other Pioneer decks, and although friction levels were slightly lower and biasing more accurate, greater error was noted on the down force calibration. However this fortunately erred on the high side and was unimportant in degree. The ubiquitous lateral outrigger which we feel should be discarded was again incorporated here; the 160 Integrated turntables

resonance and trackability rating for the arm would improve somewhat with its omission.

The combination of a very heavy and dead plinth structure plus moderately effective rubber feet endowed the PL-550 with fair acoustic breakthrough properties and a reasonably good immunity to external shock and acoustic feedback. On subjective quality, the deck rated as good. While not indicative of outstanding value this nonetheless places it above the level of many of the other direct drive models in the report.

MOTOR

General data

Type	direct drive 'Quartz', manual
Platter mass	1.85kg
Platter damping	good
Finish and engineering	excellent
Type of mains lead	three core
Type of connecting lead	phono plus earth tag

Speed

Speeds offered	33 $\frac{1}{3}$, 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.035%
Absolute speed accuracy error	<0.01%
Speed drift	zero
Speed variation under load	zero
Start-up time to audible stabilisation	2.5secs

Rumble

DIN B weighted L and R average	-70dB
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ARM

General data

Type of headshell	universal detachable
Headshell mass	8.5g
Geometrical accuracy	very good
Adjustments provided	overhang, height
Finish and engineering	very good
Ease of assembly	good
Trackability	fairly good

Friction

Typical lateral	15mg
Typical vertical	15mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	180mg
Centre	200mg

Downforce calibration error

1g	1.075g
2g	2.1g

Cue operation

Drift	negligible
Ascent (8mm)	2.5secs
Descent (8mm)	2.5secs

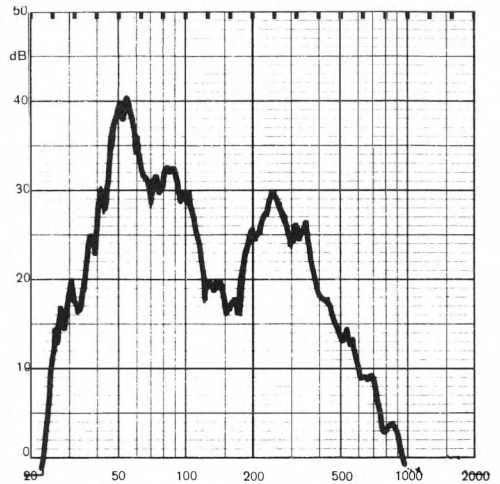
MOTOR AND ARM DATA

Size	490 W x 390 D x 177 H mm
Clearance for lid	78mm
Overall weight	12.0kg
Ease of use	very good
Typical acoustic breakthrough and resonances	fair
Subjective sound quality of complete system	good
Hum level	-73dB
Acoustic feedback	good
Vibration sensitivity	good
Arm obtainable separately	no
Typical selling price ex VAT	£170.00

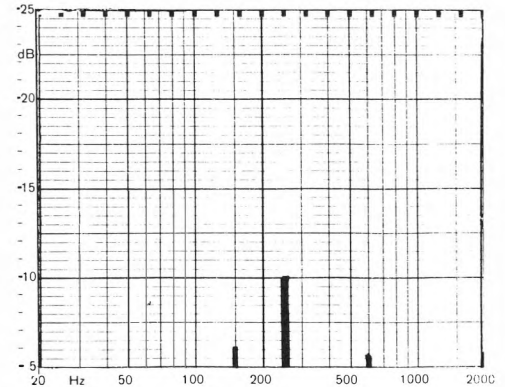
Compatibility

Effective moving mass excluding cartridge	12-14g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	A
Damping rating	J
Recommended tracking weight	1.25-3g
Low to medium compliance cartridges suitable (8-15cu)	

Acoustic breakthrough

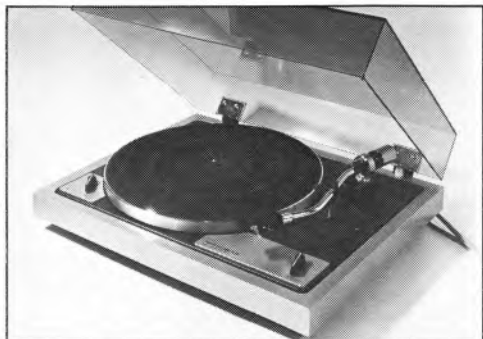


Indication of magnitude and frequency of arm resonances



Prinzsound PL15

Dixons Photographic Ltd., Prinz House, 84-88 Pinner Rd., Harrow, Middlesex. 01-863 9411.



degree of background hum was present but again, it was reasonable. Resistance to acoustic feedback was classed as good, but shock and vibration caused considerable disturbance, and resulted in the sprung steel chassis bouncing about. Although the subjective sound quality was classed as below average for the whole group using the reference cartridge, when judged against similarly priced competition, the result is quite favourable.

Prinzsound is the brand name given to Dixon's range of audio equipment. Manufactured in Japan, the PL15 is a manually operated, belt driven turntable with two speeds, namely 33 $\frac{1}{3}$ and 45rpm. A cartridge was supplied, which bore the Prinzsound label but appeared to be a UK made version of the Sonotone V100, (see cartridge reports.) It was found to be aligned in error by 3° and the recommended means of correction was far from simple; it involved measuring a 15mm overhang distance between the turntable spindle centre and the stylus tip. Other accessories included the usual 45rpm record centre and some oil for lubricating the motor spindle. This operation is recommended every three months or after 200 hours of use.

The arm provided an essentially good all round performance, with moderate friction, accurate downforce and sensible bias levels for the spherical tipped styli likely to be used with the deck. The cue action was free of drift although both ascent and descent rates were rather slow. A low mass headshell was provided (5g) but as the arm itself was fairly substantial, the total effective mass was classed as 'medium to high'. The supplied cartridge possessed a compliance value of 16cu which provided an almost ideal arm subsonic resonance at 8.4Hz. In this and other respects the cartridge was considered to be a good match for the deck, tracking at 2.0-2.5g.

On test, the motor section gave low wow and flutter, satisfactory speed accuracy and tolerance of loading, plus a rapid start. The rumble was satisfactory for the price level and proved only just audible as motor 'drone' at very high listening levels.

Some resonances were identified in the arm analysis but were not considered to be serious considering the low cost of the deck, and the resistance to acoustic feedback was fairly good. A 162 Integrated turntables

MOTOR

General data

Type manual belt drive
 Platter mass 0.5kg
 Platter damping good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead phono and earth wire

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.6%
 Absolute speed accuracy error +0.7%
 Speed drift none
 Speed variation under load -0.23%
 Start-up time to audible stabilisation 0.8secs

Rumble

DIN B weighted L and R average -62dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 5g
 Geometrical accuracy good*
 Adjustments provided height and overhang
 Finish and engineering good
 Ease of assembly poor
 Trackability fairly good

Friction

Typical lateral 50mg
 Typical vertical 50mg

Bias compensation (set to 1.5g elliptical)

Type of system thread and weight
 Rim 150mg
 Centre 100mg

Downforce calibration error

1g 0.95g
 2g 1.95g

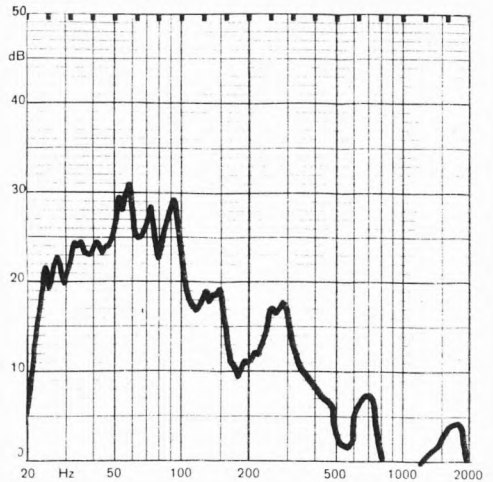
Cue operation

Drift negligible
 Ascent (8mm) 2-5secs
 Descent (8mm) 6secs

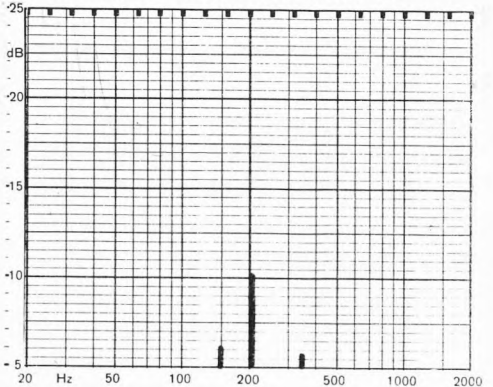
MOTOR AND ARM DATA

Size 444 W x 353 D x 167 H mm
 Clearance for lid 66mm
 Overall weight
 Ease of use good
 Typical acoustic breakthrough and resonances fair
 Subjective sound quality of complete system below average
 Hum level -64dB
 Acoustic feedback good
 Vibration sensitivity adequate
 Arm obtainable separately no
 Typical selling price ex VAT £47.00 inc cartridge

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 12-13g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.5-3g
 Low to medium compliance cartridges recommended (10-20cu)

*See text

Rotel RP-3300

Rank Audio Products Ltd., P O Box 70, Great West Rd., Brentford, Middlesex. 01-568 9222.



The RP-3300 is a well finished, belt driven turntable with an integrated arm, the latter manually operated. The motor is a servo operated type with fine speed control and a matching stroboscope with mains neon illumination, and the rigid, one piece plinth/chassis assembly is fitted with rubber cored feet to act as shock absorbers.

On test, the turntable section provided a reasonable wow and flutter level with a rapid start, fine speed accuracy and low drift with only moderate slowing under the 5g dust bug loading. The rumble level was satisfactory at -64dB DIN B weighted, if not quite as good as some of its competitors.

As regards the arm, the headshell mass was fairly low, helping to place the overall effective mass in the medium category, suited to cartridges of compliance in the 10-20cu range and tracking between 1.25 and 3.0g. The cue ascent and descent rates were sensible, but the latter showed considerable drift. Friction was quite low in both planes, the downforce calibration accurate and in contrast to the other Rotel deck, the biasing was virtually correct. However, bias force discrepancies such as were noted for the RP5300 were by no means restricted to Rotel and were common to several other manufacturers' products as well. This is a worrying situation as it not only implies that levels are inconsistent and inaccurate from model to model, but also from manufacturer to manufacturer.

On acoustic breakthrough and resonances, the deck was rated as fairly poor with the subjective sound quality as below average and similar to that produced by the RP-5300. Resistance to acoustic feedback was only adequate and immunity to external shock and vibration poor.

MOTOR

General data

Type belt drive manual
 Platter mass 0.95kg
 Platter damping good
 Finish and engineering good
 Type of mains lead 2 core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) <0.09%
 Absolute speed accuracy error <0.1%
 Speed drift <0.1%
 Speed variation under load -0.27%
 Start-up time to audible stabilisation 1.2secs

Rumble

DIN B weighted L and R average -64dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 7.5g
 Geometrical accuracy very good
 Adjustments provided overhang, height
 Finish and engineering very good
 Ease of assembly very good
 Trackability good

Friction

Typical lateral 20mg
 Typical vertical 20mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 150mg
 Centre 150mg

Downforce calibration error

1g 1g
 2g 2.05g

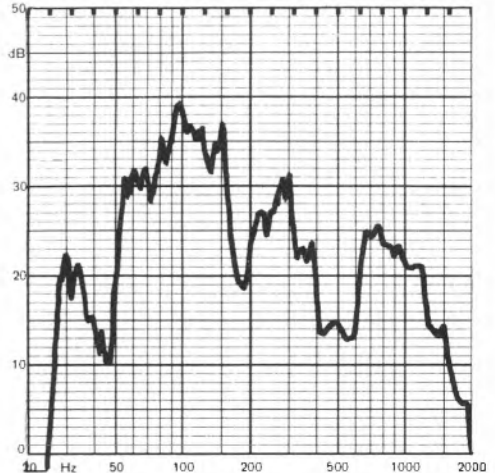
Cue operation

Drift poor
 Ascent (8mm) 0.5secs
 Descent (8mm) 3secs

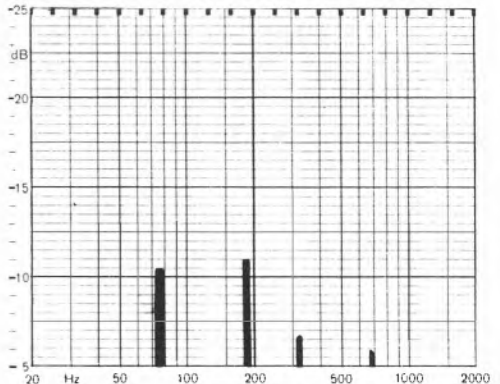
MOTOR AND ARM DATA

Size 440 W x 350 D x 130 H mm
 Clearance for lid 62mm
 Overall weight
 Ease of use very good
 Typical acoustic breakthrough and resonances fairly poor
 Subjective sound quality of complete system below average
 Hum level -67dB
 Acoustic feedback adequate
 Vibration sensitivity poor
 Arm obtainable separately no
 Typical selling price ex VAT £70.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 11-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges compatible (10-20cu)

Rotel RP-5300

Rank Audio Products Ltd., P O Box 70, Great West Rd., Brentford, Middlesex. 01-568 9222.



This manually-operated direct-drive turntable offers an attractively styled package for less than £100.00. The usual Matsushita motor is again incorporated in this design. The plinth chassis is a one piece moulded plastic assembly supported on plastic feet which have an internal rubber section for vibration absorption. Our test sample was so new that no instruction manual was as yet available, but in practice this caused few problems, as the deck proved both straight forward to set up and easy to use.

On test, the motor section offered a fine laboratory performance, with good wow and rumble figures, although neither of these parameters measured as low as certain of the other decks using the same type of motor. Of greater significance however was the slightly audible wow on difficult and revealing programme sections; with models costing under £100 this should not be judged as severely as the same effect in more expensive units, but nevertheless, several direct drive decks costing around the same as the RP-5300 have managed to avoid this problem altogether. Start-up time was fairly tardy at 3.5 seconds, and the variation under the test 5g downforce dust bug loading was judged to be significant. Absolute speed error and drift were low.

The arm exhibited good geometry with accurate downforce calibration, low friction and satisfactory cue operation. The biasing was somewhat high and if this sample is typical, a reduction of 30% on the-dialled setting would prove correct. The arm effective mass was in the medium range, suitable for cartridge compliances of 10-20cu, with downforces ranging from 1.25-3.0g.

On acoustic and subjective quality grounds however, the deck proved to be less satisfactory. The sound quality was rated as below average with 166 Integrated turntables

the acoustic breakthrough and resonances classed as fairly poor. On feedback susceptibility, it rated as good but was only considered to be adequate as regards its resistance to external vibration and shock. Mechanical tests revealed that the plinth structure of the deck was quite 'live' acoustically and this was felt to have contributed to the above results.

MOTOR

General data

Type direct drive manual
 Platter mass 0.9kg
 Platter damping very good
 Finish and engineering
 Type of mains lead 2 core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control
 Wow and flutter (DIN peak weighted) 0.07%
 Absolute speed accuracy error <0.1%
 Speed drift +0.2%
 Speed variation under load -0.4%
 Start-up time to audible stabilisation 3.5secs

Rumble

DIN B weighted L and R average -68dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 7.5g
 Geometrical accuracy very good
 Adjustments provided height, overhang
 Finish and engineering very good
 Ease of assembly very good
 Trackability good

Friction

Typical lateral 25mg
 Typical vertical 15mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 300mg
 Centre 300mg

Downforce calibration error

1g 1.03g
 2g2g

Cue operation

Drift satisfactory
 Ascent (8mm) 0.5secs
 Descent (8mm) 2.5secs

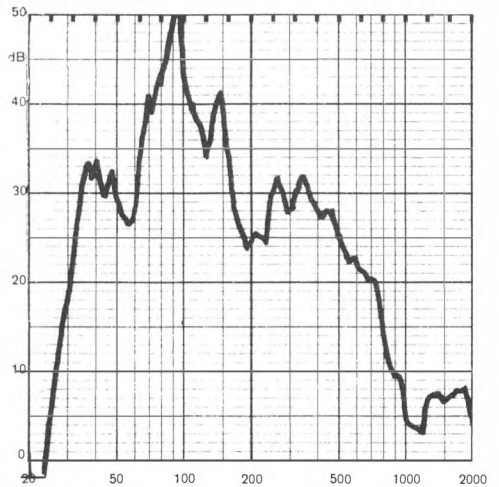
MOTOR AND ARM DATA

Size 440 W x 350 D x 130 H mm
 Clearance for lid 62mm
 Overall weight
 Ease of use good

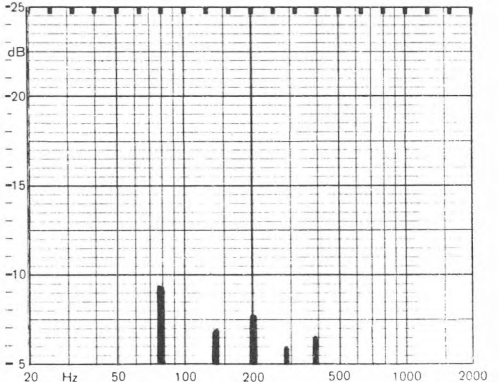
Typical acoustic breakthrough and resonances fairly poor
 Subjective sound quality of complete system below average
 Hum level -67dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £90.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 11-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges suitable (10-20cu)

Sansui SR-222

Sansui London Showroom, 39/41 Maple Street, London W1P 5FU. 01-580 5353.



have been better, and acoustic feedback and vibration resistance as good. The subjective sound quality was rated as average which is quite a good result at this price level.

A moderately priced turntable, the SR-222 offers manual operation in a lightweight two speed belt drive design. A one piece plinth/chassis construction is employed with the feet incorporating domed rubber inserts to help impart a degree of shock and vibration control.

Lab testing gave low levels of rumble and wow and flutter, and in general, the performance of both this and the other good budget priced decks in this report met remarkably high standards. The speed was found to be 0.5% slow which is significant but not excessive, and the variation under load was moderate.

The conventional 'S' shaped arm possessed the headshell fixing first used by Ortofon in the 1950s and since accepted as standard by SME and the vast majority of the Japanese manufacturers. The headshell carried a stub finger lift rivetted to the inner surface and it was found that this fixing got in the way of certain cartridges with wide flanges, particularly around the fixing screw holes. In practice however, most cartridges have cut away sides and only one or two are likely to cause any problems.

Lab testing gave low values of rumble and wow and flutter together with satisfactorily low friction values – notably better than another sample which I had previously tested. Downforce calibration was accurate, general finish to a good standard, and the bias levels of the right order. However, the ratio of the rim to centre was a trifle high and a compromise setting may have to be considered. The cue action showed some lateral drift but was otherwise satisfactory. No alignment protractor was provided, and Sansui's method of measuring the distance between stylus tip and centre spindle is awkward. Breakthrough and resonances were classed as fairly good, the hum level as satisfactory although it could

MOTOR

General data

Type..... belt drive manual operation
 Platter mass..... 0.6kg
 Platter damping..... good
 Finish and engineering..... good
 Type of mains lead..... two core
 Type of connecting lead..... phono plus earth

Speed

Speeds offered..... 33 1/3, 45rpm
 Fine speed control..... no
 Wow and flutter (DIN peak weighted)..... 0.06%
 Absolute speed accuracy error..... -0.5%
 Speed drift..... none
 Speed variation under load..... -0.35%
 Start-up time to audible stabilisation..... 1.5secs

Rumble

DIN B weighted L and R average..... -67dB

ARM

General data

Type of headshell..... universal detachable
 Headshell mass..... 8.5g
 Geometrical accuracy..... good
 Adjustments provided..... overhang*
 Finish and engineering..... good
 Ease of assembly..... good
 Trackability..... good

Friction

Typical lateral..... 30mg
 Typical vertical..... 15mg

Bias compensation (set to 1.5g elliptical)

Type of system..... spring
 Rim..... 110mg
 Centre..... 220mg

Downforce calibration error

1g..... 1.025g
 2g..... 2g

Cue operation

Drift..... satisfactory
 Ascent (8mm)..... 0.8secs
 Descent (8mm)..... 4secs

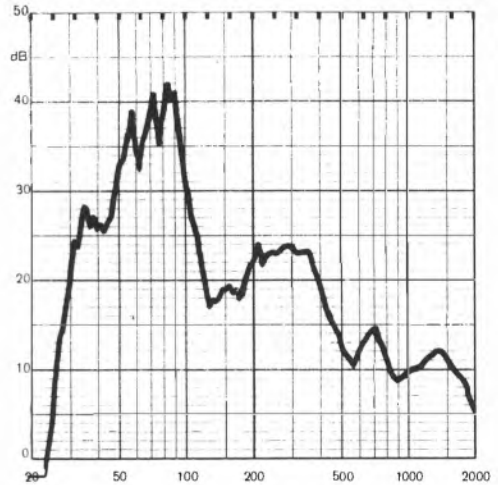
MOTOR AND ARM DATA

Size..... 453 W x 350 D x 140 H mm
 Clearance for lid..... 63mm
 Overall weight..... 6kg
 Ease of use..... good

Typical acoustic breakthrough and resonances..... fairly good
 Subjective sound quality of complete system..... average
 Hum level..... -64dB
 Acoustic feedback..... good
 Vibration sensitivity..... good

Arm obtainable separately..... no
 Typical selling price ex VAT..... £55.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances

No visible resonances

Compatibility

Effective moving mass excluding cartridge..... 11-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating..... B
 Damping rating..... K
 Recommended tracking weight..... 1.25-3g
 Low to medium compliance cartridges compatible (10-20cu)

*See text

Sansui SR-525

Sansui London Showroom, 39/41 Maple Street, London W1P 5FU. 01-580 5353.



