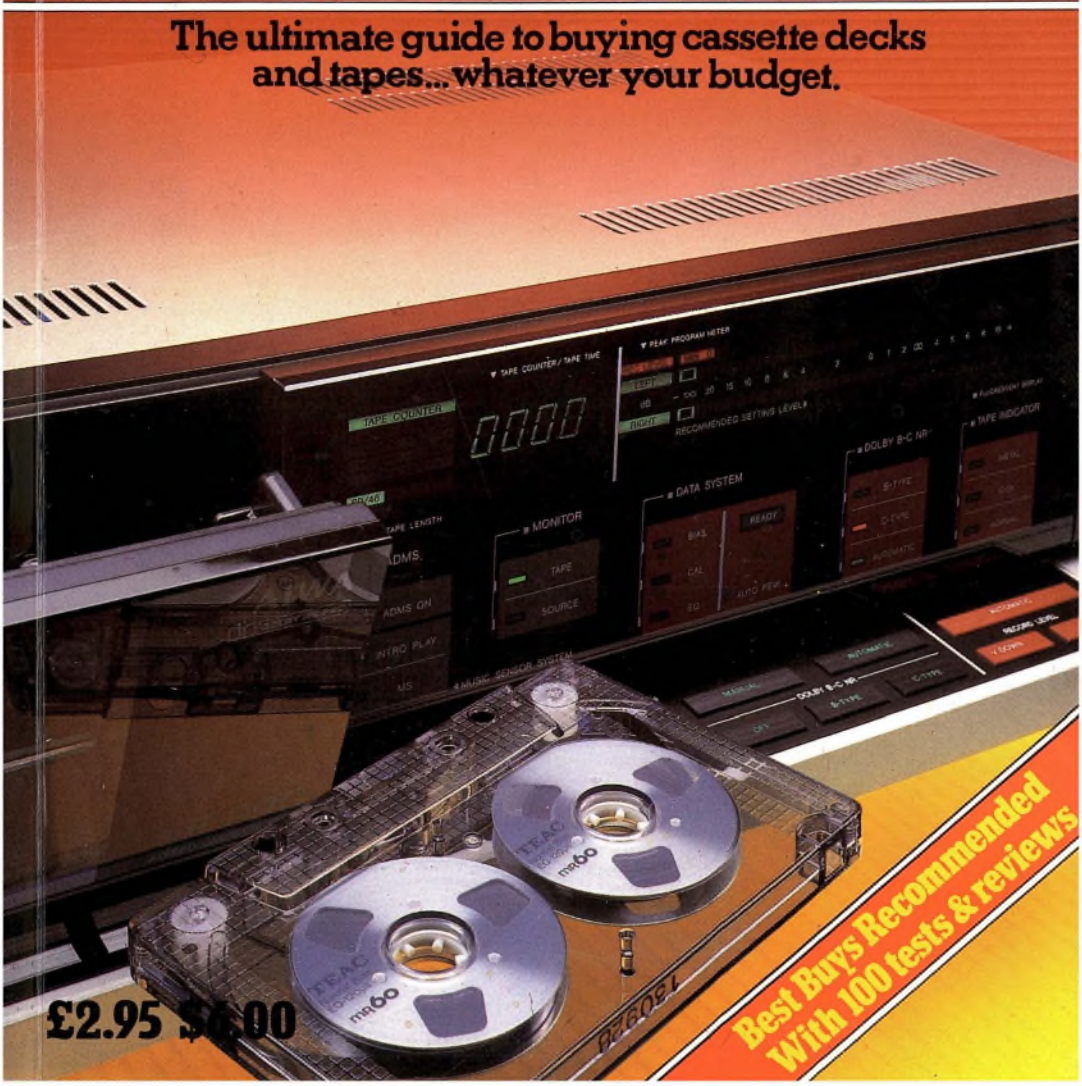
HI-FI CHOICE

CASSETTE DECKS AND TAPES

The ultimate guide to buying cassette decks and tapes... whatever your budget.



Best Buys Recommended
With 100 tests & reviews

£2.95 $6.00

The Sound of Nakamichi

Never before has so much technology been
concentrated in one modestly priced cassette deck.
No other recorder in its class can claim
to possess the three essential ingredients of
sonic perfection—the legendary Nakamichi
Discrete 3-Head approach to recording, the
unique Direct-Drive Asymmetrical Dual-Capstan
Diffused-Resonance transport, and
the most sophisticated wide-range low-distortion
electronics in the industry.
Its name—The Nakamichi BX-300.
Its heritage—Nakamichi.
Its destiny—Legendary.
See it...Hear it...You can afford
The Sound of Nakamichi.

Nakamichi B&W

Nakamichi B&W UK Ltd Marlborough Road Lancing West Sussex BN15 8TR Tel. (0903) 750750

HI-FI CHOICE No. 42
Cassette Decks & Tapes

CONTENTS
by Noel Keywood

Editor: Steve Harris
Advertisement Manager: Judith Kelly
Group Art Director: Perry Neville
Production Manager: Sonia Hunt
Publisher: Marianne McNicholas
Photography: Ian McKinnell
Cover: Chris Stevens
Illustrations: Mark Watkinson

Published by Sportscene Publishers Ltd, 14 Rathbone Place, London W1P 1DE. Tel: 01-631 1433.
Distributed by Seymour Press Ltd, 334 Brixton Road, London SW9 7AG.
Typeset by Instep Ltd, 33-41 Dallington Street, London EC1 0BB
Printed by Imperial Printers, London

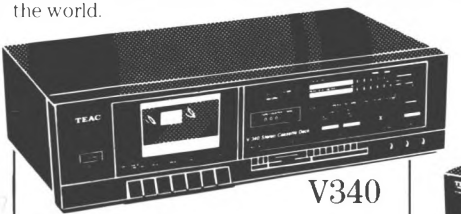
EVEN AT LESS THAN £100, IT'S NOTHING LESS THAN A TEAC

Teac is the name that stands head and shoulders above all others in the field of magnetic recording technology. A name that is respected and admired by recording professionals around the world.