Essentially, this manually operated turntable is a direct drive version of the SR-222. Like Pioneer, Sansui also make their own direct drive motors, and their current designs are free of the particular speed variation underload and overshoot recovery that are characteristic of certain models using the first generation Matsushita motor. On test the SR-525 provided an excellent -71dB rumble figure with very low wow and flutter. Drift and variation under load were classed as moderate but start-up was fairly slow at 3.5 seconds.

This arm uses a thread and weight bias compensator and inverted knife-edge bearings for the vertical plane and ball bearing races for the horizontal range. The three Sansui decks in this report exhibited differing bias levels for the same nominal setting and thus we recommend that for these and most other decks, the bias should be set with a chosen cartridge using a tracking test record rather than the dialled values on the arm.

Arm friction levels were even lower than for the SR-222, and the effective arm mass was in the medium to heavy range, indicating the use of cartridges with compliance values from 10-20cu, tracking for 1.25-3.0g.

While acoustic breakthrough and resonances were only classed as fair, the overall subjective sound quality was rated as above average, with low hum levels and very good resistance to acoustic feedback plus shock or vibration; clearly the plinth/feet combination on this deck is reasonably effective.

MOTOR

General data

Type direct drive manual
 Platter mass 1.4kg
 Platter damping good
 Finish and engineering very good
 Type of mains lead two core and earth
 Type of connecting lead phono plus earth

Speed

Speeds offered 33% & 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.025%
 Absolute speed accuracy error +0.1%
 Speed drift -0.33%
 Speed variation under load -0.33%
 Start-up time to audible stabilisation 3.3secs

Rumble

DIN B weighted L and R average -71dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 8g
 Geometrical accuracy good
 Adjustments provided overhang, height
 Finish and engineering very good
 Ease of assembly good
 Trackability fairly good

Friction

Typical lateral 15mg
 Typical vertical 10mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 400mg*
 Centre 500mg

Downforce calibration error

1g 1.05g
 2g 2.1g

Cue operation

Drift satisfactory
 Ascent (8mm) 0.5secs
 Descent (8mm) 3secs

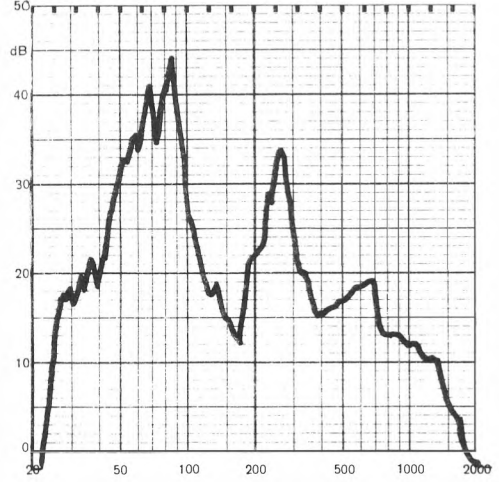
MOTOR AND ARM DATA

Size 470 W x 357 D x 152 H mm
 Clearance for lid 71mm
 Overall weight 9.5kg
 Ease of use good

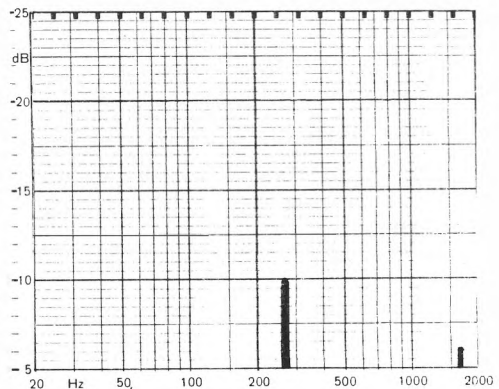
Typical acoustic breakthrough and resonances fair
 Subjective sound quality of complete system above average
 Hum level -70dB
 Acoustic feedback very good
 Vibration sensitivity very good

Arm obtainable separately no
 Typical selling price ex VAT £115.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 11-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating K
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges suitable (10-20cu)

*See text

Sansui FR-5080

Sansui London Showroom, 39/41 Maple Street, London W1P 5FU. 01-580 5353.



In a general sense, the FR-5080S may be regarded as an automatic version of the SR-525. There is good reason to suppose that a similar fine Sansui-built motor is employed, together with an arm which closely parallels that on the '222. In common with several other automatic direct drive designs, the extra power required for the auto function is derived from a separate small motor, (see Pioneer PL-530) and as with the other Sansui decks, the plinth/chassis is a one-piece structure relying on the rubber cushioned feet for shock and vibration absorption.

Lab testing confirmed the high performance of the motor with excellent 0.03% wow and flutter and -71dB rumble figures. By comparison with the SR-525, speed drift was rather lower, as was the variation under the load.

The arm demonstrated moderate friction values, accurate downforce calibration and satisfactory cue operation. The bias forces differed from the other Sansui decks, in fact lying somewhere between the near correct SR-222 and the excessive SR-525; but undersetting the bias by about 40% on the dial should give the correct result. As with most of the Japanese direct drive models, arm effective mass was fairly high, thus ruling out a large number of medium to high compliance cartridges. Models with values of 10-20cu are recommended, for the best results, which does not leave much freedom of choice as regards the recommended list of cartridges.

Acoustic feedback and shock resistance were both classed as good, acoustic breakthrough as fairly good and sound quality above average but not quite so clear as the SR-525, possibly due to the extra auto machinery.

MOTOR

General data

Type automatic direct drive
 Platter mass 1.43kg
 Platter damping good
 Finish and engineering very good
 Type of mains lead three core
 Type of connecting lead phonos plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.03%
 Absolute speed accuracy error <0.1%
 Speed drift <0.1%
 Speed variation under load 0.17%
 Start-up time to audible stabilisation 3.3secs

Rumble

DIN B weighted L and R average -71dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 8.25g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering very good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 40mg
 Typical vertical 25mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 225mg
 Centre 300mg

Downforce calibration error

1g 0.98g
 2g 2g

Cue operation

Drift satisfactory
 Ascent (8mm) 1sec
 Descent (8mm) 2secs

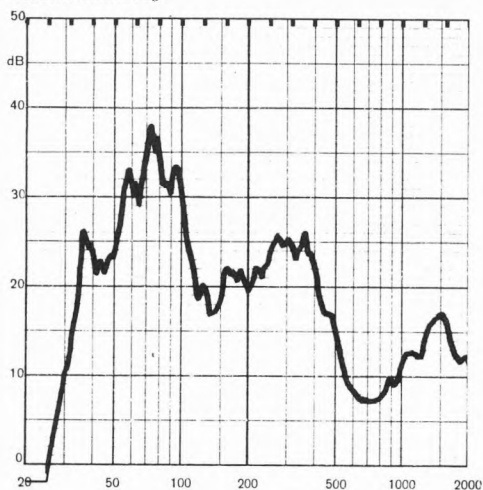
MOTOR AND ARM DATA

Size 470 W x 357 D x 150 H mm
 Clearance for lid 71mm
 Overall weight 12.8kg
 Ease of use very good

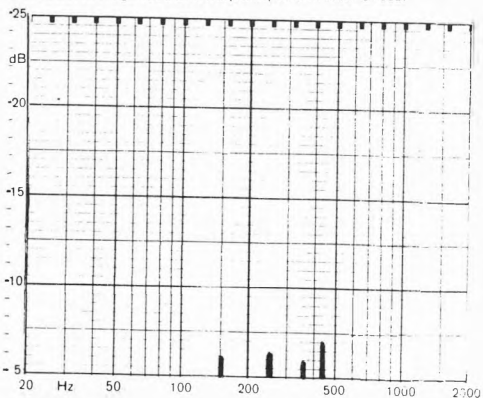
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system above average
 Hum level -72dB
 Acoustic feedback good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £155.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 11-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating B
 Damping rating K
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges recommended (10-20cu)

Sanyo TP 727

Sanyo Marubeni (UK) Ltd., Sanyo House, Bushey Mill Lane, Watford, Herts. Watford 30421.



sound quality was rated as average which is reasonable at the price, taking into account the facilities offered, but the bias compensation should be adjusted in future production.

This automatic belt drive turntable offers some unusual features at this price level, including an electronically controlled motor with an illuminated stroboscope and fine speed variation. The unit was proved generally easy to use with smooth acting controls and press buttons, and in several respects resembled the Eagle 2006A, also reviewed in this book.

On test, the rumble was just adequate at -60dB and could be heard during the listening tests. The measured wow and flutter level of 0.08% also proved to be just audible probably due to its combination with the slowing effect under moderate loading.

The arm carries a weight and lever bias compensator whose setting is fixed by the manufacturer, but which could be altered by the user via a small screwdriver adjustment. As received, the bias levels were appropriate to a spherical tip tracking at about 4g downforce, or an elliptical at 3.25g, both unlikely possibilities in the circumstances. While the arm could be used as provided with a tracking weight of 2g with a reasonable cartridge, the full tracking performance would not be realised, and an adjustment to the bias level, preferably using a tracking test disc such as HFS75, is recommended. In that case, cartridges with compliances in the 10-20 μc range and tracking at 1.5-3.0g would be suitable. On test, the other arm parameters were all found to be satisfactory, with the downforce calibration particularly accurate while the rates of ascent and descent were sensible and well controlled.

Acoustic breakthrough and resonances were classed as adequate, feedback resistance fairly good and vibration sensitivity poor. The electrical hum level was satisfactory using the audio lead earth but with the mains earth disconnected. The subjective

MOTOR

General data

Type automatic belt drive
 Platter mass 1.025kg
 Platter damping adequate
 Finish and engineering good
 Type of mains lead three core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.08%
 Absolute speed accuracy error +0.13%
 Speed drift -0.23%
 Speed variation under load -0.33%
 Start-up time to audible stabilisation 0.8secs

Rumble

DIN B weighted L and R average -60dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 8g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 45mg
 Typical vertical 35mg

Bias compensation (set to 1.5g elliptical)

Type of system weighted lever*
 Rim 450mg
 Centre 450mg

Downforce calibration error

1g 1g
 2g 2g

Cue operation

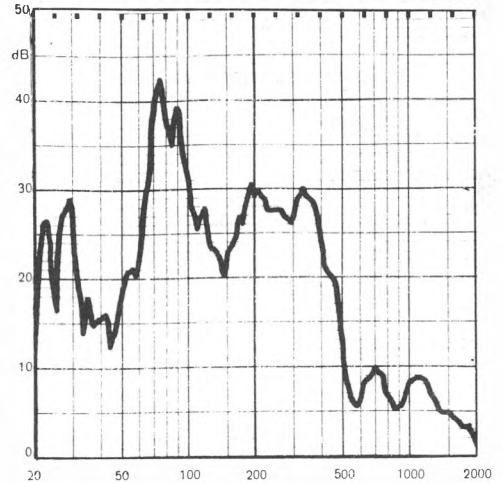
Drift satisfactory
 Ascent (8mm) 0.5secs
 Descent (8mm) 1.5secs

MOTOR AND ARM DATA

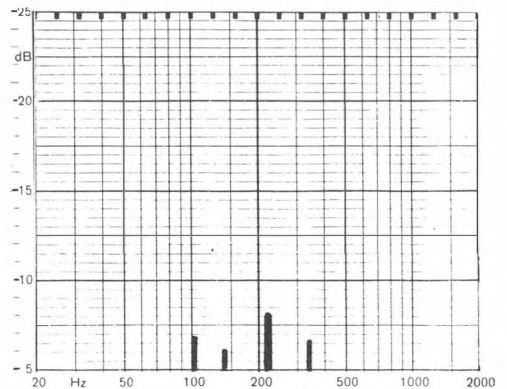
Size 470 W x 366 D x 170 H mm
 Clearance for lid 63mm
 Overall weight
 Ease of use very good
 Typical acoustic breakthrough and resonances adequate
 Subjective sound quality of complete system average
 Hum level -67dB
 Acoustic feedback fairly good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £85.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 11-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.5-3g
 Low to medium compliance cartridges recommended (10-20cu)

*See text

Sanyo TP 1100

Sanyo Marubeni (UK) Ltd., Sanyo House, Bushey Mill Lane, Watford, Herts. Watford 30421.



Downforce calibration was accurate, biasing almost ideal and trackability good. The cue action had no drift but the lift off at 3 seconds was rather slow.

Listening tests revealed inaudible rumble and wow, and an above average sound quality. Other tests rated hum levels as fine, with acoustic breakthrough and resonances, plus resistance to acoustic feedback and physical shock or vibration, as good. With the promised lighter headshell and some clarification of the cartridge alignment procedure, the TP 1100 certainly looks like good value for money.

As Sanyo's first entry into the direct drive market, the TP 1100 is, we believe, a pretty creditable one. The unit employs a heavy die cast metal plinth, with a concealed mirror type stroboscope and an automatic arm return plus stop mechanism. The motor is not the usual Matshushita type and fortunately does not exhibit the same load variations and overshoot characteristics we have noted with that model. Overall, the mechanical construction was impressive and even details such as the platter mat were well designed, and made their contribution to the overall performance.

The motor section gave very low wow and flutter and rumble figures, good speed accuracy with low drift, and a moderate speed variation under load. The latter was free of recovery overshoot effects. Start-up was however slow at 4 seconds.

The arm came supplied with a heavy headshell weighing 13g, placing the effective mass in the 16-17g range, but we have been informed by Sanyo that this is to be replaced by a light weight version, weighing about half as much as the original. (At the time of going to press, this had not been supplied to us.) The lighter shell would bring the arm effective mass into the 10-12g medium range suited for cartridge compliances of 10-20cu, instead of the rather lower values shown in the results table. Whether the following comments concerning Sanyo's instructions for cartridge alignment will then still hold true is unknown, but at present, by following the manual supplied, a cartridge misalignment of 4-5° results. This could however be easily adjusted by using a conventional card protractor.

On test, the arm generally exhibited low friction, the higher figure in the lateral plane relating to the extra force required to operate the end-of-side trip, and which is thus atypical of the normal disc radii.

176 Integrated turntables

MOTOR

General data

Type direct drive, auto-return
 Platter mass 2.0kg
 Platter damping good
 Finish and engineering very good
 Type of mains lead two core
 Type of connecting lead phonos plus earth

Speed

Speeds offered 3 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) <0.03%
 Absolute speed accuracy error -0.2%
 Speed drift +0.1%
 Speed variation under load -0.27%
 Start-up time to audible stabilisation 4secs

Rumble

DIN B weighted L and R average -70dB

ARM

General data

Type of headshell detachable universal
 Headshell mass 13g*
 Geometrical accuracy poor*
 Adjustments provided overhang
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 60mg
 Typical vertical 15mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 175mg
 Centre 210mg

Downforce calibration error

1g 1.05g
 2g 2.05g

Cue operation

Drift negligible
 Ascent (8mm) 3secs
 Descent (8mm) 3secs

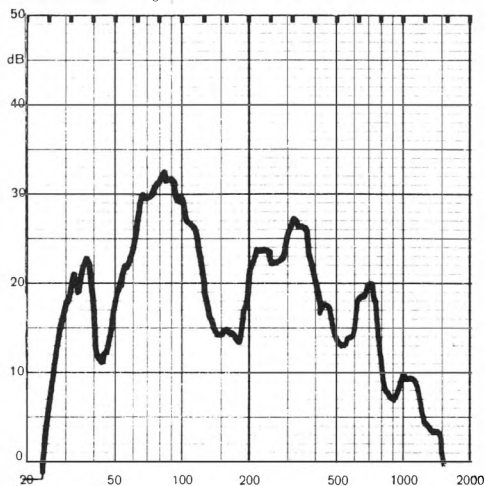
MOTOR AND ARM DATA

Size 475 W x 369 D x 146H mm
 Clearance for lid 50mm
 Overall weight 9.0kg approx
 Ease of use very good

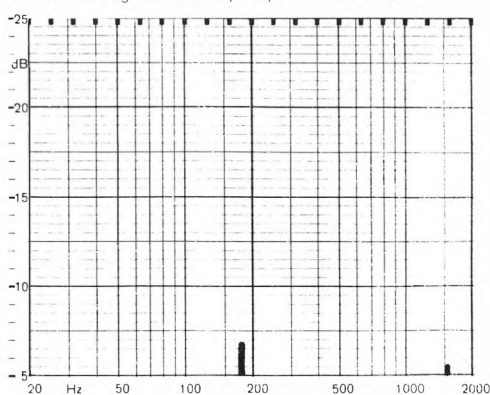
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system above average
 Hum level -68dB
 Acoustic feedback good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £110.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 16-17g*
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A*
 Damping rating J*
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges recommended (8-15cu)*

*See text

Sony PS-1700

Sony (UK) Ltd., 134 Regent Street, London W1R 0DJ. 01-439 3874.



facilities such as the downforce calibration and the cue were also satisfactory and the controls operated both smoothly and precisely. No problems were experienced with hum.

When tested with the reference cartridge, the subjective quality was rated as 'good' which is a favourable result considering its price level. The same qualification applies to resonances, vibration resistance and acoustic feedback, and overall the rating is one of 'good value for money'.

Despite this turntable's moderate price which includes a Sony cartridge factory fitted to the detachable headshell, the measured performance was found to be very little inferior to that of the considerably more expensive PS-4300 direct drive model, and in some respects superior to the more costly PS-3300.

The design comprises a straightforward two speed, belt drive motor, manually operated, with an auto return arm feature. Sony's instruction manual proved comprehensive and informative, with commendably clear indications concerning assembly and alignment; and recommending lubrication of the motor drive shaft once a year.

In the lab, Sony's specification was handsomely bettered on test. The motor section provided a very good -69dB rumble level, low wow and flutter, and good tolerance of loading, although the absolute speed was found to be 1.43% high which is excessive by the standards of this report. However, in practice few users would be aware of this speed error and a slight readjustment of the motor pulley diameter in production would easily correct this defect.

The same excessive biasing was found on the PS-1700 as with the other two Sony decks, this trend seeming to indicate that Sony favour high bias levels. Cartridges (other than the Sony model supplied) in the 1.5-2.5g downforce range, with compliance from 10-20 μ c, may be used in this deck, but the bias correction calibration should be viewed with suspicion and preferably adjusted using a tracking test record. In fact, although Sony were informed of the bias findings, they have not as yet commented.

The other arm parameters were fine, with low friction levels and accurate alignment. Other 178 Integrated turntables

MOTOR

General data

Type Belt drive, manual, auto-return
 Platter mass 0.85kg
 Platter damping good
 Finish and engineering good
 Type of mains lead phono plus earth
 Type of connecting lead detachable 3 core

Speed

Speeds offered 33 1/3, 45 rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.05%
 Absolute speed accuracy error + 1.43%
 Speed drift none
 Speed variation under load -0.23%
 Start-up time to audible stabilisation 1.0secs

Rumble

DIN B weighted L and R average -69dB

ARM

General data

Type of headshell Universal interchangeable
 Headshell mass 7.5g
 Geometrical accuracy fairly good
 Adjustments provided overhang only
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 30mg
 Typical vertical 35mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 325mg
 Centre 400mg

Downforce calibration error

1g 0.95g
 2g 1.9g

Cue operation

Drift negligible
 Ascent (8mm) 2secs
 Descent (8mm) 2secs

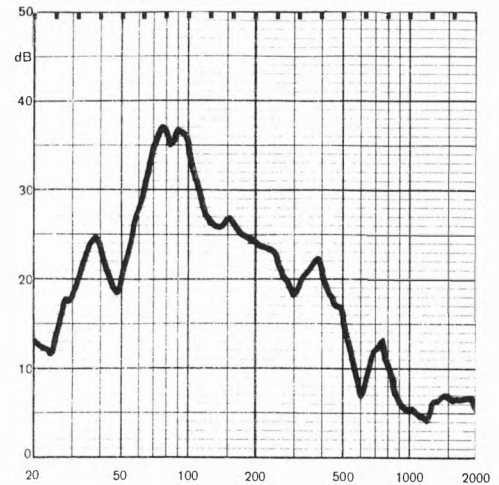
MOTOR AND ARM DATA

Size 445W x 352D x 155Hmm
 Clearance for lid 61mm
 Overall weight 7.4kg
 Ease of use good

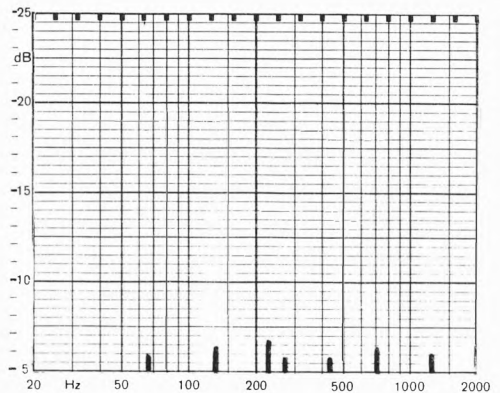
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system good
 Hum level -70dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £75.00 inc cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



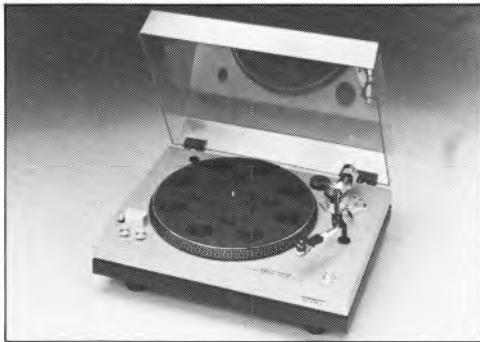
Compatibility

Effective moving mass excluding cartridge 9-10g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3.0g

Medium compliance cartridges recommended (15-25cu)

Sony PS-3300

Sony (UK) Ltd., 134 Regent Street, London W1R 0DJ. 01-439 3874.



This direct drive, manual turntable may be considered as a lower cost version of the PS-4300. It employs a similar magnetic rim detection speed control, but the heavy mineral loaded moulded chassis of the PS-4300 is here replaced by a lighter wood structure. The external finish is however to the same high standard, and as with the cheaper PS-1700, the deck comes complete with a budget type Sony cartridge ready fitted. Internal examination showed the engineering to be of a good standard for the price range.

A stroboscope is provided with variable adjustment of the two speeds, namely 33 $\frac{1}{3}$ and 45rpm. The cartridge alignment was found to be accurate, with no obvious error in any plane, the slotted headshell providing adjustment for other cartridges with respect to overhang.

While arm friction was low and downforce calibration accurate, the bias force was unacceptably high. This result is similar to that obtained for the other two Sony decks in the report; possibly they all use the same incorrect spring in their bias mechanisms! In general however, the arm performance was representative of a good quality, medium mass type, suitable for cartridges of up to 20cu compliance and tracking at 1.5g downforce, or above.

The motor did not provide quite as low a rumble level at -66dB as did both its more expensive and cheaper brothers, but the measured figure was nonetheless more than adequate. Wow and flutter was low and the speed accuracy under loading was notably good for a low cost, direct drive. The hum level was satisfactory, feedback and vibration susceptibility fair, and resonances moderate.

Subjective testing showed wow and rumble to be inaudible and the sound quality was judged to be

about average, this test made with the reference cartridge than the Sony model supplied.

Sony will need to sort out the high bias settings before unequivocal approval can be given to this deck, although a competent dealer should be able to set it up accurately with a given cartridge. The user could of course compensate by dialing a lower bias level, i.e. 1g for a 2g cartridge downforce.

MOTOR

General data

Type Direct drive, manual, with auto return
 Platter mass 0.9kg
 Platter damping good
 Finish and engineering very good
 Type of mains lead detachable 3 core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 $\frac{1}{3}$, 45 rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.05%
 Absolute speed accuracy error <0.1%
 Speed drift +0.1%
 Speed variation under load -0.23%
 Start-up time to audible stabilisation 3.0secs

Rumble

DIN B weighted L and R average -66dB

ARM

General data

Type of headshell Universal Detachable
 Headshell mass 7.5g
 Geometrical accuracy good
 Adjustments provided overhang only
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 30mg
 Typical vertical 20mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 300mg
 Centre 425mg

Downforce calibration error

1g 1.0g
 2g 1.9g

Cue operation

Drift satisfactory
 Ascent (8mm) 0.5secs
 Descent (8mm) 2.5secs

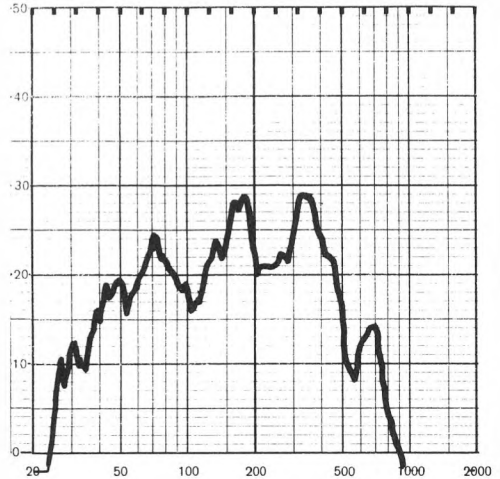
MOTOR AND ARM DATA

Size 457w x 354D x 153Hmm
 Clearance for lid 62mm
 Overall weight 8.6kg
 Ease of use very good

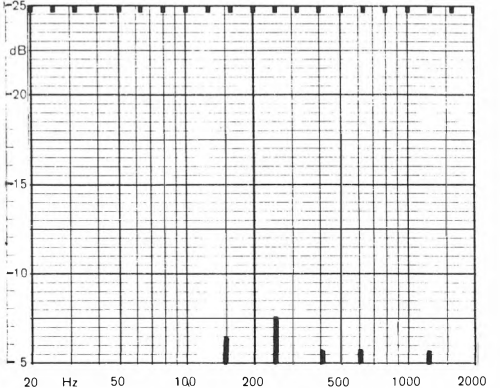
Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system average
 Hum level -67dB
 Acoustic feedback fairly good
 Vibration sensitivity satisfactory

Arm obtainable separately no
 Typical selling price ex VAT £105.00 inc cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 9-10g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3.0g

Medium compliance cartridges required (15-25cu)

Sony PS-4300

Sony (UK) Ltd., 134 Regent Street, London W1R 0DJ. 01-439 3874.



rumble both proved to be inaudible. The structure was also sufficiently heavy for the feet/isolators to be effective, and thus the resistance to vibration and acoustic feedback was classed as good.

Apart from the visual complexity, if the high bias calibration were corrected this Sony deck would rank above average for its price and hence represent 'good value for money'

This medium priced, automatic, direct drive turntable is provided with electronic touch controls for stop and start. Further levers select manual or auto operation. The motor is quite sophisticated, employing a magnetic stripe rim detection system similar to that in the Denon DP 3500. The unit is superbly finished, with a heavy moulded base/plinth mounted on resilient shock absorbing feet. The light platter has bituminous pads on the undersurface to damp resonances, and internal inspection revealed good quality engineering with a high electronics content, reflecting Sony's long expertise in this field.

The unit performed smoothly although the layout of the controls was somewhat confusing and it took time for a non-technical user to work them out. The strobe was less clear than average, but the unit's fine speed stability should ensure that it will rarely be needed. A short warm up time is necessary after first switching on otherwise the deck tends to 'reject' when 'start' is engaged, and at times, the automatic operation was frustratingly slow.

Lab testing revealed a top class performance from the motor section with very good wow and flutter figures, superb speed accuracy and load stability, and very low rumble. Start-up was quite swift for a direct drive. The arm however proved to be a trifle disappointing. Friction levels were only fair, the high lateral value reflecting a residual bias force. The bias calibration was considered to be seriously in error since at the record centre the measured value was nearly three times that required, and the effective mass placed the arm in the 'medium' range. The cue control proved accurate (for 7", 10" and 12" records) with the hum levels low.

Subjective testing ranked the PS 4300 as above average with the proviso that the bias force was set using a test record rather than the dial. Wow and 182 Integrated turntables

MOTOR

General data

Type Fully auto direct drive
 Platter mass 0.95kg
 Platter damping good
 Finish and engineering excellent
 Type of mains lead three core with plug
 Type of connecting lead phono with earth lead

Speed

Speeds offered 33 1/3, 45 rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) <0.05%
 Absolute speed accuracy error <0.1%
 Speed drift +0.1%
 Speed variation under load <0.05%
 Start-up time to audible stabilisation 2.2secs

Rumble

DIN B weighted L and R average -70dB

ARM

General data

Type of headshell Universal Detachable
 Headshell mass 7.5g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering very good
 Ease of assembly excellent
 Trackability good

Friction

Typical lateral 75mg*
 Typical vertical 35mg

Bias compensation (set to 1.5g elliptical)

Type of system Spring
 Rim 300mg*
 Centre 500mg

Downforce calibration error

1g 1.0g
 2g 1.95g

Cue operation

Drift negligible
 Ascent (8mm) 0.5sec
 Descent (8mm) 2.0sec

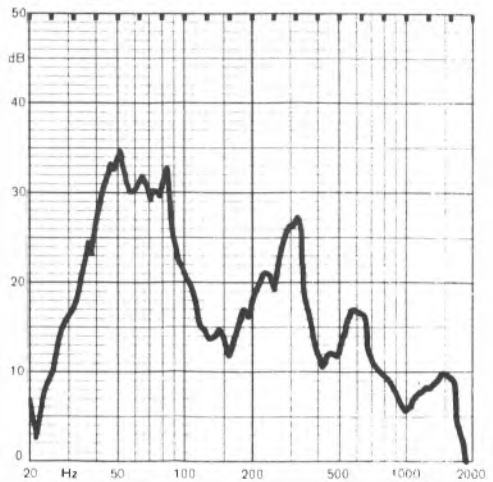
MOTOR AND ARM DATA

Size 445W x 364D x 155Hmm
 Clearance for lid 65mm
 Overall weight 10.3kg
 Ease of use automatic operation slow, otherwise good

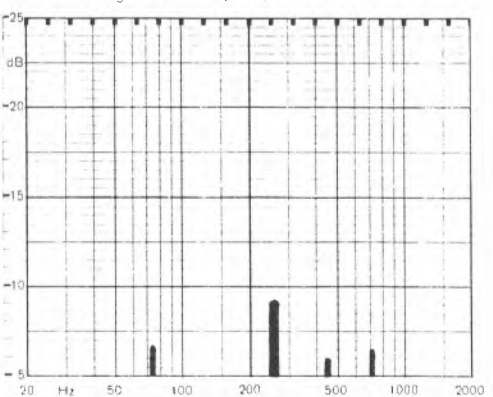
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system good
 Hum level -70dB
 Acoustic feedback good
 Vibration sensitivity good

Arm obtainable separate No
 Typical selling price ex VAT £130.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 9-10g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3.0g

Medium compliance cartridges recommended (15-25cu)

*see text

Technics SL-1700

National Panasonic (UK) Ltd., 107/9 Whitby Rd., Slough, Bucks. 01-753 4522.



There are two other Technics record players which are closely related to this model, all carrying similar arm/motor/plinth assemblies and differing only in details of operation. The model tested—the SL-1700—is a manual model with auto-return. The SL-1600 (at £22.00 extra) incorporates a high quality mechanism for fully automatic operation, and the SL-1800 (£ cheaper) is a manual only deck. Considering the group similarity, it was decided to test one model only, but the results obtained and comments made can be taken as broadly representative of the three decks.

These decks represent an unusual series where a heavy die cast plinth is employed, floating on a lower concealed base section. This system was quite well executed, although the suspension resonance was high, probably in the 5-6Hz range, and it would therefore require the arm/cartridge resonance to be kept in the 9-12Hz region for best vibration immunity. The direct drive motor is a second generation design with no overshoot and good recovery characteristics, and the overall standard of engineering is quite excellent for the price.

On test, the motor section fully justified Technics' high reputation. Particularly worthy of note were the speed accuracy and stability, and the zero variation under load. The arm also gave good test results with low friction, accurate downforce calibration and bias levels quite close to the required values. The geometry was fine although Technics own method for alignment resulted in a 1° lateral error. A fairly high arm/cartridge resonance is desirable in view of the chasis suspension rate. One criticism concerned the relatively high arm mass at around 16g, which would indicate a suitable cartridge compliance in the 8-15cu range is indicated, possibly somewhat higher if the cartridge has reasonable damping. A lower 184 Integrated turntables

mass headshell could help a little, but may introduce undesirable resonances.

Although further refinement is possible as regards aspects of improved vibration isolation and reduced arm mass, the SL-1700 nonetheless found favour on several grounds, notably good styling, excellent engineering and finish, smooth performance, sensible controls, silent operation, low hum levels and good platter and record damping. Subjective testing ranked it as above average which is a favourable result at this price level, with vibration resistance, acoustic feedback, resonances and breakthrough all classed as good

MOTOR**General data**

Type	Semi-auto, direct drive
Platter mass	1.5kg
Platter damping	very good
Finish and engineering	excellent
Type of mains lead	two core
Type of connecting lead	phonos and earth

Speed

Speeds offered	33 1/3, 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.035%
Absolute speed accuracy error	<0.1%
Speed drift	<0.1%
Speed variation under load	zero%
Start-up time to audible stabilisation	1sec

Rumble

DIN B weighted L and R average	-69dB
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ARM**General data**

Type of headshell	universal detachable
Headshell mass	.9g
Geometrical accuracy	'good'
Adjustments provided	overhang
Finish and engineering	excellent
Ease of assembly	very good
Trackability	very good

Friction

Typical lateral	20mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	175mg
Centre	160mg

Downforce calibration error

1g	0.975g
2g	1.9g

Cue operation

Drift	negligible
Ascent (8mm)	0.5secs
Descent (8mm)	3.5secs

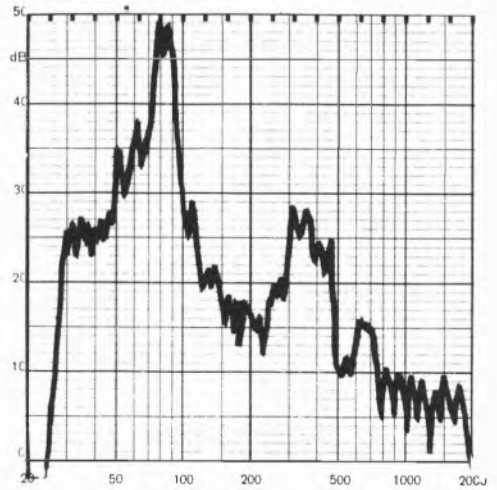
MOTOR AND ARM DATA

Size	457 W x 356 D x 126 H mm
Clearance for lid	52mm
Overall weight	9.0kg
Ease of use	very good

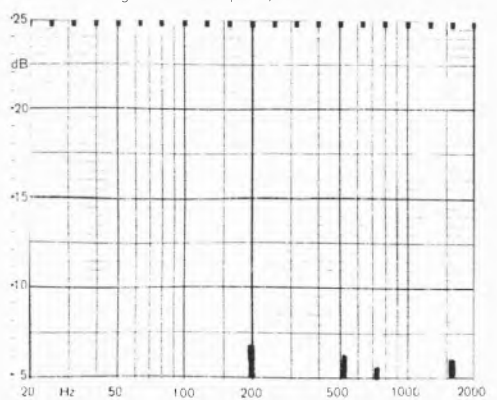
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	above average
Hum level	-70dB
Acoustic feedback	good
Vibration sensitivity	good

Arm obtainable separately	no
Typical selling price ex VAT	£127.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.

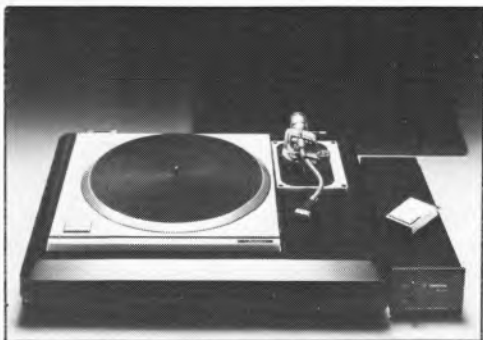
**Compatibility**

Effective moving mass excluding cartridge	15.5-16.5g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	A
Damping rating	J
Recommended tracking weight	1.25-3g
Low to medium compliance cartridges suitable (8-20cu)	

*See text

Technics SP10 with EPA 100 pick-up arm

National Panasonic (UK) Ltd., 107/9 Whitby Rd., Slough, Bucks. 01-753 4522.



This costly turntable is remarkable in many respects. Firstly, its visual simplicity indicates a professional approach to a professional market, which was precisely the case. The SP10 Mk II is a chassis motor unit requiring a base or plinth, one of which has been specially designed and denoted an SH-10B3. This was employed for testing in conjunction with the marching arm, the EPA 100. The plinth is a massive composite structure which alone weighs 12kg.

Secondly, its measured performance was second to no other direct drive in the report; start-up time, speed stability, torque, wow and flutter and rumble were all superlative. Closer examination only reinforced the aura of technical and engineering superiority; for example, the rapidity and stability of the speed change from 33 1/2 to 45 to 78 rpm has to be seen to be believed, the motor generating sufficient torque to operate a small lathe!

Designed to complement the SP-10 II turntable, the EPA-100 pick-up arm may however be used with almost any deck large enough to accept it, and although at first sight it appears to be a conventional pivoted arm, it is in fact unusually versatile. The counterweight assembly contains a special viscous fluid damper, whose effect may be adjusted to suit most cartridges merely by turning a control ring. Intended to provide a firm cartridge foundation with minimal colouration, the effective mass is fairly high despite the use of a two layer titanium arm tube—the outer layer toughened by a nitrification process. The headshell alone weighed 10g, and comprised a die casting with a vernier overhang scale and special rubber damping inserts.

Except for moderate lateral drift during cueing, every aspect of this design proved to be of the highest quality including damping, friction, biasing, cue rate, resonance and trackability—almost a

textbook performance. The highish mass virtually placed it in the heavy weight category, but the damping feature was an invaluable inclusion, as it provided good control over the resonance and hence reduced possible deleterious side effects. For this reason, the range of compatible cartridge compliances may be extended beyond that usually suggested for this mass of arm.

The plinth was mounted on fairly effective rubber feet which imparted a subsonic resonance at around 5Hz for the complete turntable unit. While the frequency was of the right order, the travel and freedom of the suspension was insufficient to endow the SP10 Mk II system with a better vibration rating than good, and a solid foundation is still recommended for positioning the unit. With respect to the remaining parameters of acoustic feedback, breakthrough and resonances plus subjective sound quality, very good ratings were achieved on all scores.

Technics SP10 with EFA 100 pick-up arm

RECOMMENDED

General data

Type	direct drive & remote stop/start
Platter mass	2.6kg
Platter damping	excellent
Finish and engineering	excellent
Type of mains lead	3 core
Speed	
Speeds offered	33 $\frac{1}{3}$, 45, 78
Fine speed control	no
Wow and flutter (DIN peak weighted)	0.025%
Absolute speed accuracy error	<0.01%
Speed droft	<0.01%
Speed variation under load	<0.01%
Start-up time to audible stabilisation	<0.4secs

Rumble

DIN B weighted L and R average	-73dB
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ARM

General data

Type of headshell	universal detachable
Headshell mass	10g
Geometrical accuracy	very good
Adjustments provided	overhang, height
Finish and engineering	excellent
Ease of assembly	very good
Trackability	very good

Friction

Typical lateral	<10mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	150mg
Centre	200mg

Downforce calibration error

1g	0.98g
2g	1.95g

Cue operation

Drift	satisfactory
Ascent (8mm)	0.8secs
Descent (8mm)	1.5secs

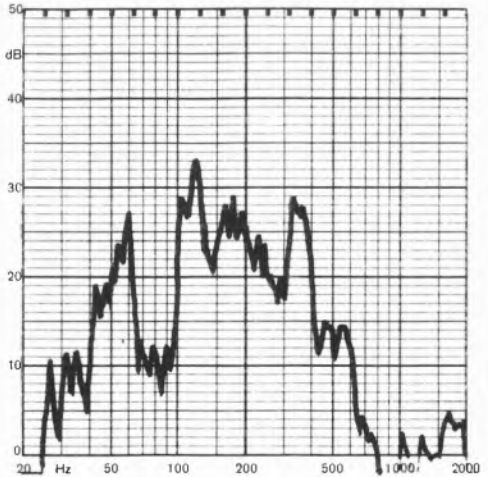
MOTOR AND ARM DATA

Size	560 W x 45 D x 170 H mm
Clearance for lid	95mm
Overall weight	21.5kg
Ease of use	very good
Typical acoustic breakthrough and resonances	very good

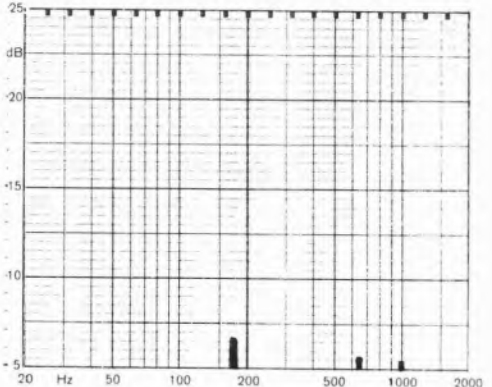
Subjective sound quality of complete system	very good
Hum level	-70dB
Acoustic feedback	very good
Vibration sensitivity	good

Arm obtainable separately	yes
Typical selling price ex VAT	£800.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge	15-17g
Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)	
Resonance rating	A/B
Damping rating	J/K/L
Recommended tracking weight	1.25-2.5g
Low to high compliance cartridges suitable (B-25 cu)	

Thorens TD 126 mk II

Metrosound Audio Products Ltd., Audio Works, Chartersfield Rd., Waltham Abbey, Essex 01-971 2712.