Which is why you might expect every Teac product to carry a fairly weighty price-tag. But, not so.

The new generation of Teac cassette decks brings Teac's proven technology to a range of products that starts at only £89.90 mrp.

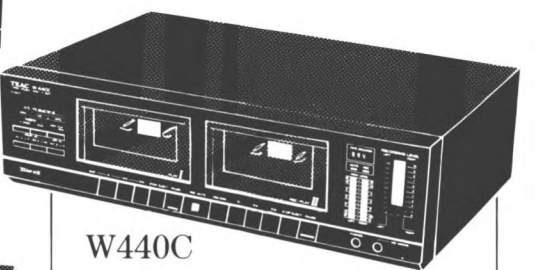
Now you can enjoy all the sheer quality of Teac, at prices that really sound good.



V340

Performance & economy, Dolby B NR, LED metres, soft touch controls.

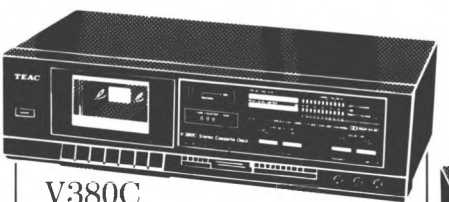
£79 mrp



W440C

Twin cassette deck, Dolby B-C NR, High speed dubbing.

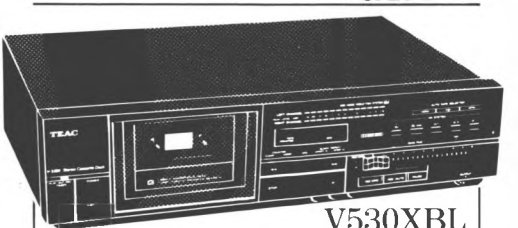
£199 mrp



V380C

Within your budget, Dolby B-C NR, LED metres, soft touch controls.

£99 mrp



V530XBL

Extensive micro computer control, Dolby B-C NR dbx, 2 motors, 2 heads. Computomatic programme search & fine bias adjustment.

£229 mrp

V450X

No compromises, Dolby B-C NR dbx, Rec. mute, cobalt amorphous head.

£159 mrp

TEAC® OUR NAME SAYS IT ALL

For further information about Teac products and details of your local dealer write to:
Harman UK, Mill Street, Slough, Bucks.

COSMIC

Established 24 Years

HI FI SYSTEM SALE

SYSTEM OF THE MONTH

£254.95 INC VAT & DELIVERY

Only the turntable can be substituted in this system

CELESTION DL4

ROTEL RA820

DUAL 505 2 INC CARTRIDGE

DUAL CS505 2 +	ROTEL RA820	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £269.95
DUAL CS505 2 +	ROTEL RA820BX	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £299.95
DUAL CS505 2 +	ROTEL RA840	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £329.95
DUAL CS505 2 +	ROTEL RA840BX	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £339.95
DUAL CS505 2 +	YAMAHA A320	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £264.95
DUAL CS505 2 +	YAMAHA A420	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £309.95
DUAL CS505 2 +	CYRUS 1	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £319.95
DUAL CS505 2 +	PROTON 520	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £299.95
DUAL CS505 2 +	QED A230	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £274.95
DUAL CS505 2 +	QED A240	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £319.95
DUAL CS505 2 +	SANSUI AUG11X	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £279.95
DUAL CS505 2 +	SANSUI AUG33X	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £329.95
DUAL CS505 2 +	DENON PMA717	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £279.95
DUAL CS505 2 +	DENON PMA737	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £324.95
DUAL CS505 2 +	A&R ALPHA	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £309.95
DUAL CS505 2 +	HARMON PM650	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £319.95
DUAL CS505 2 +	MARANTZ PM54	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £349.95
DUAL CS505 2 +	YAMAHA A07	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £279.95
DUAL CS505 2 +	YAMAHA A520	+ AR18BX OR DL4 OR MS20 OR MISSION 7011 OR MONITOR AUDIO R100 ..... £349.95

You can substitute AR18BX or DL4 or MS20 or Mission 7011 or Monitor Audio R100 in the above systems with any of the Loud Speakers listed below at the following EXTRA COST OPTION

DUAL CS505 2 DELUXE	£20	MARANTZ CD74B COMPACT DISC	£210	PHILIPS CD304 COMPACT DISC	£250
ROTEL RP830 AT110I	£30	REVOLVER/LVX	£115	MISSION DAD700R COMPACT DISC	£350
ROTEL RP850 AT110I	£100	MARANTZ CD84 COMPACT DISC	£250	YAMAHA CDX2 COMPACT DISC	£210
AR TURNTABLE EB101	£100	PHILIPS CD104B COMPACT DISC	£165	YAMAHA CD3 COMPACT DISC	£280

You can substitute AR1 8BX or DL 4 or MS20 or Mission 7011 or Monitor Audio R100 in the above systems with any of the LoudSpeakers listed below at the following EXTRA COST OPTION

B&W DM90 DM100	Nil	Castle Tyne	£30	Kef C30	£50	Mordaunt MS40	£50	Monitor Audio R352	£100
B&W DM110	£20	Castle Avon	£60	Kef Chorale	Deduct £10	Mordaunt MS30	£30	Tannoy Mercury	£20
Castle Trent	Deduct £5	Celestion DL6	£25	Kef C20	£15	Monitor Audio R252 Vinyl	£20	Whatledale 506	£20
Castle Clyde	Nil	Kef C10	Deduct £10	Mission 700 2	£20	Monitor Audio R252 Wood	£30	Whatledale 508	£60

FREE DELIVERY + LEADS (UK, MAINLAND ONLY) ON ABOVE SYSTEMS.
ALL STOCK IS BRAND NEW, BOXED, AND ALL TURNTABLES SUPPLIED WITH CARTRIDGE.