This imposing belt drive turntable fitted with a well designed floating sub-chassis, is one of the few models in the report to offer three speeds— $33\frac{1}{3}$, 45 and 78 rpm. Motive power is electronic, and fine variable speed adjustment and a stroboscope are both incorporated. The various functions are also under electronic control, the major ones actuated via soft touch buttons with inbuilt illumination. The complete turntable, as reviewed, is fitted with the latest Thorens low mass arm, with automatic stop and lift, plus power cueing. However, the TD 126 Mk II may also be purchased without arm and related features, a blank mounting board being supplied instead.

In general, the engineering of the unit was excellent save in one respect. In our view, the fit of the main bearing could have been better considering the price level, and although the rumble reading of -69dB is undoubtedly a good one, we felt that with an improved bearing tolerance, an upgrading to -72dB could be fairly easily achieved. We also felt that the platter mat would benefit from a redesign.

On test, the subsonic chassis resonance proved to be nicely judged at below 4Hz, and was so well designed that very good immunity to shock, vibration and feedback were demonstrated—an unusual combination.

The arm returned a similarly fine performance to that of the TD 145 Mk II, and must be ranked as one of the best models currently fitted to a production turntable at this price level.

As with the other two Thorens decks, it was not possible to obtain really low hum levels. However, we felt this problem could be overcome with rewiring, and to test our theory, we separated the chassis earth from the signal earth to which it was attached under the base plate, and connected it direct to the amplifier terminal. The excellent

bracketed figure for hum level in the table then resulted. One further problem was encountered with respect to hum, this time from the mains transformer. It was audible three feet away from the deck in a quiet listening room, with the unit mounted on a pretty substantial shelf.

The TD 126 Mk II was rated as very fine on acoustic breakthrough and resonances, but on listening test it was only classed as good. However, the performance of the TD 126 Mk II was felt to be an improvement over that of the other two Thorens decks. In fact, with a little further design modification, we felt the TD 126 Mk II would be capable of a really top class subjective performance.



MOTOR

General data

Type..... belt drive, auto stop and lift
 Platter mass..... 2.5kg
 Platter damping..... good
 Finish and engineering..... excellent
 Type of mains lead..... two core
 Type of connecting lead..... phono, no earth wire

Speed

Speeds offered..... 33 1/3, 45, 78 rpm
 Fine speed control..... yes
 Wow and flutter (DIN peak weighted)..... 0.04%
 Absolute speed accuracy error..... + 0.1%
 Speed drift..... + 0.2%
 Speed variation under load..... - 0.27%
 Start-up time to audible stabilisation..... 5secs

Rumble

DIN B weighted L and R average..... - 69dB

ARM

General data

Type of headshell..... detachable headshell/tube
 Headshell mass..... N/A
 Geometrical accuracy..... very good
 Adjustments provided..... tilt, angle, overhang
 Finish and engineering..... very good
 Ease of assembly..... fairly good
 Trackability..... very good

Friction

Typical lateral..... 15mg
 Typical vertical..... <10mg

Bias compensation (set to 1.5g elliptical)

Type of system..... magnetic
 Rim..... 150mg
 Centre..... 150mg

Downforce calibration error

1g..... 1.1g
 2g..... 2.1g

Cue operation

Drift..... negligible
 Ascent (8mm)..... 1sec
 Descent (8mm)..... 1sec

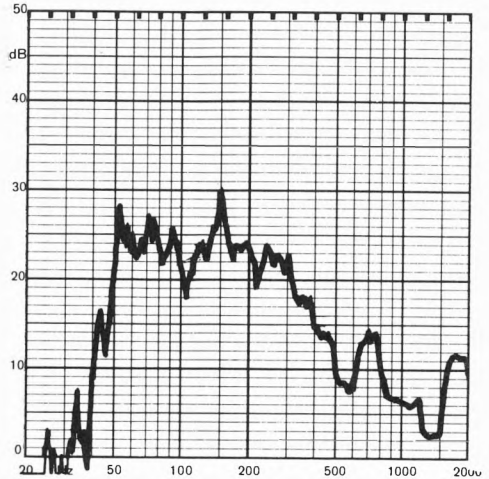
MOTOR AND ARM DATA

Size..... 487 W x 393 D x 170 H mm
 Clearance for lid..... none required
 Overall weight.....
 Ease of use..... very good

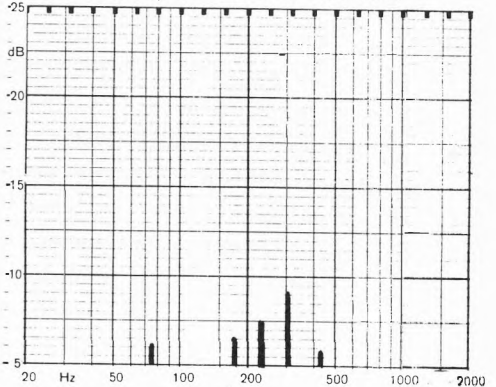
Typical acoustic breakthrough and resonances..... very good
 Subjective sound quality of complete system..... good
 Hum level..... 60 (-70dB)*
 Acoustic feedback..... very good
 Vibration sensitivity..... very good

Arm obtainable separately..... no*
 Typical selling price ex VAT..... £200.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge..... 6.8g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating..... C
 Damping rating..... K
 Recommended tracking weight..... 1.25-3g
 Medium to high compliance cartridges compatible (15-30 cu)

* See text

Thorens TD145 mk II

Metrosound Audio Products Ltd., Audio Works, Chartersfield Rd., Waltham Abbey, Essex 01-971 2712.



good rating as regards its subjective quality and resistance to acoustic feedback. However, as a result of the combined chassis and audio lead earths the hum level was only adequate, but a dealer should be able to provide a separate chassis earth to rectify this problem. Taken overall, the lab performance, plus low arm mass and good subjective quality are all highly favourable.

As with the other Thorens decks, a fully floating isolated sub-chassis is employed to carry both the arm and the platter. In most respects the TD145 mk II is similar to the Thorens TD160 mk II, which is not included in this report. The latter may be obtained without an arm, and in most essentials the results for the 145 motor section may also be assumed to be representative of the '160. The special '145 feature is simply the inclusion of an auto-stop and arm lift at the end of a record side, this being accomplished without any degradation of the arm lateral friction. The heavy platter of this design is belt driven at two fixed speeds, namely 33½ and 45rpm.

On test, the motor section gave low wow and flutter but the absolute speed was high by some 0.7%—significant, although not excessive—and a moderate slowing of -0.4% was noted under the dust bug loading. The rumble level was more than satisfactory on both test and audition.

The arm utilises frictionless magnetic biasing and the same low mass detachable head shell and arm tube which are fitted to the '166. A feature of the geometry of this arm is the angled mounting block against which the cartridge body rests. Thus with a correctly aligned cartridge, parallel to the record, the arm tube leans downwards towards the pillar at an angle of about 10°. Thorens research found that this results in an improvement as regards cartridge performance.

The arm provided very low friction values on test with fairly accurate downforce calibration and sensible biasing. Cue drift was negligible and although the ascent and descent rates were quick, they were well controlled. Arm trackability was certainly well above average.

On acoustic breakthrough and resonances the deck was classed as very good, while it achieved a 190 Integrated turntables

MOTOR

General data

Type	belt drive auto stop and lift
Platter mass	2.5kg
Platter damping	good
Finish and engineering	very good
Type of mains lead	two core
Type of connecting lead	phono, no earth wire

Speed

Speeds offered	3 3/4, 45rpm
Fine speed control	no
Wow and flutter (DIN peak weighted)	0.05%
Absolute speed accuracy error	+0.7%
Speed drift	none
Speed variation under load	-0.4%
Start-up time to audible stabilisation	3.5secs

Rumble

DIN B weighted L and R average	-67dB
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ARM

General data

Type of headshell	detachable shell and tube
Headshell mass	N/A
Geometrical accuracy	very good
Adjustments provided	tilt, overhang, height*
Finish and engineering	very good
Ease of assembly	fairly good
Trackability	very good

Friction

Typical lateral	<10mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	magnetic
Rim	150mg
Centre	150mg

Downforce calibration error

1g	1.15g
2g	2.15g

Cue operation

Drift	negligible
Ascent (8mm)	0.8secs
Descent (8mm)	1sec

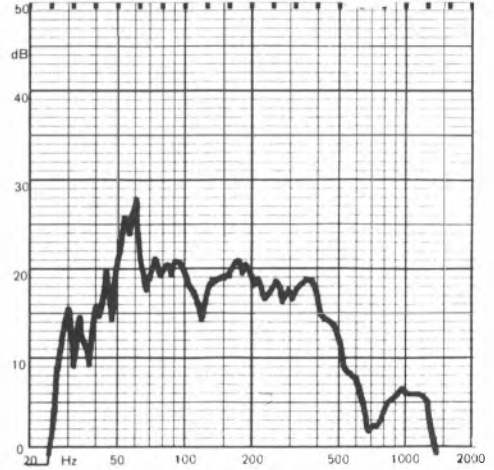
MOTOR AND ARM DATA

Size	430 W x 340 D x 150 H mm
Clearance for lid	95mm
Overall weight	
Ease of use	very good

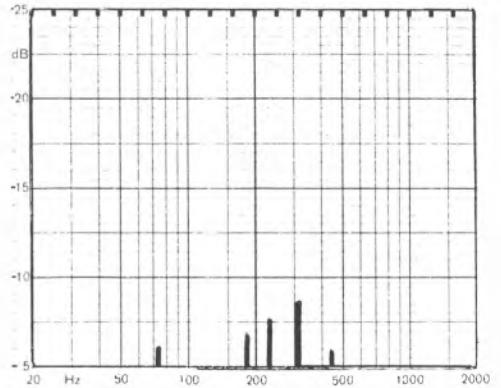
Typical acoustic breakthrough and resonances	very good
Subjective sound quality of complete system	good
Hum level	-63dB
Acoustic feedback	good
Vibration sensitivity	very good

Arm obtainable separately	no*
Typical selling price ex VAT	£105.00

Acoustic breakthrough



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge

Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating	C
Damping rating	K
Recommended tracking weight	1.25-3g
Medium to high compliance cartridges required (15-30cu)	

*See text

Thorens TD 166 mk II

Metrosound Audio Products Ltd., Audio Works, Chartersfield Rd., Waltham Abbey, Essex 01-971 2712.



feedback very good with rejection of shock and vibration classed as good. However, Thorens' practice of combining the chassis earth with one of the audio lead earths gave an adequate rather than a good hum level, although most dealers could readily correct this by adding another separate earth lead. In summary, this is one of the very few moderately priced decks in the report of good subjective performance, which proved to be compatible with higher compliance cartridges.

Thorens have long been exponents of the suspended sub-chassis carrying the arm and platter, the latter mechanically isolated from the motor and external vibration at frequencies above the main spring/chassis-mass resonance. Ideally, the cartridge/arm resonance should lie in the 10Hz range, and the sub-chassis resonance should be removed by at least an octave to a lower frequency, to prevent additive effects. This suggests a sub-chassis resonance in the 2-4Hz region, which is in fact the value achieved by Thorens.

The Thorens 166 mk II is the cheapest model in their current range and comprises a belt driven turntable with a low mass, manually operated arm fitted with a thread and weight bias compensator.

On tests, the motor section returned a fairly typical performance for the price level. Wow and flutter was moderate, speed accuracy very good, start-up fairly slow at 3 seconds, and speed reduction under loading somewhat high. It is conceivable that a low compliance cartridge tracking at 2-3g could impart audible wow on difficult and loud music passage, but fortunately, the low mass arm is sensitive enough to partner quite delicate, medium compliance models. The rumble level was judged as only satisfactory by measurement, but did not in fact prove to be audible during the listening session.

The arm provided a fine performance with very low friction, sensible bias levels, moderately low effective mass, plus satisfactory cue operation which did not cause any arm disturbance. The downforce calibration was on the low side but not unduly so.

The listening tests resulted in an overall rating of good for the subjective sound quality, which is a fine result considering the price. Acoustic breakthrough and resonances were reasonable, resistance to

MOTOR

General data

Type belt drive manual operation
 Platter mass 2.1kg
 Platter damping good
 Finish and engineering very good
 Type of mains lead two core
 Type of connecting lead phono, no earth wire

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.07 %
 Absolute speed accuracy error <0.1 %
 Speed drift none
 Speed variation under load 0.47 %
 Start-up time to audible stabilisation 3secs

Rumble

DIN B weighted L and R average -63dB

ARM

General data

Type of headshell special detachable arm tube
 Headshell mass N/A
 Geometrical accuracy good
 Adjustments provided tilt, height, overhang
 Finish and engineering good
 Ease of assembly fairly good
 Trackability very good

Friction

Typical lateral 15mg
 Typical vertical <10mg

Bias compensation (set to 1.5g elliptical)

Type of system thread and weight
 Rim 200mg
 Centre 200mg

Downforce calibration error

1g 0.9g
 2g 1.85g

Cue operation

Drift satisfactory
 Ascent (8mm) 1sec
 Descent (8mm) 3secs

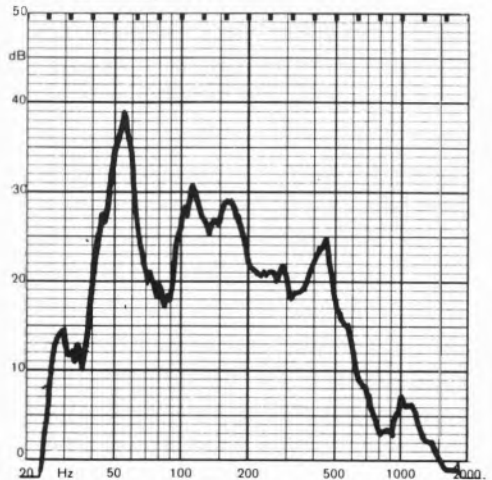
MOTOR AND ARM DATA

Size 430 W x 340 D x 150 H mm
 Clearance for lid 95mm
 Overall weight 8.5kg
 Ease of use very good

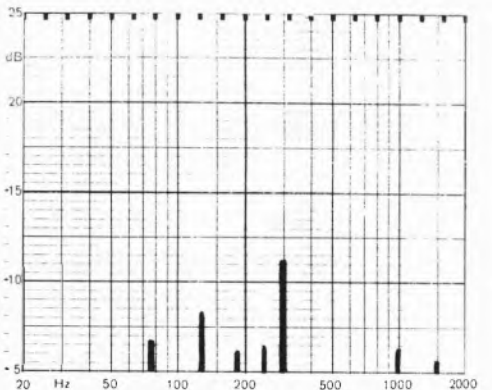
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system good
 Hum level -63dB
 Acoustic feedback very good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £76.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 7.9g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating B-C
 Damping rating K
 Recommended tracking weight 1.25-3g
 Medium to high compliance cartridges suitable (15-30cu)

Toshiba SR-255

Toshiba (UK) Ltd., Toshiba House, Great South West Rd., Feltham, Middlesex. 01-751-1281.



The two Toshiba direct drive decks in this report both use the same Matshushita motor and hence offer a similar performance. Major points of difference concern the plinth and arm. The SR-255 reviewed here uses a normal structure with a fixed arm, whereas the SR-370 by contrast offers an extremely massive, mineral loaded, moulded plinth, and will accept arms from other manufacturers.

The usual two speeds are provided on the SR-255, with a neon illuminated stroboscope engraved on the platter rim. Both speeds have fine variable controls. The arm is a conventional 'S' type with detachable headshell and spring generated bias compensation. Cleanly styled, the unit proved straightforward to use.

On tests, the motor returned the usual low wow and flutter result, with good speed accuracy, low drift but also a significant slowing under the moderate test loading. The start-up time was slow at 4 seconds and the expected overshoot characteristic was noted as correct speed was attained. The latter is believed to be linked to the slight audible wow on loud programme sections that is frequently noted with this type of motor. The rumble level was very good at -68dB , DIN B weighted.

The arm demonstrated accurate downforce calibration, moderate friction and a 'medium' effective mass. It is thus suited to cartridges with dynamic compliances in the 15-25 μc range, tracking from 1.25-3.0g. The bias compensation was excessive at about double the required value, but was in the correct proportion, rim to centre. A reduced dial setting is advisable. We also noted significant lateral arm drift as the cue control was operated, although the ascent and descent rates were about right.

The acoustic breakthrough and arm resonance results were quite good, but the rejection of external

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shock and vibration was barely adequate, and it would be advisable to stand the turntable on a substantial, rigid shelf. Resistance to acoustic feedback was good, but the subjective assessment only rated average, a typical level for its price bracket. As with several other models of generally similar design, a less resonant plinth and effective vibration isolation could produce a significant improvement in subjective quality.

MOTOR

General data

Type direct drive manual operation
 Platter mass 1.5kg
 Platter damping adequate
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead phono plus earth wire

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.04%
 Absolute speed accuracy error <0.1%
 Speed drift -0.11%
 Speed variation under load -0.41%
 Start-up time to audible stabilisation 4.0secs

Rumble

DIN B weighted L and R average -68dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 7.75g
 Geometrical accuracy good
 Adjustments provided overhang
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 60mg
 Typical vertical 30mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 300mg
 Centre 400mg

Downforce calibration error

1g 1.075g
 2g 2.05g

Cue operation

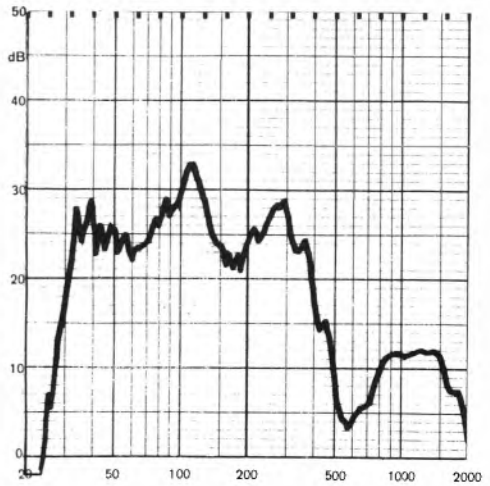
Drift poor
 Ascent (8mm) 0.5secs
 Descent (8mm) 3secs

MOTOR AND ARM DATA

Size 455 W x 358 D x 160 H mm
 Clearance for lid 75mm
 Overall weight 8.5kg
 Ease of use good
 Typical acoustic breakthrough and resonances good
 Subjective sound quality of complete system average
 Hum level -68dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £90.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.

No visible resonances

Compatibility

Effective moving mass excluding cartridge 10-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3g
 Medium compliance cartridges recommended (15-25cu)

Trio KD-550

B H Morris Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex. 01-902 9422.



arms could be fitted, allowing the use of almost any desired cartridge.

While acoustic breakthrough and resonances were classed as fairly good, the resistance to acoustic feedback in a real listening set up proved to be very fine. The vibration sensitivity was rated good, achieved mainly by the sheer inertia of the massive plinth rather than by the effectiveness of the rubber cored mounting feet, and the use of a solid and substantial shelf support is still recommended. The sound quality of the system was rated as above average but strangely enough, it was not as highly favoured as its cheaper brother, the KD-2055.

The massive plinth structure of the KD-550 is manufactured from the same mineral loaded, compression moulded plastic as the KD-2055, and in combination with a special multiply wood lower section, brings the total weight to over 15kg. Trio describe very low resonant properties for the structure, as detailed in the leaflet for the KD550/500.

This direct drive turntable does not use the standard Matsushita motor and comes in two forms—as the KD-500, without arm but with spare mounting boards, one of which is pre-cut to take an SME, and as the KD-550 reviewed here, which comes complete with arm. The price difference is around £20.00.

On test, the motor section produced some excellent figures; for example, the low wow and flutter and negligible rumble, both proving to be inaudible on listening tests. Particularly worthy of note was the high tolerance of loading with only an imperceptibly small speed change. Run up was moderately fast for a direct drive motor, at 1.8 seconds.