OPEN SEVEN DAYS A WEEK 9.00AM-6.00PM

★ Prices subject to change without notice ■ Please phone to check that prices still apply

Cheque/PO made payable to Cosmic

Please Supply _____

Enclose £ _____ Cheque PO / Access/Barclaycard

Name _____ Telephone _____

Address _____

HFC/11/85

You may telephone your order quoting Barclaycard or Accessnumber

COSMIC

244/256 STATION RD, ADDLESTONE, WEYBRIDGE, SURREY.
Tel: (0932) 54522/51753/43769.

WHY BE BIASED?

Why not-it makes sense. Use the wrong tape and even the best of the Best Buys can sound like an also-ran. That's why we want you-or rather your tape deck-to be biased.

Buy a deck from us before the end of '85 and we'll bias it for free. And to help keep that performance we'll even throw in a head cleaner too. All you have to do is to choose a deck from the wide range we have on demonstration. No appointment necessary. Then choose a tape from our selection at Top Tape prices.

Easy isn't it.

If you already have a cassette deck we'll still help you. Bring it to us before the end of '85 and we'll bias it for half our normal price. That's just £10. Not much for your deck to be in tune with its tapes.

For biased advice on biasing and unbiased advice on decks call us.

BADA THE ULTIMATE IN SOUND ADVICE

SINGLE SPEAKER DEMONSTRATION

CASSETTE DECKS WE STOCK & RECOMMEND:- AIWA DENON NAD NAKAMICHI YAMAHA

AT Labs
159 Chase Side
Enfield
Middlesex EN2 0PW
01-367 3132

Audio T
190 West End Lane
London
NW6 1SQ
01 794 7848

AT Labs
442-444 Cranbrook Rd.
Gants Hill Ilford
Essex IG2 6LL
01-518 0915

EDITORIAL

The Hi-Fi Choice series offers a uniquely comprehensive and consistent guide to current hi-fi equipment. Each issue covers one product category, testing and comparing as many models as possible, and offers thorough technical coverage, as well as straightforward buying advice.

Cassette decks are the most fascinating products in the hi-fi field, and they can present a bewildering variety of technical features, facilities and flashing lights. In this edition of *Cassette Decks and Tapes*, we have included all the more innovative models now coming on to the market — and we have tested them, in every case, with a careful eye to how the much-vaunted 'gizmos' really benefit the user.

We have found that some decks can give stunningly faithful recordings, and banish the traditional failings of the cassette tape medium. The best decks also allow you to take full advantage of the improved standards of pre-recorded musicassettes. The sound quality available from these is now astonishingly good, and could shake the convictions of many 'disc-only' hi-fi enthusiasts. On the other hand, the potential quality can be lost on many decks. Quite a few models, we found, could record and play back their own tapes well but sounded poor on musicassettes.

With this in mind, each deck has been tested fully for both its 'replay' performance on pre-recorded tapes, and for its 'record/replay' performance using ferric, chrome and metal tapes. As usual, the *Hi-Fi Choice* test format gives instant comparison between models.

Many decks now have microprocessor-controlled automatic tape-matching circuits, and in theory, any tape will give good results, not sounding too bright or too muffled. Some of these systems worked much better than others, as the reviews explain.

We weighed up the overall performance of each deck very carefully before making our recommendations. It should be noted that the adjectival judgements next to each lab test figures are related to 'absolute' performance — that is, irrespective of price — while the 'Best Buys' and 'Recommended' ratings do take price into account. We have looked for what we believe to be useful facilities as well as for good sound, and of course not everyone will agree with the importance, or otherwise, that we have attached to some of these features. So it must be stressed that our value judgements should be taken only as a guide, particularly as they are based on the typical retail prices quoted. These should be correct at the time of going to press, but subsequent fluctuations should be taken into account by intending purchasers when interpreting value ratings.

A large section of the book is devoted to cassette tapes, which are covered more comprehensively than ever before. Excluding the lowest-grade ferric tapes, which do not have hi-fi pretensions at all, we tested virtually every tape available to us — special thanks here to Noel Keywood for efforts far beyond the call of contractual duty!

We believe that this *Hi-Fi Choice* tape test programme offers the only authoritative source of tape performance comparisons which are of value to the consumer. The object has been to assess how tapes will behave in domestic use — not simply to see how we could get the best out of the tape under artificial laboratory conditions. The tape test results accordingly tell you first and foremost whether the tape will make recordings that sound 'bright' (too much treble) or 'dull' (too little treble). Complete measurements of tape noise (hiss) and overload characteristics, which between them determine the dynamic range of capability of a tape, and additionally the tests look into the speed instability (wow and flutter) contributed by the cassette mechanics, not by the deck.

Most valuably, perhaps, the tape test results can be used, in conjunction with the simple checking procedure given in the Technical Introduction to get the very best from a given deck, without the need for any specialist knowledge or equipment.

It is not possible to cover the subject of cassette decks and tapes responsibly without mentioning the subject of copyright. As the law stands, *any* unauthorised tape copying of recorded copyright material, whether for private or public use, is an infringement of copyright. The record industry continues to lobby for a levy on blank tapes, to restore lost earnings to the copyright owners, and legislation now looks likely soon.

Having issued this warning, I must end by saying that this season's crop of new cassette decks does include some really outstanding performers, though we did come across some models which were surprisingly poor. But with the help of this book, and of course that of a good dealer, any cassette deck buyer should be able to find the model which is best suited to his needs.

Steve Harris

Why do more woofers respond to TDK than any other cassette?

TDK sells three audio cassettes to every one sold by any other manufacturer.

TDK. The great name in tape cassettes.

CONSUMER INTRODUCTION

This section covers the basics of cassette equipment and is designed for the general reader. It should serve as a preface to the much more detailed Technical Introduction

In 1963, the giant Dutch-based electrical company Philips launched a new type of tape recorder, which did away with the tedious business of threading tape onto spools and around tapes guides. They called it the Compact Cassette.

But Philips did not conceive the cassette as a medium for high fidelity music reproduction. In order to make the cassette compact, they had used tape half the width of standard recording tape, and in order to get a reasonable playing time from the Compact Cassette they had fixed on a speed half that used by most domestic reel-to-reel recorders. All other things being equal, the sound quality to be had from tape is proportionately worse the slower the tape runs and the narrower the recorded tracks. So the sound of the Compact Cassette was adequate for speech recording in business and other functional applications, but left a lot to be desired. The cassette certainly caught on quickly — largely because Philips allowed other manufacturers to produce decks and tapes without paying any licence fee, provided the technical specifications and dimensions laid down by them were adhered to — but for some years it was looked at askance by hi-fi purists.

From the hi-fi point of view, there were several points of criticism. First and most obvious was the amount of audible tape hiss which could be heard when listening to most kinds of music, but was particularly objectionable on classical music, where there might be very quiet passages or silences. Second, and related to this, was the cassette's lack of dynamic range — in other words, the cassette was incapable of realistically reproducing the range between crescendos and quiet passages because either the loud passages would overload the tape and sound distorted, or the quietest bits would be buried in the hiss.

Dolby noise reduction

However, one very clever innovation transformed the performance of the Compact Cassette as a recording medium, and opened the way for further developments. This was of course the Dolby *B* noise reduction system, invented by the American Ray Dolby, at the end of the 1960's.

Dolby had successfully introduced a professional noise reduction system, known as Dolby *A*, but this was too expensive and cumbersome for inclusion in domestic equipment. Dolby *B* was a very much simplified but nonetheless very effective domestic system using similar basic principles. It is impossible here to give more than a very simple idea of how the system works, although its subtleties in actual use are fully covered in later sections! Basically, the Dolby circuits operate on the audio signal both prior to recording and prior to the playback output — *processing* and *deprocessing* (or sometimes 'encoding' and 'decoding') respectively.

On record, the Dolby circuit selectively boosts low-level treble signals, leaving high-level treble signals and bass parts of the signal untouched. So when the audio signal reaches the tape, the level of the quietest treble sounds has been raised so that they will record above the intrinsic hiss level of the tape.

On replay, the signal is given the reverse treatment — those treble parts of the signal which were boosted on record are brought back down to their proper level relative to the rest of the music signal — but this automatically means that the hiss from the tape (which is mostly treble frequencies) is brought down too. When working correctly, Dolby *B* can reduce the apparent level of tape noise by 9 or 10dB, which means in practical terms the difference between quite annoying and practically inaudible amounts of hiss.

Dolby *B* is now universal on hi-fi decks, but has been effectively upgraded with the introduction of Dolby *C*. This employs the same principles, but with the processing and deprocessing in effect made twice as drastic, thus giving twice as much hiss reduction — with the benefit of improved usable dynamic range.

Further development

With the inclusion of Dolby *B*, the cassette deck became, potentially at least, an important part of the hi-fi scene. Although Philips in Europe had invented the system, it was really the Japanese who raised the level of cassette technology to its current heights. During the 1970s, when Philips were only grudgingly beginning to acknowledge the existence of Dolby, the Japanese manufacturers were forging ahead with research and development programmes aimed at making cheaper and better decks (and tapes), and with the ultimate

aim of making cassette performance as good as reel-to-reel tape recording. How well they succeeded will be obvious if you compare the performance and facilities on a good £100 deck of today with a machine that cost £150 five years ago — cassette decks *have* got better and cheaper, even without allowing for inflation! As for the comparison between cassette deck performance and that of reel-to-reel tape, there is no doubt that while reel performance has stood still, cassette tape is now capable of results surprisingly close to the original sound.

Along with the genuine advances though, there have been some innovations that turned out to be unsatisfactory in one way or another, and of course there have been some extra 'facilities' which turned out to be little more than gimmicks. It is also perhaps ironic that while the cassette was meant originally as a simple and convenient recording system which was very easy to use, some modern decks fall into the 'Concorde flight-deck' category, being covered with an excessive amount of switches and flashing lights. These will be a delight to compulsive knob-twiddlers, but a nightmare to the non-technical.