Our first arm was a prototype sample with a damaged bearing, but we were later able to examine a representative production model for assessment purposes. Friction levels were low and bias force about right, but with the disc/rim ratio unfortunately inverted; it should of course be higher at the centre than at the rim. Considering the price, the downforce calibration error of 15% was considered to be excessive and also erred in the lighter and less favourable direction. Some arm drift was noted during cueing, but the ascent and descent rates were sensible. The effective arm mass indicated the use of cartridge compliance values in the 8-15cu range tracking between 1.25 and 3.0g. However if the KD-500 option were chosen, then lower mass

MOTOR

General data

Type manual direct drive
 Platter mass 1.5kg
 Platter damping very good
 Finish and engineering excellent
 Type of mains lead two core
 Type of connecting lead phono, arm earth and motor earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.04%
 Absolute speed accuracy error <0.1%
 Speed drift +0.16%
 Speed variation under load <0.03%
 Start-up time to audible stabilisation 1.8secs

Rumble

DIN B weighted L and R average -73dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 10g
 Geometrical accuracy very good
 Adjustments provided lateral, vertical, and overhang
 Finish and engineering excellent
 Ease of assembly very good
 Trackability very good

Friction

Typical lateral <15mg
 Typical vertical <15mg

Bias compensation (set to 1.5g elliptical)

Type of system weighted lever
 Rim 175mg
 Centre 150mg

Downforce calibration error

1g 0.85g
 2g 1.75g

Cue operation

Drift satisfactory
 Ascent (8mm) 0.5secs
 Descent (8mm) 3.5secs

MOTOR AND ARM DATA

Size 502 W x 382 D x 158 H mm
 Clearance for lid 12mm
 Overall weight 15.5kg
 Ease of use very good

Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system above average
 Hum level -70dB
 Acoustic feedback very good
 Vibration sensitivity good

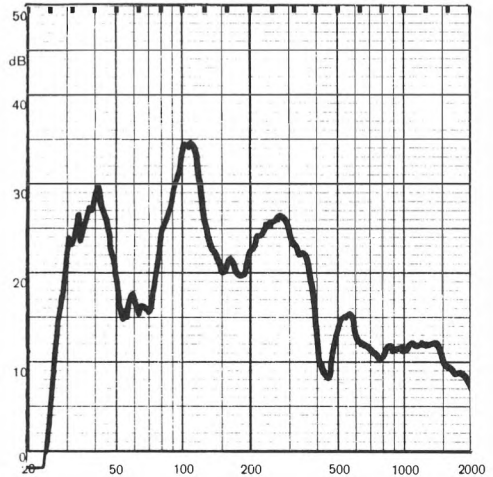
Arm obtainable separately yes, and motor section
 Typical selling price ex VAT £180.00 inc arm

Compatibility

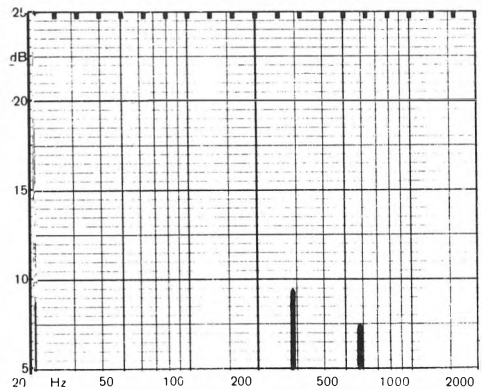
Effective moving mass excluding cartridge 11-12g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating B
 Damping rating J
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges recommended (8-15cu)

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Trio KD-2055

B H Morris Ltd., Precision Centre, Heather Park Drive, Wembley, Middlesex. 01-902 9422.



On acoustic breakthrough and resonances, the deck was rated as fairly good, and although it could have been better the hum level was classed as satisfactory. Rejection of external vibration and shock was fine while a very good resistance to acoustic feedback was shown. The sound quality was rated as good—a fine result for this price range—the majority of its competitors being classed as only average or below average on this vital aspect.

Trio have put some thought into the matter of acoustic resonances and have come up with a very heavy mineral loaded plastic. Called 'ARCB' these initials stand for 'anti resonance compression base', composed of 60% (by weight) of ground limestone, 25% unsaturated polyester resin, 5% of PVC powder and the remainder largely glass powder. This material is compression moulded and used for both the Trio decks in the report. In appearance, it has a pale cream colour with visible grains and flecks of the mineral filler, the overall effect to some extent resembling polished granite.

The cheaper of the two decks is the KD-2055 which is a belt driven model offering 33 1/3 and 45rpm with an automatic arm return and stop. Trio have also provided a control which permits the adjustment of the speed of arm return which can thus be set to suit individual taste or more importantly, to compensate for the temperature variations which may affect the viscosity and hence speed of the arm return.

On test, the motor section provided a creditable performance. Wow and flutter and rumble were both very good, start-up was rapid and the speed variation under load acceptable. Absolute speed accuracy was also fairly good, at +0.43%.

The arm demonstrated low friction with accurate downforce calibration, but bias compensation was on the high side and should be reduced by nearly 50%. (A corresponding adjustment should be made when setting values on the dial.) The cue control operated well as did the automatic arm return feature. The counterweight decoupling proved quite effective, helping to produce a moderate effective mass with some damping. The arm thus proved capable of accepting a number of the more compliant cartridge types.



MOTOR

General data

Type belt drive, auto stop and return
 Platter mass 0.88kg
 Platter damping very good
 Finish and engineering very good
 Type of mains lead two core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.05%
 Absolute speed accuracy error +0.43%
 Speed drift none
 Speed variation under load -0.37%
 Start-up time to audible stabilisation 0.8secs

Rumble

DIN B weighted L and R average -68dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 7g
 Geometrical accuracy good
 Adjustments provided overhang, height
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 25mg
 Typical vertical 10mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 300mg
 Centre 350mg

Downforce calibration error

1g 1.03g
 2g 2g

Cue operation

Drift negligible
 Ascent (8mm) 1.5secs
 Descent (8mm) 3secs

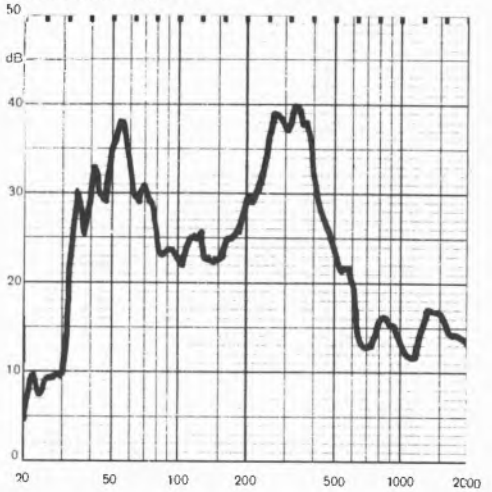
MOTOR AND ARM DATA

Size 480 W x 350 D x 146 H mm
 Clearance for lid 57mm
 Overall weight 11kg
 Ease of use very good

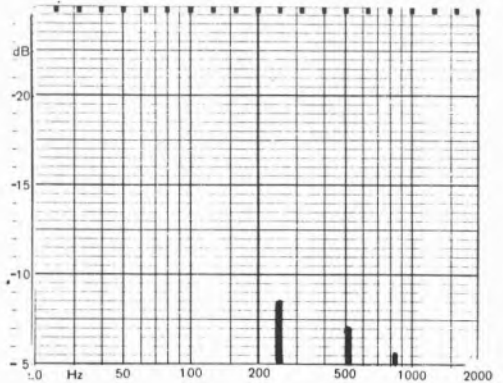
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system good
 Hum level -65dB
 Acoustic feedback very good
 Vibration sensitivity good

Arm obtainable separately no
 Typical selling price ex VAT £75.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances



Compatibility

Effective moving mass excluding cartridge 7.9g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating C
 Damping rating L
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges suitable (15-30cu)

Yamaha YP-211

Natural Sound Systems, 10 Byron Road, Wealdstone, Harrow, Middlesex. 01-863 8622.



This deck offers two speeds with belt drive and an automatic arm return and stop at the end of the record side. We discovered that Yamaha had made a mistake with the geometrical alignment of this deck, which the importers are aware of. However, the problem is not disastrous, as any competent dealer should be able to correct the cartridge lateral alignment. Simply, the spacing of the arm pivot to the turntable centre is incorrect and the instructions provided compound the error, resulting in a considerable lateral misalignment of 4-5°. It turns out that there is an insufficient range of overhang to correct this, and the expedient of angling the cartridge axis with respect to the headshell must be adopted; in practice this is easily done using a conventional printed card adjustment protractor.

The headshell is common to the entire Yamaha turntable series and is fairly heavy, at 10.5g. This places the effective mass in the high range, and indicates the use of cartridges with compliance values in the region of 8-12cu, with 15cu regarded as the maximum. On test, the arm exhibited moderate friction, accurate downforce calibration and somewhat low bias. The cue facility proved accurate with sensible ascent and descent rates. It should however be noted that the arm is set fairly low and some cartridges may need an angled packing piece or spacer to produce the correct vertical tracking angle.

The motor section gave good wow and flutter figures, was tolerant of loading and started up quickly. It did however run slightly slow. The rumble figure was satisfactory, but some motor vibration could be heard on audition, when used with a wide dynamic range system at high volume levels. The hum level was satisfactory but as it showed an imbalance between the two channels, it could well be improved.

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Acoustic feedback was good, with acoustic breakthrough and resonances both classed as fairly good. Vibration and shock resistance were poor, but the sound quality on listening tests was judged to be slightly above average. However, I feel it would be helpful if the importers were to enclose a note concerning the incorrect alignment and the misleading instructions in the operating manual, as well as supplying a printed card protractor to facilitate adjustment.

MOTOR

General data

Type belt drive, auto-return and stop
 Platter mass 1.0kg
 Platter damping good
 Finish and engineering good
 Type of mains lead two core
 Type of connecting lead phono plus earth

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control no
 Wow and flutter (DIN peak weighted) 0.06%
 Absolute speed accuracy error -0.5%
 Speed drift none
 Speed variation under load -0.23%
 Start-up time to audible stabilisation 1.1secs

Rumble

DIN B weighted L and R average -64dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 10.5g
 Geometrical accuracy poor
 Adjustments provided lateral tilt, overhang*
 Finish and engineering good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 40mg
 Typical vertical 30mg

Bias compensation (set to 1.5g elliptical)

Type of system thread and weight
 Rim 100mg
 Centre 100mg

Downforce calibration error

1g 1.03g
 2g 2.05g

Cue operation

Drift negligible
 Ascent (8mm) 0.75secs
 Descent (8mm) 4secs

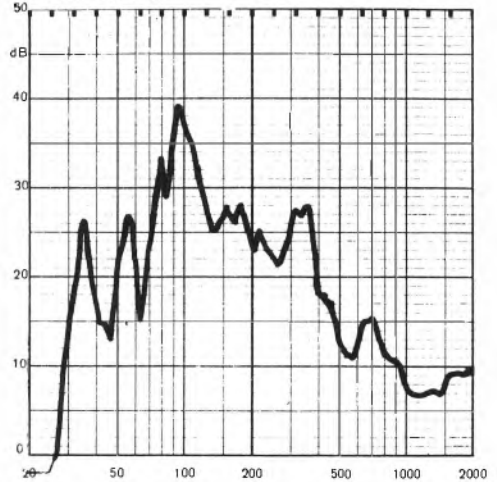
MOTOR AND ARM DATA

Size 435 W x 347 D x 150 H mm
 Clearance for lid 72mm
 Overall weight 6kg
 Ease of use very good

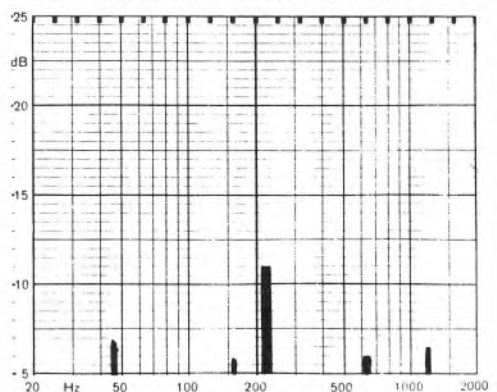
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system average
 Hum level -66dB
 Acoustic feedback good
 Vibration sensitivity poor

Arm obtainable separately no
 Typical selling price ex VAT £75.00

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 16.17g

Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)

Resonance rating A

Damping rating J

Recommended tracking weight 1.25-3g

Low to medium compliance cartridges recommended (8-15cu)

*See text

Yamaha YP-511

Natural Sound Systems, 10 Byron Road, Wealdstone, Harrow, Middlesex. 01-863 8622.



The YP511 was the more expensive of the two Yamaha decks to be included in this report. It is a manually operated direct drive model, utilising the ubiquitous Matsushita motor which, on test, produced above average results for this motor type, possibly due to a fortuitous combination of centrifugal platter mass, and structural support provided by the heavy plinth. The measured wow and flutter and rumble figures were both very good, although the reservations expressed elsewhere in this survey concerning this motor are still valid here; namely that slight wow was audible on records with telling programme sections. The run-up time was slow, however, speed accuracy and drift were both fine and the slowing under load moderate.

The arm is a conventional pivoted type with a detachable headshell, and in contrast to the YP211, Yamaha's instructions were valid for producing the correct geometrical alignment. Again, the low-set arm may require angled spacers in the headshell if using certain cartridges with a large stylus-to-mounting plane dimension. Under test, the arm produced satisfactory friction levels, accurate downforce calibration and slightly high bias levels. It is suggested that the user corrects these levels by dialling a lower value on the scale; about 30% less than is required. The cue control showed some lateral drift during descent, the rate of movement however was fine.

The acoustic feedback threshold was quite good, while acoustic breakthrough and resonances were classed as slightly better. However, as with a number of rigid plinth designs fitted with so called shock isolating feet, we found the resistance to vibration to be in general quite poor, with the main resonance of the plinth mass on the suspension appearing from 6-20Hz. This range overlaps the suggested arm/cartridge resonance at around 10Hz,

202 Integrated turntables

and the two interact, imparting both poor shock resistance and occasionally colouration to the sound, although subjective testing overall rated the deck as marginally above average.

MOTOR

General data

Type direct drive manual
 Platter mass 1.95kg
 Platter damping good
 Finish and engineering very good
 Type of mains lead two core
 Type of connecting lead phono plus earth wire

Speed

Speeds offered 33 1/3, 45rpm
 Fine speed control yes
 Wow and flutter (DIN peak weighted) 0.035%
 Absolute speed accuracy error +0.1%
 Speed drift -0.1%
 Speed variation under load -0.33%
 Start-up time to audible stabilisation 4.0secs

Rumble

DIN B weighted L and R average -70dB

ARM

General data

Type of headshell universal detachable
 Headshell mass 10.5g
 Geometrical accuracy good
 Adjustments provided lateral tilt and overhang
 Finish and engineering very good
 Ease of assembly good
 Trackability good

Friction

Typical lateral 40mg
 Typical vertical 35mg

Bias compensation (set to 1.5g elliptical)

Type of system spring
 Rim 220mg
 Centre 280mg

Downforce calibration error

1g 1.03g
 2g 2g

Cue operation

Drift satisfactory
 Ascent (8mm) 0.5secs
 Descent (8mm) 3.5secs

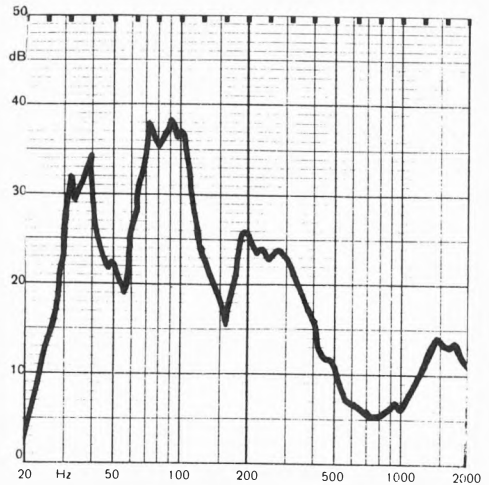
MOTOR AND ARM DATA

Size 470 W x 358 D x 146 H mm
 Clearance for lid 74mm
 Overall weight
 Ease of use good

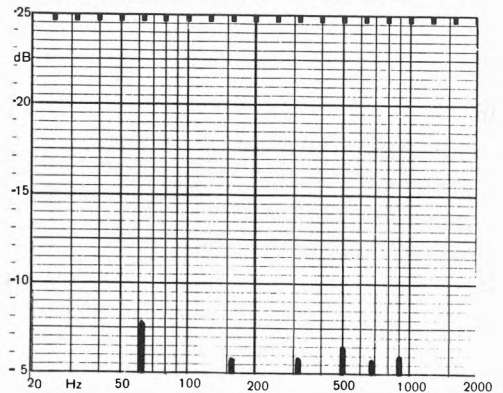
Typical acoustic breakthrough and resonances fairly good
 Subjective sound quality of complete system above average
 Hum level -74dB
 Acoustic feedback good
 Vibration sensitivity adequate

Arm obtainable separately no
 Typical selling price ex VAT £120.00

Acoustic breakthrough.



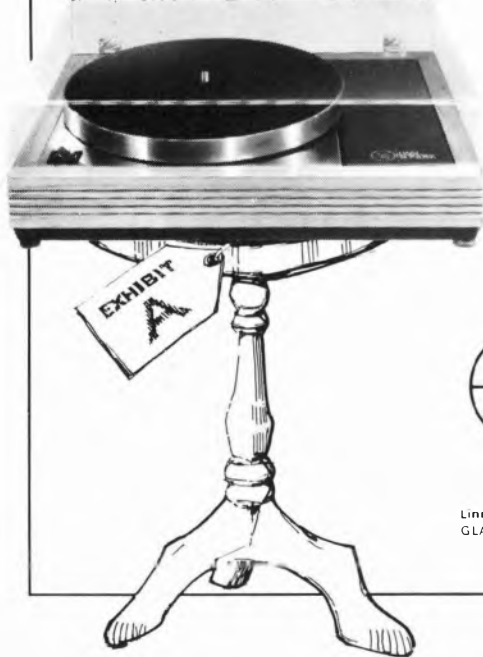
Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge 16-17g
 Match up these letters (ABCD/JKLM) in this section with those in the cartridge compatibility section. (The damping rating is less critical, but worth achieving if possible.)
 Resonance rating A
 Damping rating K
 Recommended tracking weight 1.25-3g
 Low to medium compliance cartridges suitable (8-15cu)

The truth the whole truth and nothing but the truth.



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Fons CQ30

Fons Int. Ltd., Maybole, Ayrshire, Scotland. 0655 82424.



In common with Ariston and Linn Sondek, the Fons is another British turntable manufactured in Scotland. This latest sample exhibits some changes as compared with the earlier model, notably the replacement of the original wood arm mounting board by a mild steel pressing which is itself attached to the suspended sub-chassis via a rather weak, bent metal plate. This unfortunately allows the arm section to resonate in combination with the sub-chassis, a condition likely to induce colouration in the subjective sound. The sub-chassis suspension of both samples we tried did not appear well adjusted, and we also found the platter to be poorly damped. Even with a record, it could be made to ring for a significant time. In addition, on both decks the fit of the rubber mat over the spindle was poor, causing a bump in the centre of the mat that elevated a disc.

On test, we recorded moderate wow and flutter, significant slowing under load, a slow run-up time and a good rumble level, the latter taken after the manufacturer's recommended '24 hours' running-in period. While the acoustic feedback resistance was very fine, vibration rejection was only adequate, with acoustic breakthrough fairly good and subjective quality about average.

General data

Type	electronic belt drive
Size	444 W x 350 D x 156 H mm
Clearance for lid	70mm
Overall weight	8kg
Ease of setting up	good
Ease of use	good
Platter mass	—
Platter damping	poor
Finish and engineering	adequate
Type of mains lead	two core
Vibration sensitivity	adequate
Hum level	—60dB
Acoustic feedback	very good

Acoustic breakthrough and resonances	fairly good
Subjective sound quality	average

Speed

Speeds offered	33 $\frac{1}{3}$, 45, 78 (29-100rpm)
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.08%
Absolute speed accuracy error	—
Speed drift	+0.2%
Speed variation under load	-0.4%
Start-up time to audible stabilisation	4.5secs

Rumble

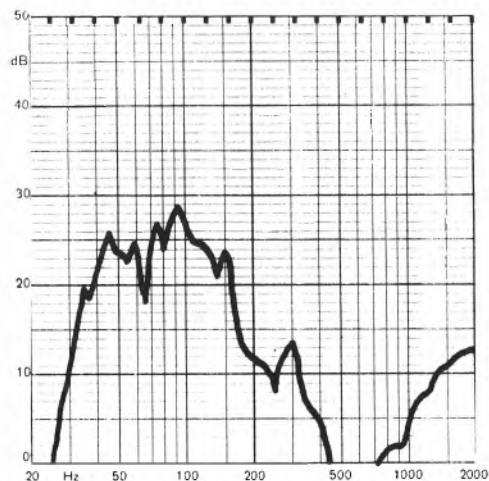
DIN B weighted L and R averaged	—67dB*
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Arm recommended

Typical selling price ex VAT

*see text

Acoustic breakthrough



RECOMMENDED

Linn Sondek LP12

Linn Products Ltd., 235 Drakemire Drive, Glasgow. 041 634 3860.