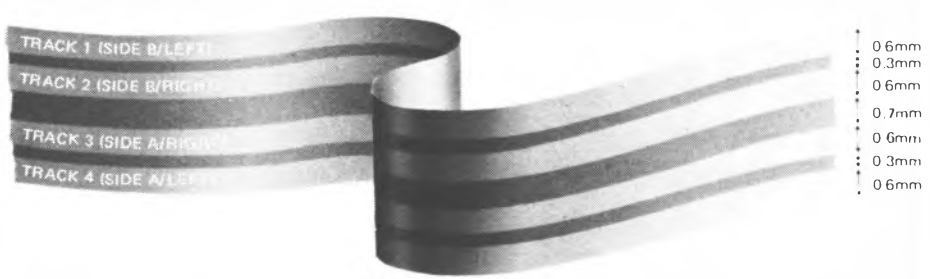
However, many of the extra controls found on cassette decks now actually are put there to make the machine easier to use. There are a number of variations on the 'programme search' theme — features designed to enable you to find the beginning or end of a piece of music quickly and easily. Most of these work simply by detecting a gap between recorded items while fast winding or rewinding, but some decks also have complex microprocessor-based counter and 'memory' facilities to enable you to preselect particular parts of the tape and replay them as desired. These kind of options are very much a matter of personal taste, and if you are attracted to particular models because of them, do try them out in the shop before buying to make sure that the deck will really do what you want, and not just make life more complicated!

Microprocessor technology has brought another very important benefit to cassette decks, though, and that is the possibility of designing a deck to set itself up to give optimum results on whatever tape you insert into it. Several Japanese manufacturers have introduced such decks, and as will be seen from the models reviewed in this edition, have proved successful. Their efforts are to be applauded, for the business of matching tapes to decks is really the bane of the serious cassette user. But to cover this subject, we had better first look at the basics of cassette recording.

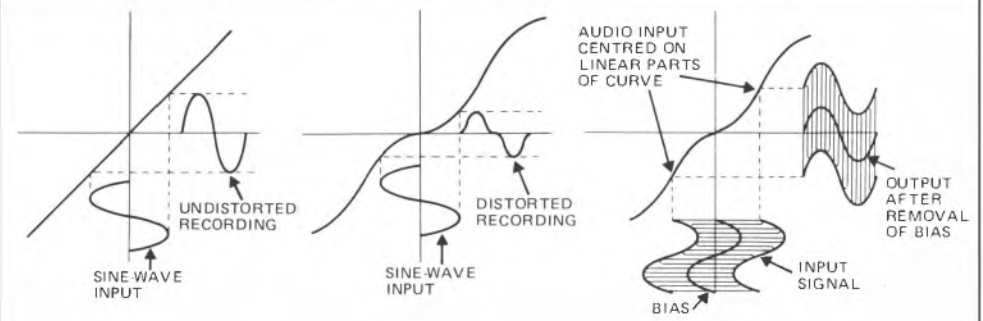
How tape recording works

In tape recording, sound signals are stored as a magnetic pattern along the length of the tape. The tape consists of a polyester-type plastics backing layer, on which is applied a special coating with magnetic properties. This coating usually contains very tiny particles of ferric iron oxide (hence *ferric* tapes) though advanced tape types may use chromium dioxide particles (*chrome* tapes) or most recently pure or metal alloy particles instead of oxides (*metal* tapes).

To produce a recording, the tape is pulled at constant speed past the recorder's *tape head*. This is essentially an electromagnet, in which



Typical track dimensions on cassette tape.



Why bias is needed. Left, what would happen if the input-versus-magnetisation characteristic of head and tape was perfectly linear. This can never happen in reality! Centre diagram shows what would actually happen, without bias, due to the 'kink' in the input-versus-magnetism characteristic. The output is clearly distorted. Right, the high-frequency bias current effectively 'lifts' the audio signal to a linear part of the curve. The bias frequency itself is self-erased as the tape leaves the head gap.

a current passing through a coil creates a magnetic field in the core on which the coil is wound. The two ends of the core, the *pole pieces*, are brought together with only a minute *gap* between their ends, so that the magnetic flux is concentrated in and around this gap. The current fed to the record head (and hence the magnetic flux) is varied in accordance with the audio signal to be recorded, and so as the tape passes the gap a constantly varying degree of magnetisation produces a stored analogue of the original sound waveforms.

Playback may be accomplished using the same head. This time, as the tape passes over the head gap the varying magnetic field of the tape coating induces tiny currents in the coil. These can be amplified and converted back into sound by a loudspeaker or headphones.

Bias

If the record head was simply fed with the alternating audio signal current, the recording would be very distorted. This is because the relationship between input current and amplitude of magnetisation on the tape is non linear — in other words, a graph of input-versus-magnetisation is not a straight line going up at 45 degrees from zero, but is distinctly S-shaped.

This non-linearity is overcome by *biasing* the audio signal. As well as the wanted audio frequency signal, the record head is fed with a carefully-controlled amount of the very high frequency alternating current used for erasing. The audio modulations are in effect superimposed on this bias current, which thus raises them in level to a part of the input-versus-magnetisation curve which is virtually a straight line. This is shown in the diagrams. Note that the bias frequency, in any case far above the audible range, disappears from the output.

This electronic dodge would hardly concern the cassette deck user, except that different tapes need different amounts of bias to work at their best. All modern hi-fi cassette decks provide bias setting which is switchable between three positions optimised for ferric, chrome (or pseudochrome) and metal tape types.

Bias requirements vary between different brands of tape within the same category, though, and so for example the 'ferric' setting on any given machine will suit some tapes better than others. The most obvious audible results of incorrect biasing are changes in frequency response — too little bias for the tape being used will emphasise the treble and make the sound 'bright' while too much bias will make the sound lacking in treble, dull and muffled. In fact the optimisation of bias setting is a compromise between various factors, (see *Technical Introduction*).

Fortunately there now seems to be a greater effort on the part of tape manufacturers to standardise bias requirements in accordance with the stipulations of the IEC, as will be seen from the *Cassette Tapes* section in this book.

Steve Harris

Beocord 9000.
Beyond doubt, the world's most technically advanced cassette deck.

A tape headroom expansion system called HX Professional, developed by Bang & Olufsen, gives you metal tape quality from ordinary, cheaper tapes.

A real-time tape counter with a dual function indicator showing elapsed and remaining time, so you can plan recordings right up to the end.

A computerised tape calibration system measures the bias, equalization, sensitivity and distortion parameters of each individual tape and adjusts the machine's own recording characteristics to match them exactly. Battery-supported RAM for storage and future accessing of tape calibration data.

Dolby B and Dolby C noise reduction systems.

The new Beocord 9000 – accuracy, economy and a new level of quality for home recordings.

These advanced features and their benefits are described in a 28 page Design Story.

For a free copy write to Bang and Olufsen UK Ltd., Dept HFC1, Eastbrook Road, Gloucester GL4 7DE. Tel. (0452) 21591.

HX PRO

Bang & Olufsen

TECHNICAL INTRODUCTION

For the more technically minded, this Introduction explains the background to our extensive laboratory tests, the significance of subjective assessments and, finally, several points for maximising cassette deck performance.

Pre-recorded cassettes are small and easy to use. They are transferable between personal stereos, car stereos and domestic players of all sorts — including hi-fi decks. Tape recordings can be made on a domestic deck too, so the cassette has become a universal medium — something the LP could never achieve because of its size, susceptibility to damage and lack of recording abillty.

Sales of pre-recorded cassettes and blank tapes are increasing steadily, whilst conventional LP record sales are in decline. UK musicassette sales are likely to match LP sales, at around 50 million, during 1986.

Interestingly, Compact Disc (developed by Philips, who also developed the cassette in the early 1960's) is touted as the successor to cassette, in flexibility of use; both CD-car players and CD-Walkmans are now close to market release. Compact Disc is larger than cassette, much more expensive and cannot be used for recording, so it is unlikely to ever match the cassette in popularity. Therefore, the cassette appears to be well set for complete dominance as a music transmission medium in the future.

Technical developments in cassette technology promise to keep its quality improving too, but it is just as likely — in my opinion — that better all-round standards applied now are enough to improve quality to a degree that would put the medium on par with LP and satisfy a large majority of users.

This has become apparent from our tests and the quality of recordings we could achieve from Compact Disc, using good players and ordinary chrome tapes. I hestitate to mention metal tape, because it is very expensive and accounts for only 1% of blank tape sales, so people seem reluctant to use it — as is the music business, with regard to pre-recorded cassettes.

Of course taping from Compact Disc infringes the artist's copyrights; I mention it here to make the point that with good, ordinary tape, a good recorder and good programme source, cassette recordings can be made which rival or improve upon LP standards. This suggests that pre-recorded cassettes could do likewise, and it is a fact that cassette transcription houses are making quite a lot of effort to improve their product.

The increasing popularity of pre-recorded cassettes and blank tapes has stimulated cassette deck sales dramatically. The domestic deck is used to play pre-recorded tapes and to record tapes for use in personal stereos, car stereos and at home in the recorder itself of course.

In this book we have kept these trends very much in mind. All the cassette decks were treated as:-

1) *Replay Devices* — tested for their ability to reproduce musicassettes well.
2) *Recording devices* — tested for their ability to provide high quality recordings.

The distinction may, at first sight, seem unimportant, but it is not. Although recording appears to be a more complex function than replaying cassettes that have already been recorded (that is, musicassettes), the reverse is true.

The best way to illustrate this is with examples. To make a recording, a cassette deck could run at any speed: say manufacturer 'A' chose to make his deck run at 6cms/sec. Tapes would be recorded at 6cms/sec and then replay at 6cms/sec, giving normal sound. But manufacturer 'B' may choose 4cms/sec. His machine would record and then play properly, too. Owners of these machines would be entirely happy with their recordings.

Problems would only arise if the owners of these machines wanted to swap tapes. Then the 6cms/sec tape made on machine 'A' would run slow at 4cms/sec on 'B', lowering pitch by 33%. Conversely, recordings made on 'B' would run fast on 'A', but this time pitch would rise by 50%. There would be no 'software compatibility', as the industry now calls it. Exactly the same situation exists with things like VHS and Betamax video tapes and, in the end, this usually results in commercial disaster, due to market fragmentation.

Continuing this example, what speed would tape duplicators choose, in order to make pre-recorded tapes available? If they decided on 5cms/sec their tapes would be wrong for both machines — and so it goes on.

Either manufacturers agree on a standard and stick to it, which is what happened when the IEC Committee agreed on replay frequency response, for example, or one manufacturer can set a standard that others then follow.

Philips did this with Compact Cassette, when they released it as a medium for speech and low quality music in 1963. They have done the same thing, in conjunction with Sony, for Compact Disc too.

The standard laid down for Compact Cassette was comprehensive. It has since undergone minor modification and improvement at the hands of the IEC, replay frequency response being just one example of an improvement. But comprehensive standards do exist for cassette; they are internationally recognised and, to some extent, still policed by Philips. Manufacturers recently attempted to introduce dual-speed cassette decks, for example, and were actively discouraged from doing so by Philips.