General data

Type	belt drive, manual operation
Size	445 W × 350 D × 145 H mm
Clearance for lid	.65mm
Overall weight	.....
Ease of setting up	..... good
Ease of use	..... excellent
Platter mass	..... 3.85kg*
Platter damping	..... good
Finish and engineering	..... excellent
Type of mains lead	..... two core + earth
Vibration sensitivity	..... good
Hum level	..... -70dB
Acoustic feedback	..... very good
Acoustic breakthrough and resonances	..... good
Subjective sound quality	..... very good

Speed

Speeds offered	..... 33 1/3 only
Fine speed control	..... no
Wow and flutter (DIN peak weighted)	..... 0.08%
Absolute speed accuracy error	..... -0.33%
Speed drift	..... none
Speed variation under load	..... -0.17%
Start-up time to audible stabilisation	..... 5.5secs

Rumble

DIN B weighted L and R averaged -70dB

Arm recommended Grace G-707, Hadcock GH228

Typical selling price ex VAT £185.00

*see text

This turntable has acquired a reputation for high quality sound, irrespective of lab measurement. The results in this group test certainly do it credit, although the price is regarded as rather high considering the apparent simplicity of the design and the lack of almost any of the usual facilities.

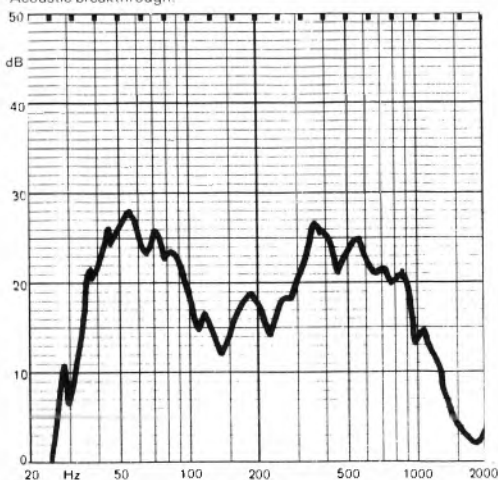
A belt drive model, in many respects similar to the Thorens TD 160/145 series, the LP12 uses a small synchronous motor to provide the single speed of 33 1/3. One minor source of annoyance in fact concerned motor vibration, which occurred when the unit was switched off and could only be resolved by disconnecting the mains supply.

As the manufacturer correctly points out, the unit should be accurately set up in terms of levelling the sub-chassis through adjustment of the spring tensioning, and in addition, the wiring from the arm must be dressed so that no unwanted mechanical coupling can occur between the arm board and the plinth.

Possessing but a single on/off switch, the ease of use rating can only be excellent! However, there is a complication which will arise with most arms having integral cue controls, as operation of the latter results in an undesirable bouncing of the sub-chassis, and hence cueing must always be done with caution.

Lab tests provided good wow and flutter figures and a very fine rumble result, with fairly good speed accuracy and only slight slowing under load. The vibration rejection was not optimal due to harmonic modes in the suspension but was nonetheless good, and both breakthrough and feedback were fine. On audition, neither rumble nor wow effects could be discerned and the LP 12 with the Grace G707 arm was one of the few decks in the report to gain a very good sound quality rating.

Acoustic breakthrough.



Lux PDI31

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



The appearance and finish of this direct drive turntable is quite excellent, and the engineering quality is also to a high standard, with a massive, die cast alloy foundation for the plinth, and a superbly machined, none resonant platter. The deck also carries one of the best record mats from a resonance damping point of view that we have yet come across. A simple bayonet lock system for the arm mounting board meant that arms could be changed readily if required.

Ingenious hydraulically damped legs are fitted, which looked effective but unfortunately did not prove to be so on test. We believe this model's failure to achieve a top ranking on sound quality is partially due to the ineffectiveness of these legs, but an improvement was effected by placing the deck on a firm, wall supported shelf rather than on a free-standing cabinet.

Apart from the slow run-up time, the other motor parameters were quite excellent, with drift, stability and load tolerance almost in the quartz locked class. Acoustic feedback, breakthrough and resonances were rated as very fine, but vibration susceptibility was only adequate. Acoustic feedback and subjective sound quality were both good, the latter assuming that a high calibre arm is employed

General data

Type	direct drive
Size	472 W x 372 D x 144 H mm
Clearance for lid	75mm
Overall weight	12.0kg
Ease of setting up	Excellent
Ease of use	very good
Platter mass	2kg
Platter damping	excellent
Finish and engineering	excellent
Type of mains lead	three core
Vibration sensitivity	adequate
Hum level	-70dB
Acoustic feedback	good
Acoustic breakthrough and resonances	very good

Subjective sound quality good

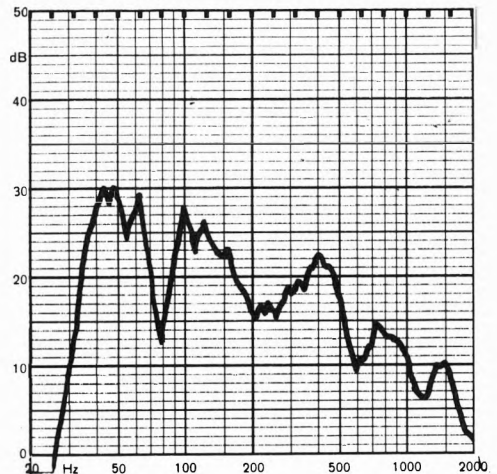
Speed

Speeds offered	33 1/3, 45 rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.05%
Absolute speed accuracy error	<0.03%
Speed drift	<0.05%
Speed variation under load	<0.01%
Start-up time to audible stabilisation	4secs

Rumble

DIN B weighted L and R averaged	-70dB
Arm recommended	AT 1009, Hadcock 22B, Micro MA505 etc
Typical selling price ex VAT	£230.00

Acoustic breakthrough.



RECOMMENDED

Micro Seiki DDX 1000

Tannoy Products Ltd., St Johns Rd., Tylers Green, High Wycombe, Bucks. 049 481 5221.



This extraordinary looking turntable is based on a massive alloy block resting on impressive but relatively ineffective shock absorbing feet. It is unique in that it simultaneously accepts up to three pick-up arms, mounted on quick release bases which clamp onto massive support pillars. No provision for a lid is apparent, and a large acrylic dome would seem to be the only appropriate solution.

On test generally excellent figures were recorded, with a particularly fine speed stability accuracy and tolerance of loading. The platter damping was particularly good, offering a solid, dead platform for the record. While the vibration sensitivity was only fair, (those feet really need readjusting!) breakthrough and resonances were classed as fairly good, feedback resistance as good and subjective sound quality as very fine. The latter is conditional on the use of a good arm, but more particularly on employing a substantial and well founded shelf or platform on which to stand the unit. Without this precaution, the low frequency range may begin to sound prominent and ultimately coloured, but with a firm foundation the clarity and neutrality of the mid-range can be excellent.

Using the Hadcock GH 228 arm, the subjective quality closely rivalled the £1000 odd Technics 'super system' based on the SP10 11.

Type	direct drive with remote control
Size	395 W x 378 D x 125 H mm
Clearance for lid	no lid
Overall weight	11kg
Ease of setting up	very good
Ease of use	very good
Platter mass	2.1kg
Platter damping	very good
Finish and engineering	excellent
Type of mains lead	3 core
Vibration sensitivity	fair
Hum level	-70dB

Acoustic feedback	good*
Acoustic breakthrough and resonances	fairly good
Subjective sound quality	very good

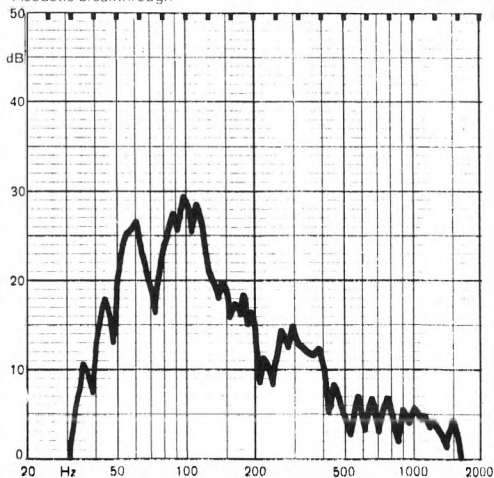
Speed

Speeds offered	33 1/3, 45 rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	0.035%
Absolute speed accuracy error	-0.1%
Speed drift	+0.1%
Speed variation under load	-0.1%
Start-up time to audible stabilisation	approx. 2.5secs

Rumble

DIN B weighted L and R averaged	-69dB
Arm recommended	Micro MA505, Hadcock 228, AT1009etc.
Typical selling price ex VAT	£320.00

Acoustic breakthrough



Toshiba SR-370

Toshiba (UK) Ltd., Toshiba House, Great South West Rd., Feltham, Middlesex. 01-751 1281.



Absolute speed accuracy error	..... + 0.27%
Speed drift	..... + 0.2%
Speed variation under load	..... - 0.4%
Start-up time to audible stabilisation	..... 4secs

Rumble

DIN B weighted L and R averaged	..... - 69dB
Arm recommended	..... SME 3009 II or others
Typical selling price ex VAT	..... £115.00

Representing Toshiba's entry into the field of motor units, the SR370 offers a very heavy one-piece plinth and chassis, moulded in mineral loaded plastic. It incorporates the by now well-known Matsushita direct drive motor and platter with a mounting board pre-cut to take an SME 3009 II baseplate fixing. However, with suitable adapter plates, presumably almost any arm could be fitted.

The whole assembly was suspended on resilient rubber cored feet, these probably proving to be the most effective of their kind among the many examples included on decks in this report. On acoustic feedback the shock or vibration isolation the SR370 was highly rated, while on breakthrough and resonances it was judged good. Its subjective sound quality was above that for the run-of-the-mill direct drive decks, although a slight incidence of wow was discernible on revealing programme passages. A typical performance for this type of motor was recorded, with the usual 0.4% slowing under load, but otherwise, generally very good results were obtained.

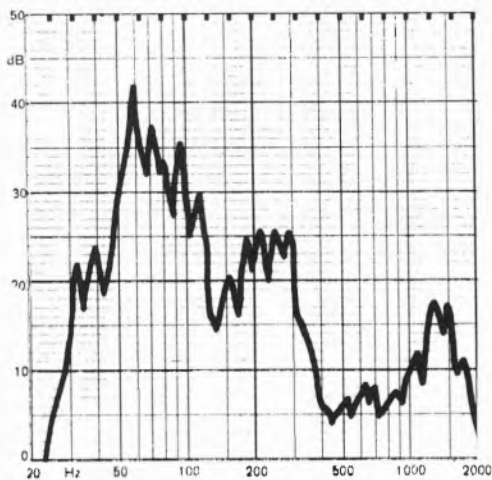
General data

Type	..... direct drive
Size	..... 468 W x 384 D x 174 H mm
Clearance for lid	..... 80mm
Overall weight	.....
Ease of setting up	..... very good
Ease of use	..... good
Platter mass	..... 1.55kg
Platter damping	..... good
Finish and engineering	..... good
Type of mains lead	..... 2 core + chassis earth
Vibration sensitivity	..... very good
Hum level	..... -69dB
Acoustic feedback	..... very good
Acoustic breakthrough and resonances	..... good
Subjective sound quality	..... fairly good

Speed

Speeds offered	..... 33 1/3, 45 rpm
Fine speed control yes
Wow and flutter (DIN peak weighted) 0.05%

Acoustic breakthrough



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2000E-III

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Frequency response range: 20Hz - 20kHz \pm 2dBs.

Tracking force range: $\frac{3}{4}$ - 1 $\frac{1}{2}$ gms.

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2000Z

The top of the range of our stereo cartridges.

Frequency response range: 20Hz - 20kHz \pm 1dB.

Tracking force range: $\frac{3}{4}$ - 1 $\frac{1}{4}$ gms.

Price: £67.50 including V.A.T.

4000D-1

This model is suitable for four channel systems including CD-4 and is compatible with stereo systems.

Frequency response range: 15Hz - 45 kHz \pm 3dBs.

Tracking force range: 1 - 1 $\frac{3}{4}$ gms.

Price: £33.18 including V.A.T.



2000E-1

Our popular cartridge suitable for use with a wide variety of turntables.

Frequency response range: 20Hz - 20kHz \pm 3dBs.

Tracking force range: 1 - 2 gms.

Price: £17.43 including V.A.T.



2000E

An inexpensive cartridge with a good specification.

Frequency response range: 20Hz - 20kHz \pm 3dBs.

Tracking force range: 1 $\frac{1}{4}$ - 2 $\frac{1}{2}$ gms.

Price: £12.26 including V.A.T.

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Cartridges: Best buys, recommendations and conclusions.

Recommending a cartridge is by no means as straightforward as one might expect. The compiled data in the results table can not tell the entire story; further factors which must be taken into consideration include price, and the need for good compatibility with a presently owned or chosen turntable and arm. In a less well defined area, the sound quality and more particularly its character must also suit the amplifier, and most important of all, the matching loudspeakers. Ideally, these components should be chosen at the same time as the cartridge, after listening sessions.

The fact that the sound quality rankings are primarily based on a cartridge's overall 'accuracy' may place several good quality designs quite low. However, in conjunction with a suitable amp and pair of speakers, these models may still be capable of good sound quality in a complete system. Thus, the first recommendation if purchasing a cartridge to accompany an existing system, is to consider auditioning several models, including some which on our sound accuracy ratings may not have scored too well, as these could nonetheless sound pleasing with your equipment.

Best value for money

One model which stood out as offering a very good all round performance at a very reasonable price, was the **Ortofon FF15E**. At a typical selling price of £12.00 ex VAT, serious competition was only offered by models costing upwards of twice this price. Low to medium mass arms are required for optimum results, making the cartridge entirely suitable for most of the detachable headshell models—except the very heaviest.

The remaining cartridges in the survey came nowhere near the FF15E in terms of value for money, and their classification is best given on the basis of combined performance and price levels.

The 'superfi' group, typically over £60.00 ex VAT

Albeit at a much higher price level, a number of cartridges recorded a generally excellent overall performance with outstanding musical accuracy.

A best buy is not easy to identify, but the nearest to it must be the **Sonus Blue** at around £60.00 ex VAT. While a low mass arm is essential, damping is not, and the overall balance of sound quality and laboratory performance is first rate. It was unique in that it rivalled the excellent mid-band quality of the moving coil models, while offering the trackability and low

downforce levels expected of a top class conventional cartridge.

At a comparable price the **Ultimo 20A** (£65.00 ex VAT), almost qualifies for a similar ranking, and it is one of the few moving coil designs that does not require a transformer. By the standards of this report, the **Ultimo 20A** was only a shade inferior to the other two highly rated moving coils—the **Supex 900 Super** at approximately £85.00 ex VAT and the **Fidelity Research FR1 mk II** at approximately £45.00 ex VAT—but both of these require the additional expense of purchasing a pre-amplifier or a transformer. All the models mentioned in this top group would undeniably do justice to the very best system, but for the record (excuse the pun!) the **Ultimo 20A** has a slightly forward presence band, while the **Sonus Blue** is essentially neutral and the **Supex 900 Super** and the **Fidelity Research FR1 mk II** are both slightly on the dull side. It should also be noted that the **Ultimo 20A** does require a special electrical loading for optimum performance.

Excellent performance, typically £50-60.00 ex VAT

A slight reduction in price and quality brings us to a second group of cartridges, all of which exhibited a very good performance. It is impossible to single out one as more deserving of merit. The group comprised the **AKG P8ES** (typically £58.00 ex VAT), the **AKG P8E** (typically £52.00 ex VAT), the **Pickering XSV3000** (typically £53.00 ex VAT) and the **Empire 2000Z** (typically £53.00 ex VAT). As all four samples possessed less than perfect diamonds, potentially their performance might further improve were they 'tipped' to the standard expected at this price level. In addition, the two AKGs could also benefit from improved screening. Both the AKGs and the Pickering cartridges are compatible with low to medium mass arms, but the Empire will give optimum results with only a very light mass arm.

Cartridges: Best buys, recommendations and conclusions.

Good quality, typically £25-40.00 ex VAT

All the models in this group offer a performance mid-way between the 'budget' and 'superfi' models. The **Pickering XV 15 625E** (typically £25.00 ex VAT) is compatible with medium mass arms, but the other three in this category—the **Audio Technica AT20SLa** (typically £36.00 ex VAT), the **Goldring G900SE**—when warm—(typically £35.00 ex VAT) and the **ADC XLM mkII** (typically £26.00 ex VAT) all need low mass arms.

Good quality at a budget price, typically £5-15.00 ex VAT

Apart from the Ortofon FF15E—the best buy of the survey—this group includes the two Audio Technica cartridges, the **AT11EP** (typically £7.00 ex VAT) and the **AT13EaP** (typically £12.50 ex VAT). The latter requires a low mass arm, but the **AT11EP** is one of the very few good performance budget models suited to the medium and high mass arms usually found on cheaper decks. Another high compliance cartridge offering good performance at a moderate price (typically £9.00 ex VAT) is the Philips GP 400 mk II.

Recommended alternatives offering reasonable value for money

This group contains a broad range of cartridge types which offer useful combinations of performance in terms of compatibility, good subjective quality and good laboratory results. The **Empire 2000EIII** (typically £18.00 ex VAT) and the **Ortofon VMS20E** (typically £27.00 ex VAT) require low mass arms for optimum results. The two B & O models—**MMC3000** (typically £25.00 ex VAT) and **MMC4000** (typically £32.00 ex VAT)—are both suitable for low to medium mass arms. The other four which are recommended in this category—the **ADC VLM mkII** (typically £23.00 ex VAT), the **AKG P7E** (typically £23.00 ex VAT), the **Grace F9L** (typically £65.00 ex VAT) and the **Stanton 500A** (typically £16.00 ex VAT) are all compatible with medium mass arms, the latter also being suitable for some high mass arms.

Conclusions

While undoubtedly there are a few 'rogue'

cartridges on sale today, the general standard of performance attained by this test group was quite impressive. Most will trace modern records with authority, recovering a large proportion of the information pressed, and a few achieve this with a degree of neutrality and accuracy which has to be heard to be believed. Consequently, these deserve to be used with ancillary equipment of similarly high neutrality.

Some models are undoubtedly sensitive to load impedance variations and it is worth trying to meet the recommended values as specified in the results table. If additional capacitance is required, it is convenient to use extended cables from the arm to the amplifier, and where a lower resistance is needed, this may be provided by miniature components either soldered across the terminal pins of the headshell or else contained in a small box. Most component dealers should be able to advise on this subject, and as exact values of loading are not critical, a working range is given in the tables. A few amplifiers offer a variable input impedance facility to help solve this problem.

The cartridge/arm compatibility question is potentially a source of far greater problems. It would be no exaggeration to say that the majority of hi-fi systems in use today have a mismatched arm/cartridge combination. The fact that records can be played on these systems merely shows how tolerant the disc playing arrangements are. The more this tolerance is imposed upon, the less likely it is that the potential performance of the cartridge will be realised. An unsuitable match, particularly that of a high mass arm and a high compliance cartridge, will impair to a greater or lesser degree almost every aspect of performance, including bass colouration, vibration susceptibility, stereo image, clarity, precision and depth, and not least trackability. Finally, the excessive subsonic energy produced by even mild record warps unduly stresses both amplifier and loudspeaker.

If faced with the choice between two cartridges—one of which is compatible and the other which is nominally superior in sound quality but which is unsuited to the deck in question—the former is likely to be the correct choice because it would deliver its best performance, while the latter would suffer a

Cartridges: conclusions.

performance degradation due to incompatibility problems, thus overruling the nominal difference in sound quality. Detailed recommendations are given in the individual reports with the compatibility code offering a ready means of matching arm and cartridge. An ideal combination would be, for example:

Cartridge Frequency rating B, damping rating L
Arm Frequency rating B, damping rating L.

Satisfactory results would be obtained with matching arm and cartridge to adjacent codes such as:

Cartridge Frequency rating A, damping rating L.
Arm Frequency rating B, damping rating M (or K)

Some general comments concerning the recommended cartridges are worth making. Generally, their compliance values were rather high. Taking the best value for money—the Ortofon FF15E—this would appear to be a logical choice for a decent low cost system, and its compliance value allows it to work well with the majority of medium mass arms. A number of other recommended models including the Sonus Blue, Empire 2000Z and 2000E111, Audio Technica AT20SLa and 13EaP, plus Goldring 900SE & Philips GP400 mkII, Ortofon VMS20E and ADC XLM mkII all needed low mass arms and these cartridges are thus, strictly speaking incompatible with the vast majority of medium to high mass detachable headshell arms. Those which will function well in the latter include the Ultimo 20A, Supex 900, Fidelity Research FR mkII, Pickering XV15 625E, AKG P8ES, P8E and P7E, Audio Technica AT11Ea, ADC VLM mk II, Grace F9L and Stanton 500A. Borderline models include the Pickering XSV3000 and both the B&O MMC3000 and MMC4000, all of which ideally require arms in the 5-10 g range, but will work well enough in the lighter type of detachable headshell arm.

Although at present very few arms are able to provide a damping facility, it would appear that most cartridges would benefit from this. The table gives the code 'J-M', ranging from J = high arm damping and M = minimal damping. Decoupled counterweights may help to provide some damping but often they are ineffective or else they introduce additional colouration. Of the

individual arms tested, only the Formula 4 and Hadcock unipivots offer damping as standard, although the SME 3009 11 will shortly be available with a damper which may also be fitted to existing models. Any inherent damping which a cartridge possesses will have a greater effect if the subsonic resonance frequency is high, and hence the use of a low mass arm is the most important step when choosing a high compliance design.

Perhaps the greatest disappointment concerned the poor quality of the diamond tips that were fitted to far too many reputable makes of stylus. Readers will be horrified to learn that mass produced diamonds designed for cheap, commercial grade models and costing a matter of a few pence each, were fitted to a number of hi-fi cartridges retailing at as much as £40.00. These comments apply more particularly to the European and American models, whose styli proved to be greatly inferior, regardless of price level, to their Japanese counterparts. The latter all possessed top class diamond styli, with even the modest priced AT13EaP sporting a well finished and accurate naked tip. Since the diamond is the component which actually traces the delicate vinyl groove, its geometrical alignment, dimensional accuracy and surface polish should obviously be of the highest practicable quality. Variations in diamond tip quality are bound to affect high frequency distortion, frequency response (due to tracing loss) and trackability. Channel separation and the noise level from record surfaces will also be affected, and undoubtedly some of the differences noted by hi-fi enthusiasts in samples of the same cartridge model, can be attributed to inconsistencies of tip manufacture. With some cartridges, the difference in relative values between the asking price and the quality of diamond fitted can only be likened to that of purchasing a high performance car, only to find that it has been fitted with remould crossply tyres.

Now you know an Ortofon FF15E cartridge works well with a Thorens TD145 turntable. But will they be compatible with the rest of your system?

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Turntable: Best buys, recommendations and conclusions.

Very good value for money

With respect to specific price ranges, we did not find that any integrated record players costing over £150.00 offered very good value for money.

Typically £100-150.00 ex VAT

There are five models in this category. The **Thorens TD 145 mk II** at typically £105.00 ex VAT is a fine suspended sub-chassis model with auto stop and a fairly low mass arm. The **Beogram 1902** (typically £125.00 ex VAT) is a classically simple automatic turntable with an excellent system design which is sold complete with a good integrated cartridge. There are three direct drive models. The excellent **Technics SL-1700**, which is typically £127.00 ex VAT, offers quite an effective anti-vibration suspension and an auto arm return, which the **Sanyo TP-1100** (typically £110.00 ex VAT) is broadly similar to the Technics on grounds of performance, and the **Sony PS-4300** (typically £130.00 ex VAT) offers fully automatic facilities. Although not tested, both the fully automatic Technics SL-1600 (typically £145.00 ex VAT) and the manual SL-1800 (typically £105.00 ex VAT) are very similar to the SL-1700. Also, the Thorens TD 160 mk II at typically £90.00 ex VAT is basically a TD 145 mk II without the auto stop.

Typically £75-95.00 ex VAT.

This group is headed by the semi-automatic **Sony PS-1700** (which costs about £75.00 ex VAT) including the cartridge. Also recommended the **Thorens TD 166 mk II** at typically £76.00 ex VAT—a manual belt drive turntable with a fully suspended chassis and a fairly low mass arm; and the **Trio KD-2055** (typically £75.00 ex VAT), another belt drive turntable with auto stop and return and a versatile arm.

Typically £50-70.00 ex VAT

The manually operated **Pioneer PL-112D** at typically £50.00 ex VAT is certainly excellent value for money, offering a laboratory performance which was little inferior to that of a good direct drive unit. Also in this price category, is the **Philips GA-437** (typically £60.00 ex VAT), which is supplied with the recommended GP-400 mk II cartridge. Although the deck and cartridge are not highly compatible, they are still very good value for money.

Typically £15-45.00 ex VAT

The **BSR BDS 80** is remarkable value for money at typically £27.00 ex VAT, a price which includes plinth, cover and cartridge. While the performance

is not 'hi-fi' in the true sense of the word, the deck does its job well and offers fully automatic operation to boot. Lacking a cartridge, but offering an improved performance in comparison with the BSR in a similar automatic package is the **Garrard 125SB** (typically £42.00 ex VAT) the second of our budget recommendations. (It may be obtained with a fitted cartridge at an increased cost.) Finally, the **Connoisseur BD2A** at typically £45.00 ex VAT offers an upgraded performance but fewer facilities. It may also be bought without the auto stop as the BD2 for about £5.00 less.

Recommended alternatives

While not representing such obviously good value for money, the following are listed as performing well overall, offering an above average sound quality and may be considered as possible alternatives to the first choice models listed above.

The **Prinzsound PL-15** at typically £45.00 ex VAT is a manually operated belt drive turntable supplied with a cartridge. The **Sansui SR-222** (typically £55.00 ex VAT), a belt drive turntable which gave a generally good performance. The **Micro Seiki MB10** a manual belt drive model also costing approximately £55.00 ex VAT. The **Philips GA-312** at typically £95.00 ex VAT including cartridge is a touch control, belt drive deck. The **Pioneer PL-510A**, which at approximately £100.00 ex VAT is one of the cheapest direct drive models in the survey giving a very satisfactory overall performance. The **Ariston RD11E**, (typically £110.00 ex VAT) is a belt drive turntable with variable speeds and auto stop. And finally, the **Thorens TD126 mk II** which at typically £200.00 ex VAT is a good quality three speed belt drive motor, with a semi-automatic low mass arm, and a variety of facilities.

Separate motor units

Assembling a turntable system from separates is a far more costly business than buying an integrated unit, and thus 'best buys' do not really apply.

But, there are two models which are reasonably good value for money and gave a generally satisfactory performance. The **Connoisseur BD1**, at typically £20.00 ex VAT, is a kit chassis form of the BD2A motor section, but it must be mounted on a substantial plinth structure to give optimum performance. The **Thorens TD160** is the motor

Turntable: Best buys, recommendations and conclusions.

section of the TD 160 mk II/145 mk II. It has a floating sub-chassis and costs about £70.00 ex VAT.

However, the following three models possessed both a high subjective sound quality plus a very good laboratory performance, and if money is no object, then these can certainly be recommended. The **Linn Sondek PL12** at typically £185.00 ex VAT is a manual, single speed belt drive unit. The **Micro Seiki DDX1000** has a multiple arm facility, and providing that it is placed on a very firm base, this two speed direct drive model can be recommended, although it is rather expensive at typically £320.00 ex VAT. At an even higher price, the direct drive **Technics SP10**, costing approximately £610.00 ex VAT including chassis and plinth, offers an excellent sound quality – as it should at this price.

Pick-up arms

The **Connoisseur SAU2** reviewed in this book with the Connoisseur BD2A record deck, is the only low cost arm in the survey at typically £13.00 ex VAT. It gave a generally satisfactory performance and is compatible with medium compliance cartridges. For £30.00 more, the **Hadcock GH228** at around £40.00 ex VAT can be recommended for its very good sound quality, but its general finish and assembly instructions were rather inadequate. It is compatible with medium to high compliance cartridges. Offering a similar high sound quality, but an improved finish is the **Grace G707** (typically £70.00 ex VAT), which is also suitable for medium to high compliance cartridges.

The following pick-up arms gave a generally satisfactory performance and offer compatibility with a variety of cartridges. The **SME 3009 mk 2 improved** at typically £35.00 ex VAT can be obtained with or without a detachable headshell. With the detachable headshell model (the SME 3009 mk 2 improved D) medium compliance cartridges are suitable, and with the non-detachable headshell unit (SME 3009 mk 2 improved ND), low to medium compliance cartridges are recommended. The optional facility of damping further adds to its versatility. The **Audio Technica AT1009** at approximately £40.00 ex VAT is compatible with low compliance cartridges, while the **Mayware Formula 4** arm is suitable for use with high compliance cartridges, particularly those of a delicate nature.

Conclusions

In concluding the report on turntables, one cannot overlook the fact that few entirely satisfactory

models were submitted. For example, few decks received an 'excellent' rating for sound quality, namely the Technics SP10 Mk II system, and even then minor reservations still exist despite the £1000 odd price tag. However, this is not to say that a fine sounding deck needs to be quite that expensive; witness the good subjective performance of the much cheaper Philips GA-437.

The data gathered during this survey proves conclusively that a turntable system must be regarded as an acoustic structure with possible resonances in any section. These may affect sound quality as much as the basic factors of subsonic arm resonance and damping, rumble or wow and flutter.

A surprising discovery concerned the subjectively perceived wow from certain direct drive motors, whose steady state wow and flutter readings lay in the range 0.035 to 0.06% DIN peak weighted; a level which should technically be inaudible. Investigation revealed the source to be 'dynamic wow' produced by the short term extra stylus drag that results when high levels of groove modulation are being traced. Two performance characteristics were seen to be relevant in this context. Firstly, a significant slowing under moderate load – for example, 0.4% for a 5g dust bug, and secondly, the servo control which allows overshoot in order to attain the correct speed. Thus, the dynamic wow can be explained as follows. The loud passage slows the motor and its recovery is delayed. The error is then noticed by the servo control which applies extra power, causing the motor speed to overshoot the correct value. Finally, the speed error swings back to normal. The converse cycle occurs when the extra loading is removed. We estimated that the peak wow generated during this cycle reached 0.3-0.4%, which explains its audibility. However, on steady state measurement, (ie: a constant wow and flutter tone) once the load conditions have stabilised, the wow and flutter settles back to a very low value, as recorded in the tables. If this effect was present in models costing over £100, we considered it to be a serious problem, and for this reason, these decks are not included in the list of recommended best buys.

A further point influencing sound quality concerned the fact that the majority of the solid plinth, plus rubber feet models fared poorly as regards shock and vibration resistance. We are sure that this adversely affected their colouration and hence sound quality performance. Very few so called 'shock absorber' feet were of any practical use. In addition, we found that the form of the platter mat could prove influential; the examples

Turntable: Best buys, recommendations and conclusions.

having vestigial ribs or rings with minimal record contact were inferior from a sound quality point of view to the more conventional plain and heavy mat designs.

With regard to pick-up arms, the fact that a large number were incompatible with the majority of typical cartridges on grounds of effective mass alone, is amazing. Whether it is the fault of the cartridge or arm manufacturers is difficult to say, but on the evidence collected the latter would appear to be more to blame. For example, the Philips turntables which did pretty well otherwise, showed a marked incompatibility between their pick-up arms and their ready fitted cartridges, although manufactured by the same company. By contrast, B&O illustrate an excellent example of a completely integrated design, both models possessing a suspended sub-chassis with properly matched arm/cartridge compatibility. In the latter case, the sum of the whole can exceed the sum of the parts.

In general, arm masses were found to be far too high. With one direct drive model costing around £200.00, the arm mass was so high that only cartridges with compliances of below 12cu were strictly suitable, but at this level there are very few designs of adequate quality available. The fine example of Thorens with their new low mass

interchangeable headshell arm will surely be taken up in future by other manufacturers.

We also noted great variations in bias force, and to a lesser extent, arm friction. Too much bias can be worse than none at all, while both conditions considerably impair cartridge trackability and may also have an adverse effect on channel balance and separation. Arm biasing clearly needs more care and attention than would appear to be accorded it at present.

A further problem concerned lateral balancers or outriggers which are, in our view, a menace. Most introduced secondary resonances and colouration, and a few actually caused mis-tracking, which disappeared when the weight was removed.

Overall, the turntable market proved to be a disappointment, as it would appear that most models, despite the generally high quality of surface finish and usually good performance on the laboratory tests, are acoustically as primitive as loudspeakers were about 20 years ago. System faults attributed to colouration in the loudspeakers, etc., may in fact be caused by the turntable/arm combination. Many manufacturers are going to have to work hard to solve obvious basic problems of design if they are to maintain their credibility in this field.

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Stop press Monitor Audio ET1000

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This UK built motor unit usually comes supplied with an SME 300911 pick-up arm (see arm section) but with the addition of suitable adapter plates, several other models may in fact be fitted. Any competent dealer should be able to advise on this point. The deck incorporates the ubiquitous Matshushita direct drive motor with the matching machined and stroboscopically marked platter. A low profile, solid plinth construction is employed with height adjustable, rubber cored feet. The lid has the added bonus of requiring very little rear clearance upon elevation.

Our review sample was stated to be provisional in two respects. The present combined transformer/power supply plug does not meet the safety regulations due to the non-standard plug pins and the absence of a fuse. Monitor Audio are currently resolving this problem and in addition, the plinth is also undergoing upgraded acoustic damping treatment.

The deck offered two features unique to the direct drive group under review. Firstly, there were the touch sensitive electronic controls for start and stop, speed change and fine speed control, the latter in 0.2% increments, indicated by a binary read-out of four characters. Secondly, the Monitor Audio auto arm lift device was incorporated, in this case electrically coupled to the motor, causing it to switch off when the end-of-side arm-lift operates.

On lab tests, the typically favourable motor performance was recorded but with the usual slow start-up and variation under load. With the use of critical programme material slight wow could be heard, but otherwise the sound quality was classed as fairly good, with no obvious vices.

MOTOR

General data

Type direct drive, auto stop and lift
Platter mass 1.35kg

Platter damping good
Finish and engineering good
Type of mains lead low voltage, special

Speed

Speeds offered 33 1/3, 45rpm
Fine speed control yes
Wow and flutter (DIN peak weighted) 0.035%
Absolute speed accuracy error <0.1%
Speed drift <0.2%
Speed variation under load 0.35%
Start-up time to audible stabilisation 3.75secs

Rumble

DIN B weighted L and R average -69dB

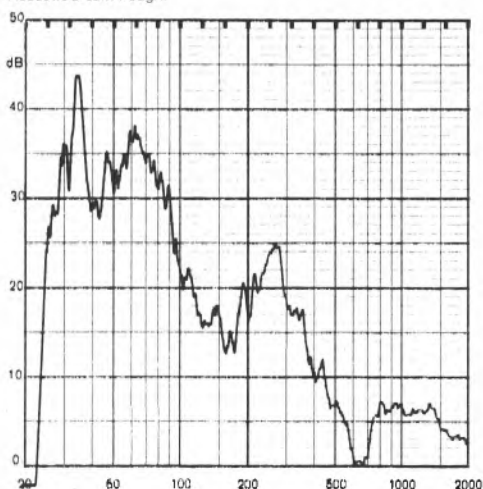
MOTOR AND ARM DATA

Size 470W x 370D x 120Hmm
Clearance for lid 20mm
Overall weight —
Ease of use very good

Typical acoustic breakthrough and resonances fairly good
Subjective sound quality of complete system good
Hum level -68dB
Acoustic feedback very good
Vibration sensitivity good

Typical selling price ex VAT £175.00 inc. SME arm.

Acoustic breakthrough



Stop press Dual CS-510

Audiodecks Ltd., PO Box 7, Sandbeck Way, Wetherby, West Yorkshire, LS22 4YS. 0937 5477.



The vibration isolation, feedback and acoustic ratings were all pretty good. Our sample was supplied with a DIN plug which gave satisfactory if not outstanding hum levels and these would no doubt improve if the phono lead option were exercised instead. Sound quality was judged well above average and overall, the results were indicative of good value for money.

Manufactured not far from the Thorens factory in West Germany, the CS510 is one of Dual's large turntable range, which at present are all supplied with ready fitted Shure cartridges. In this case an M95B with a spherical tip was included, although with Dual's convenient lock-in cartridge carrier, most other types may be easily substituted. (We did not use the Shure for the listening tests, employing instead our reference, the Ultimo 20A).

The CS510 incorporates a pressed steel chassis deck suspended on a well designed coil spring arrangement, with some damping. We judged both the spring rate and the total chassis resonance frequency to be optimal. An ingenious variable speed control and an excellent $3\frac{1}{3}$ stroboscope were fitted and all controls were found to operate smoothly. The finish and engineering were commendable at the price, although we did feel that a more substantial platter mat would be an advantage, as would the elimination of a slight ticking noise from the motor, audible when the lid was up, though this did not obtrude into the cartridge output.

On test, the motor section proved impressive with very good wow and flutter (inaudible on listening tests) and both good speed stability and accuracy. The rumble was more than satisfactory at -66dB , and was barely noticeable under audition.

This model possessed an unusually fine pick-up arm of medium-high effective mass which exhibited very low friction, accurate biasing and downforce calibration, and fine trackability. The cue action was precise with useful record size indicator 'notches', but the ascent time was considered to be on the slow side, at 1.5 seconds. The counterweight incorporated some damping, which will help to control the inevitable subsonic arm/cartridge resonance, but little if any effective mass reduction was accorded.

MOTOR

General data

Type	Belt Drive, auto stop and lift
Platter mass	
Platter damping	good
Finish and engineering	very good
Type of mains lead	three core
Type of connecting lead	DIN or phono

Speed

Speeds offered	3 3/4, 45rpm
Finespeed control	yes
Wow and flutter (DIN peak weighted)	0.04%
Absolute speed accuracy error	+ 0.2%
Speed drift	negligible
Speed variation under load	-0.2%
Start-up time to audible stabilisation	1.2secs

Rumble

DIN B weighted L and R average	-66dB
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ARM

General data

Type of headshell	detachable carrier
Headshell mass	n/a
Geometrical accuracy	very good
Adjustments provided	overhang
Finish and engineering	excellent
Ease of assembly	very good
Trackability	very good

Friction

Typical lateral	<10mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	175mg
Centre	175mg

Downforce calibration error

1g	1.0g
2g	2.0g

Cue operation

Drift	negligible
Ascent (8mm)	1.5secs
Descent (8mm)	2secs

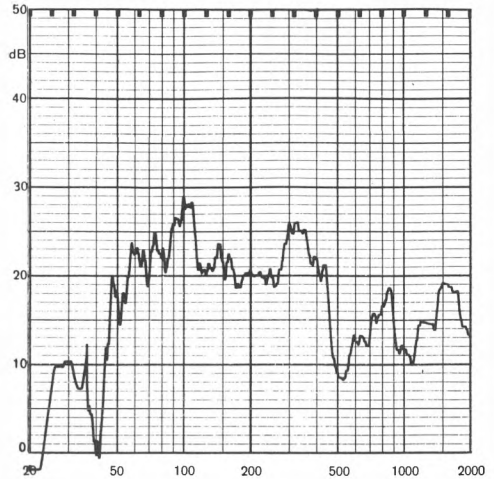
MOTOR AND ARM DATA

Size	420W x 365D x 148Hmm
Clearance for lid	50mm
Overall weight	4.3kg
Ease of use	very good

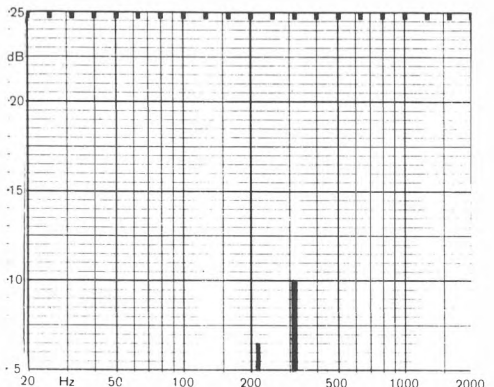
Typical acoustic breakthrough and resonances	good
Subjective sound quality of complete system	
Hum level	-65dB
Acoustic feedback	very good
Vibration sensitivity	very good

Arm obtainable separately	no
Typical selling price ex VAT	£110 inc Shire M95B cartridge

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge	16-18g
Resonance rating	B
Damping rating	K
Recommended tracking weight	1.25-3g
Low to medium compliance cartridges recommended (10-25cu)	

Stop press Strathearn STM4

Strathearn Audio Limited, Kennedy Way, Belfast BT11 9AP, Northern Ireland.



This inexpensive, manual, direct drive deck was designed in the UK, and comes with a Shure M75ED II cartridge, which was correctly fitted. The unit is a rigid design mounted on rubber feet for vibration and shock isolation; in contrast to many of the models in the review, they proved to be fairly effective. General presentation and finish were excellent, but we found the speed change and cue control lever to be rather stiff, with the latter lifting the stylus an excessive distance above the record. In addition, the decorative mat was of the vestigial, low contact type, which will offer minimal control of both platter and record resonances.

On test, the turntable gave an adequate wow and flutter result of 0.18%, DIN peak weighted but the speed drop under load was significantly high at 0.5%, and some wow could be heard during the listening tests. The rumble level at -58dB was also audible, although it was not judged to be severe.

The deck possessed a genuinely low mass arm, well suited to the model of Shure cartridge fitted. However, other cartridges with compliances of up to 35cu would also be compatible, this being a very unusual facility in a turntable at this price level. One small problem concerned the loose fit of the sliding counterweight on the rear arm section, as no threaded or locking arrangement was provided. In practice, however, the high friction between the rubber counterweight insert and the arm bar will probably keep it in place. When tested, the biasing was found to be imperfect, the values measuring around twice the level required, with considerable bias still present at the dialled zero setting. Although excellent in the vertical plane, lateral arm friction was only fair, at 100mg .