The purpose of cassette replay standards is to ensure perfect compatibility. Pre-recorded tapes bought in the shops must run at correct speed, set at 4.75cms/sec (the metric equivalent of the old 1⅞ inches/sec). The recording equipment used to make them must have the same frequency response as the decks used to replay them, so they sound tonally correct — and so on.

It is very easy to take all this for granted, but in practice standards are extremely important, and testing for adherence to them a necessary and vital part of any cassette deck review.

In reality, ensuring adherence currently presents more problems to manufacturers than anything else, though to a degree this is inevitable. New cassette standards, like those for blank tapes (IEC Primary Reference Tapes) are now a matter of international agreement, but an astonishing amount of industry dissension and rivalry frustrates widespread adherence to this or any other standard that can be formulated.

Figure 1. BASF calibration tape, used to check adherence of replay response to the current IEC standard

In this book, standards virtually reign supreme; they have been taken as the gospel which manufacturers must follow, even when it is known they are not perfect. I personally haven't much sympathy for those manufacturers who choose to ignore or 'interpret' standards to suit their own ends. It is this sort of thing that defeats the effectiveness of standards. At the same time, where a whole body of manufacturers have ignored a standard, like that for chrome tape sensitivity for example, the outcome cannot be ignored and the conclusions have taken this into account.

CASSETTE DECK REPLAY PERFORMANCE

Replay frequency response

It has taken nearly 20 years of cassette development for a proper test tape to be made, defining the replay frequence response of cassette decks. The International Electrotechnical Commission agreed, at a meeting in Prague during 1981, to issue a new revised replay response standard. The BASF Calibration tape (ferric, 120μS) used to test agreement to this standard is shown in *Figure 1*.

Because, even now, the strength of a signal on a tape cannot be accurately measured, it is impossible for specified tape flux levels to be used. In light of this, the tape itself becomes a standard, rather than the signal levels on it. Here is what BASF say in the explanatory notes provided with this IEC Calibration tape: 'A physically incontestable method to determine the flux frequency response on calibration tapes is not known. For this reason the flux frequency response curves of calibration tapes are based on agreed substitute measurements by means of specified calibration playback heads.'

Because the matter is 'contestable' there are always those who seek to contest it. Nakamichi first contested the accuracy of the old standard, devised in the 60s. Finding that they were right, the IEC then had the daunting task of changing the whole standard — or saying that it sticks, even though imperfect. Surprisingly, they went for change, which meant that all domestic decks had to have a new replay response, and all cassette transcription houses had to alter the record equalisation of their equipment. The change was not vast, consisting of around – 2dB drop in level around 6kHz on the test tape itself.

The rub is this: Dolby B accentuates frequency response errors, making this error become something like 4dB at low levels. Any companding noise reduction system (dbx, ADRES, Hi-Com) does the same, because this is inherent to the companding noise reduction process. So, response errors are magnified, but mostly on low level signals. High level signals are affected less, or not at all. I will be coming back to all this when discussing Dolby action.

In the meantime, bear in mind that small response errors are always made larger by Dolby, so they are not to be ignored!

The IEC changed replay response in 1981: this appears to have been met by a very large snoring sound from the East, judging from the replay frequency responses we measured on a large majority of decks. Many have falling replay frequency response, which suggests that the decks have been set up using the old standard. Azimuth error also produces falling treble but usually results in sudden and rapid fall in extreme treble, rather than the slow fall above 800Hz that our replay graphs show.

Listening tests were carried out on all decks to compare replay sound quality with that of a Nakamichi ZX-9. Falling treble, magnified by Dolby B action at low levels, consistently resulted in a dull, boring sound, lacking in attack or definition compared with the ZX-9.

The ZX-9, unbeatable on replay performance except by Nakamichi's own remarkable Dragon, shows what could really be achieved in replay performance, though of course comparisons had to take price differential into consideration. At lower prices we found models to prove that a flat replay response was worthwhile, providing a much clearer and livelier sound than on most decks.

Low level treble signals, such as at the start of 'The lady in my life' on Michael Jackson's 'Thriller' cassette, are the sort of thing that can get heavily attenuated by falling replay response and the inaccurate Dolby tracking it produces.

My interest in Dolby B replay tracking accuracy was stimulated by the appearance of a BASF Dolby B tracking test cassette. Sadly, it turned out to be inaccurate and misleading, much to the consternation of myself and Dolby Laboratories. In its short and confusing life-span though, it did demonstrate that enormous differences exist between recorders in this area, and that a really accurate test tape is badly needed to sort them out. No credit to Dolby Laboratories for not providing one — and not wanting to provide one.

However, as I said earlier, a small fall in replay frequency response is magnified by Dolby action, making a dull sounding machine even duller when playing Dolby musicassettes — as most are these days. We quote replay frequency response within 2dB limits, but preferred to see it stay within 1dB right up to 10kHz, at least. This requirement is not impractical and one or two manufacturers obviously try hard to meet it, Yamaha and Nakamichi being two examples. Note also that such response accuracy is every bit as good, if not better, than that achieved with pickup cartridges and the LP.

Contrary to my earlier fears, extended high frequency response to at least 19kHz does not compromise sound quality by reproducing distortion harmonics. We consistently found that decks with extended HF had sharper imaging, better detail and definition, and were generally more lively and exciting to listen to. Extended HF (above 10kHz) is not an academic requirement — it provides useful subjective benefits.

Replay speed stability

Speed variations in the transport mechanism of a cassette deck affect fidelity of pre-recorded cassettes quite significantly. Although musicassettes themselves can have poor inherent pitch stability, often suffering wow, the additional wow and flutter introduced by a mediocre transport mechanism audibly detracts from quality.