Listening tests placed this model at an average sound ranking and other aspects such as acoustic breakthrough and resonances could only be classed as fair. The susceptibility to acoustic feedback was

good, and while vibration resistance was judged as fairly good, we felt the hum level could be improved, possibly by the addition of a separate chassis earth. As it stands and judged by the standards of the group, the STM4 offers barely average value for money.

MOTOR

General data

Type	manual direct drive
Platter mass	1.4kg
Platter damping	poor
Finish and engineering	good
Type of mains lead	two core
Type of connecting lead	DIN

Speed

Speeds offered	33 1/3, 45rpm
Fine speed control	yes
Wow and flutter (DIN peak weighted)	< 0.18%
Absolute speed accuracy error	< 0.3%
Speed drift	< -0.2%
Speed variation under load	-0.5%
Start-up time to audible stabilisation	secs

Rumble

DIN B weighted L and R average	-58dB
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ARM

General data

Type of headshell	fixed
Headshell mass	n/a
Geometrical accuracy	good
Adjustments provided	overhang
Finish and engineering	good
Ease of assembly	good
Trackability	good

Friction

Typical lateral	100mg
Typical vertical	<10mg

Bias compensation (set to 1.5g elliptical)

Type of system	spring
Rim	350mg
Centre	300mg

Downforce calibration error

1g	0.95g
2g	1.85g

Cue operation

Drift	negligible
Ascent (8mm)	0.5secs
Descent (8mm)	2secs

MOTOR AND ARM DATA

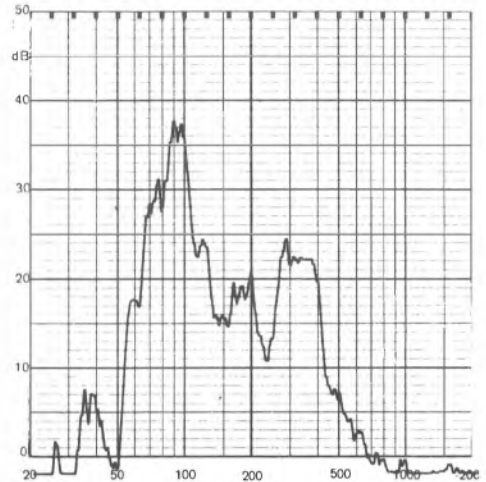
Size	370W x 320D x 140Hmm
Clearance for lid	70mm
Overall weight	6.5kg
Ease of use	very good

Typical acoustic breakthrough and resonances

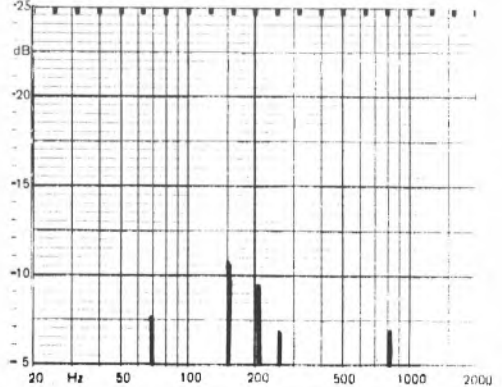
Subjective sound quality of complete system	average
Hum level	-60dB*
Acoustic feedback	good
Vibration sensitivity	fairly good

Arm obtainable separately	no
Typical selling price ex VAT	£71.00 inc M75EDII cart

Acoustic breakthrough.



Indication of magnitude and frequency of arm resonances.



Compatibility

Effective moving mass excluding cartridge	5.6g
Resonance rating	C
Damping rating	K
Recommended tracking weight	1.5-3g
Medium to high compliance cartridges suitable (15-35cu)	

Glossary of terms

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 when it 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 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 a rotating spiral groove, groove-tip 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-pulley systems, magnetic loading, and springs. Bias compensators are usually adjustable, and produce forces of around 10-15% of the tracking downforce.

Colouration: 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 colouration.

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 of 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: A relatively recent development, 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.

Distortion: The total percentage of unwanted signal in a wanted signal.

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.

Dynamic range: The range, measured in dB, between the lowest and highest (in volume level) signals handled or produced by a piece of audio equipment.

Frequency response: A measurement of the ability of an item of audio equipment to reproduce different frequencies, which is conventionally displayed as a graph. Ideally the curve is a straight line, indicating equal reproduction ability at all audio frequencies.

Gimbal: A pair of concentric bearings used in pick-up arms to give freedom of movement in the vertical and horizontal planes.

Harmonic distortion: The percentage of unwanted harmonics which appear in the output of an audio system, along with the desired signal.

Headshell: On some arms the cartridge is securely mounted in a light casing or headshell, which is itself mounted at the end of the 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 1 kHz = 1000 cycles-per-second.

Intermodulation distortion: The percentage of unwanted harmonics produced from the interaction of two wanted audio signals.

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.

Line contact stylus: A modern form of stylus, introduced mainly for tracking CD-4 discrete quadrasonic records, but now more widely used. The diamond is fashioned to contact the record groove walls in an extended line right up each side. The two best known types of line contact stylus are the Shibata and Pramanik.

Naked tip: A diamond mounted directly onto the cantilever arm of the cartridge by adhesive, rather than indirectly by means of a metal or similar cup.

Ohms: A measure of electrical resistance, a kilohm (kohm) being 1000 ohms.

Overhang: The extent to which the cartridge stylus extends beyond the centre of the platter is critical, and controlled by fore and aft adjustment of the cartridge on the arm. 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.

Piezo-electric: Some materials, such as natural crystals or artificial ceramics, generate electricity when stressed. This piezo-electric effect is often used in cheaper cartridges (and microphones) as an alternative to the now more conventional and sophisticated magnetic method, whereby a moving iron, coil or magnet transduces mechanical movements into electrical signals.

Picofarad (pf): One millionth of a microfarad, the standard unit of capacitance.

Resonance: Any article 'rings' or 'sounds' at a natural resonant frequency when vibrated. So, all parts of a record deck may exhibit resonance. The main resonance of an arm is the low frequency at which it resonates when the cartridge stylus is resting in a record groove supported by 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 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 head shell 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.

Trackability: An all-embracing term covering the general ability of an arm-cartridge stylus combination to track a given test signal.

Monitor Audio launch a new turntable...

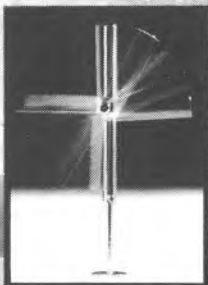
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Monitor Audio take another big step into the future . . . with the launch of the new ET1000 Direct Drive Turntable with STYLIFT the unique 'lift off' device.

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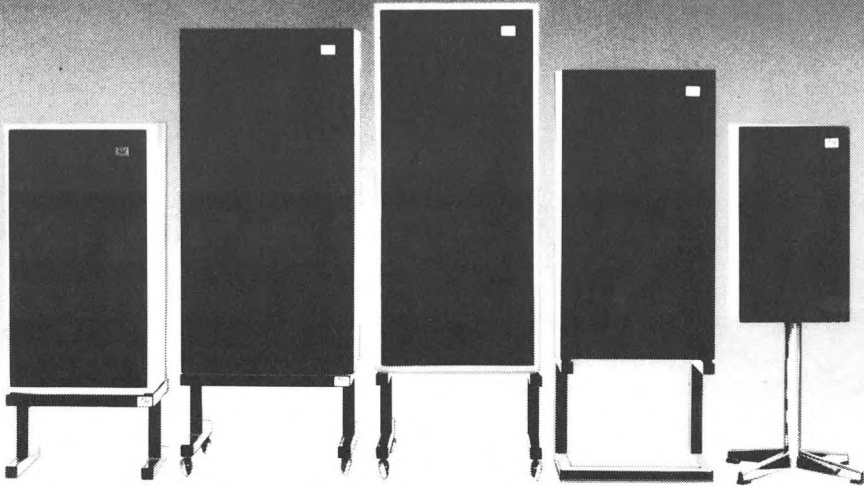
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What is your first component?

Is it your receiver?



Your Turntable?



Your speakers?



or is it your cartridge?



We have become convinced that it really is your phono cartridge, even though we have been modestly advertising it for the past few years as your *fourth*.

Let's face it, the cartridge is that important *first* point where the music begins, and if the stylus cannot follow its path accurately, no amount of expensive equipment — speakers, turntable or receiver

can make up for the distortion it can produce. That is why you need a cartridge you can depend on. One that's the best your money can buy. Specifically, a Pickering.

Because a Pickering cartridge has the superior ability to "move in the groove" from side to side and up and down without shattering the sound of your music on your records.

Because a Pickering cartridge possesses low frequency tracking ability and high frequency tracing ability (which Pickering calls traceAbility™). It picks up the highest highs and the lowest lows of musical tones to reveal the distinctive quality of each instrument.

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Your stereo cartridge is the *first* part of your music system. It is too important to overlook, and so is a Pickering.



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Many of you will have read the various comparative reviews printed in this and other Hi-Fi magazines. Perhaps you too have found amusing in them the increasing use of the word 'subjective', because it wasn't very long ago when the results of objective test procedures formed the basis of equipment recommendations. You may also remember that it was one of our fellow dealers who really put the cat amongst the pigeons by stating in his advert that a certain very well measured amplifier sounded "foul"! What a controversy that caused!! The outcome is plain to see — the word 'subjective', now being used in almost every equipment review, proves that the human ear *must* be the final judge in assessing the performance of any audio component. Unfortunately old habits die hard and it is still too easy to be impressed by the written word, words which really tell us so little about the actual sound. At Hi-Fi Consultants we have created a stylish listening environment where you can compare everything from cartridges to loudspeakers. We carry good stocks and keep our prices comparable with the lowest advertised. So come and *listen* — you can't blame your ears if you don't!

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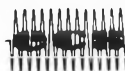
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You get a free ADC cartridge when you buy this turntable, but we advise you to read all the small print.

It seems only fair to warn you that the BSR McDonald BDS95 is a tempting enough purchase as it is.

We made this belt-drive turntable with certain people in mind.

People who still have the turntable that came with their first hi-fi system.

And they've begun to notice the imperfections.

The BDS95 means you've not only moved up to a turntable that meets the most exacting standards of design and performance, but you still have a turntable you can really rely on.

So let's take a closer look by lifting the friction hinged lid, which stops at any angle on the slimline plinth.

Notice the 'S' shaped, low resonance,

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The counterbalance for primary weight adjustment, and micro-balance obtained by the ultra-fine rotary control.

Now let's get things in motion using the viscous cueing device, and discover the great combination of silent power transmission and ultra modern styling.

The discerning eye will spot features such as the bias compensator that equalises stylus pressure on both sides of the groove, and the special lightweight headshell.

And this of course is where the free cartridge comes in.

The ADC Q32 is a superb *Induced Magnet* cartridge with an elliptical stylus, worth

around £14.

If you should prefer the BDS80 turntable instead, we'll include an ADC Q30 cartridge in the price.

That's worth around £10.

Both these offers close on 31st July.

We're sorry if this leaves you with a feeling of deep dissatisfaction with your present turntable, but we did warn you.

If you are in any doubt about compatibility just write to Richard Jones at the address below.



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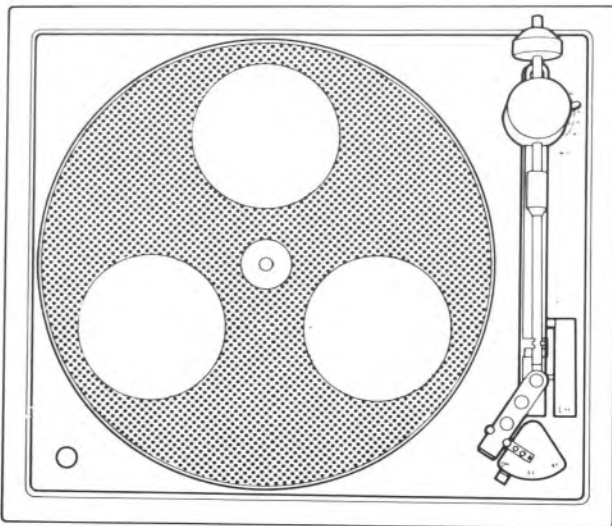




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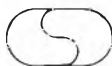
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Strathearn's STM4 is a two-speed electronic servo direct drive turntable with a precision, low-mass pickup arm. New technology has made it possible to construct a direct drive motor more simply. Thus this new manual turntable

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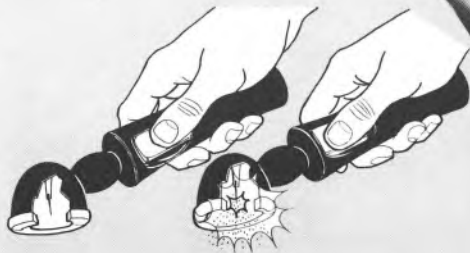
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is the most up-to-date protection your records can have.

In a single sweep over your record, the EARC effectively neutralises any static charge and gently removes the loosened dust – all at the same time.

Your records stay clean and dust-free much longer. Prolonging the life of your records and stylus.

The EARC cleaner uses high reliability, completely safe, piezo-electric techniques for antistatic protection and long life. Batteries are not needed, it's designed for long service and backed with a 3 year guarantee.



Obtainable from your record centre,
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"ON AIR"



From the beginning the Technics SP 10 Mark II was designed as a 'no-compromise' broadcast-standard turntable.

It is already installed in many broadcasting stations both here and abroad.

The reasons are many and varied.

In 1969, Technics were the first to introduce the DC electronically controlled direct drive principle to the world with the SP 10.

With the experience gained we've never looked back, and the SP 10 Mark II represents a considerable advance in turntable technology.

Take speed accuracy. Wow and flutter are an insignificant 0.025% WRMS. And speed drift + or - 0.002%. Rumble is also very low at -70 dB.

Through the use of a quartz locked drive system a very high torque is developed by the motor. This results in an instant start facility which takes the record from 'stop' to 33 1/3 in 0.25 secs.

And in addition you can change from one speed to another very quickly. 33 1/3 to 45 in 0.1 sec.

Another benefit is that a record can be easily cleaned 'on air' with no audible speed variation.

The three speeds (33, 45, 78) are selected by illuminated microswitches and the start/stop function can also be remotely operated. Extremely useful if you are operating a bank of turntables.

The power supply is separate and the mains supply is not directly linked to the turntable, thus avoiding any possible hum problems.

For more information about these and other benefits contact your nearest Technics dealer.

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The SP 10 Mark II Quartz-controlled Direct Drive Turntable.

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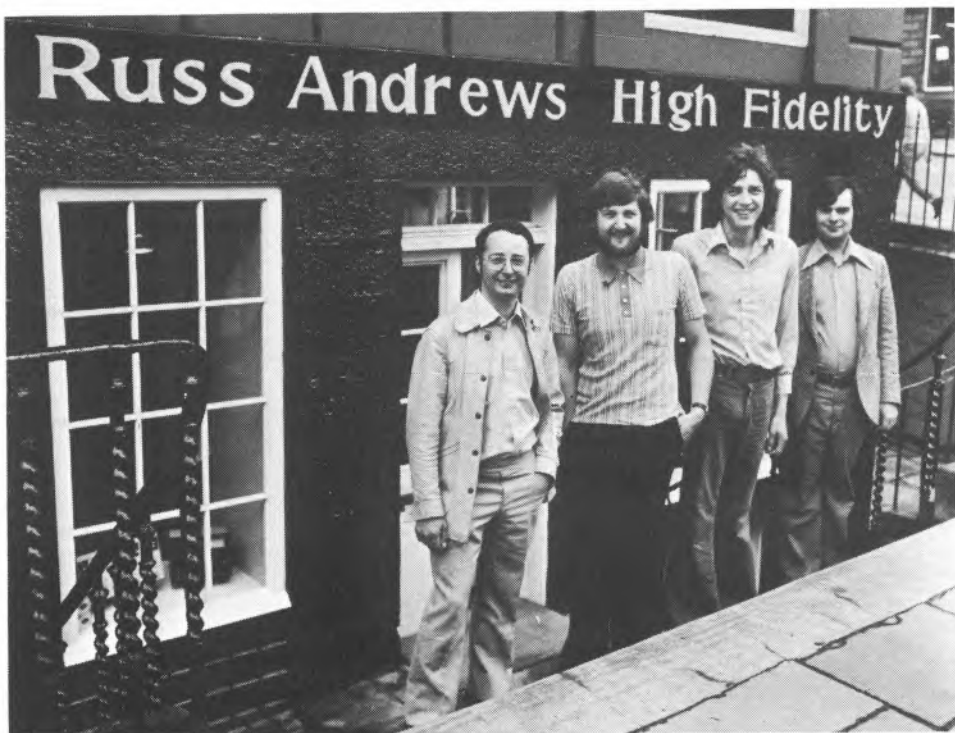
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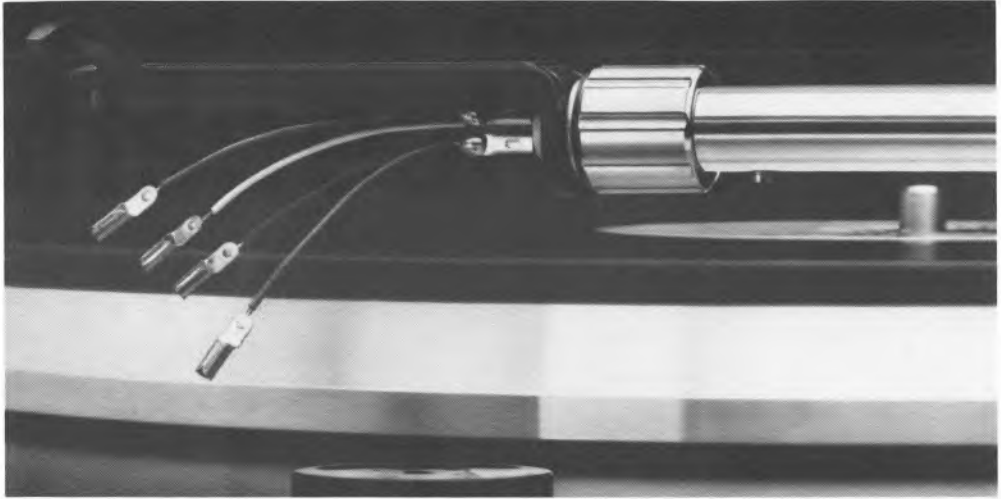
**For further information about the SP10 Mark II
and other Technics products contact your local Technics dealer.**



Reading this magazine is the worst way to choose a turntable. The best buy of the lot hasn't even been reviewed. The only rational, sane way is to make the A-B comparisons between turntables yourself and buy the combination that sounds best to you with the rest of your system. No-one else's opinion is any use to you. You are welcome to come into our shop and listen to an A-B turntable comparison anytime, anyday.

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Is Ortofon the first £15 cartridge to come into your head?

If you are prepared to pay a very great deal of money for a no-compromise high fidelity system, you're probably considering moving coil cartridges.

If, that is you don't own one already.

In either case, an Ortofon has probably entered into your calculations.

What many people don't realise is that Ortofon also make a range of magnetic cartridges with a performance/cost ratio that's hard to ignore.

From the faithful FF15E to the magnificent M15E Super, they all share a unique feature.

The Variable Magnetic Shunt (VMS) principle.

Our engineers were given a daunting brief: to approach as closely as possible the performance of the Ortofon moving coil pickups, without sacrificing the undoubtedly greater practicality of existing magnetic designs.

After a great deal of time and effort, much of it spent in the company of simple formulae such as $R_m = 0.95 \times 10^9 \sqrt{s}$, the VMS principle is what they came up with.

The greatest single benefit is the reduction of mass, both in the stylus assembly and in the cartridge as a whole.

The former is possible because, unlike other magnetic cartridges, the magnet itself doesn't have to move. Instead, the stylus deflects a tiny armature, which moves in the field of a lightweight ring magnet.

This is important, since the lower the stylus mass, the more easily it can follow the complex contortions of a record groove without having a nervous breakdown.

The magnet and the minute coil-wound pole pieces are also smaller than most, making the total cartridge weight among the lowest available.

But since you're probably more interested in music than mathematics, what difference does it all make?

The answer is twofold: better contact with the record groove, and lower distortion.

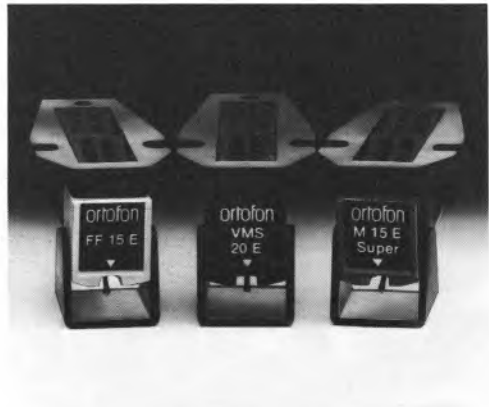
And whether you're after a medium priced cartridge like the FF15E (capable of producing sweet sounds in the most unpretentious of arms), or a state-of-the-art device such as the M15E Super (which, in a suitably refined arm, will track happily at less than a gram), the Ortofon difference is not just a theory.

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The PL-112D specifications sheet The Pioneer Colour Catalogue

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