Listening tests consistently showed that decks with poor speed stability, clearly heard when recordings were made on them, also affected pre-recorded tapes to an audible and often disconcerting degree. For a few reasons, this wasn't at all obvious before we had the chance to prove it.

Confusing factors here were the fact that musicassettes often have dreadful recorded speed instability, implanted during the transcription process, or even before it, in the studio tape machines. Then there's the poor quality of the cheap musicassette housings, which add both wow and flutter. Finally, there's the replay-only speed performance of recorders to consider. This is different from their record/replay performance, where the tape passes through the transport twice — once during recording and once during playback. During replay only, it passes through only once, of course.

109-113 London Road
SEVENOAKS Kent
☎ (0732) 459555

162 Powis Street Woolwich
LONDON SE18
☎ (01) 855 8016

34 Mount Ephraim
TUNBRIDGE WELLS
☎ (0892) 31543 Kent

4 Railway Street
CHATHAM Kent
☎ (0634) 46859

55 Preston Street
BRIGHTON Sussex
☎ (0273) 733338

51 Beckenham Road
BECKENHAM Kent
☎ (01) 658 3450

SEVENOAKS HI-FI + VIDEO

If you can buy cheaper elsewhere, tell us - we want to know!

ALL BRANCHES CLOSED WEDNESDAY

Amplifiers

A & R Alpha	£129.95
A & R A60	£189.95
AR THE AMP	£169.95
Cyrus One	£139.95
Cyrus Two	£259.95
Nad 1020 preamp	£99.95
Nad 2155	£209.95
Nad 3120	£119.95
Nad 3020B	£139.95
Nad 2150 power amp	£159.95
Nad 3150	£189.95
Nad 3155	£249.95
Nad 1155 preamp	£179.95
Nad 2200 power amp	£339.95
Pioneer SA301	£59.95
Proton P520	£129.95
Proton D540	£239.95
Quad 34/44/405 2/520	P.O.A.
QED	£99.95
Rotel RA820	£109.95
Rotel RA820BX	£139.95
Rotel RA840	£169.95
Rotel RA840BX	£179.95
Rotel RA870	£285.95
Sansui AUG55X	£249.95
Sansui AUG11X	£109.95
Sansui AUG33X	£169.95
Technics	P.O.A
Trio KA54	£99.95
Yamaha A320	£89.95
Yamaha A420	£139.95
Yamaha A520	£189.95

Cassette Decks

Akai GXR55	£199.95
Denon DR171	£134.95
Denon DRM11	£179.95
Denon DRM22	£244.95
Denon DRM33HX	£289.95
Denon DRM44HX	£349.95
Hitachi DE3	£119.95
JVC KDV200	£99.95
Nad 6130	£119.95
Nad 6125	£149.95
Nad 6050C	£194.95
Nakamichi RX202	£324.95
Nakamichi very affordable when you buy from us!	P.O.A.
ProtonP720	£169.95
Rotel RO830	£124.95
Trio KX54	£99.95
Yamaha K 220	£119.95
Yamaha K 320	£149.95

Tuners

A & R T21	£199.95
Cyrus Tuner	£179.95
Hitachi FT5500 II KT54L	£184.95 £99.95
Nad 4155	£229.95
Nad 4020B	£139.95
Pioneer F99X	£199.95
Pioneer TX301L	£84.95
Pioneer TX540L	£59.95
Proton P420	£119.95
Proton P440	£189.95
Quad FM4	P.O.A.
Rotel RT820	£79.95
Rotel RT830	£99.95
Rotel RT850	£149.95
Sansui TUD33XL	£109.95
Sansui TUD99XL	£229.95
Yamaha T320	£89.95
Yamaha T520	£139.95

Tuner Amps

Nad 7125	£239.95
Nad 7140	£339.95
Nad 7155	£389.95
Yamaha R3	£179.95

Turntables

Acoustic Research/AR	£199.95
Acoustic Research/LVX	£234.95
Acoustic Research EB101	£189.95
Dual CS505/2	£94.95
Dual CS505/2 deluxe	£109.95
Dual CS514	£59.95
Mission 775LCT	£179.95
Nad 5120	£99.95
Oak	£99.95
Pink Triangle	£399.95
QED T231	£139.95
Rotel RP830	£129.95
Rotel RP850	£199.95
Sansui SR222V	£109.95
SystemdekIV	P.O.A.
Systemdek IIX	£125.95
Systemdek IIX electronic	£184.95
Thorens TD166	£129.95
Thorens TD316	£179.95
Thorens TD318	£199.95
Thorens TD321	£234.95
Thorens TD321/LVX	£314.95
Thorens TD320	£277.95

Video HiFi

Ferguson 3V43	£619.95
JVC HR725	£699.95
Panasonic NV830	£449.95
Panasonic NV870	£649.95
Sony SLHF100	£499.95

Compact Disc Players

Buy your player this month and claim

£30

worth of

FREE DISCS

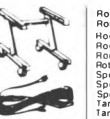
(except ★)

EXTRA SPECIAL OFFER:

Marantz CD54 Gold ★ **rated "Best Buy"** ***few only at*** **£239.95**

Akai COA7L ★	£399.95
Akai COM88 ★	£399.95
Marantz CD54 ★	£269.95
Marantz CD74 ★	£279.95
Marantz CD84 ★	£319.95
Mission DAD7000R	£449.95
Nad 5255	£399.95
Nakamichi	P.O.A.
Philips CD104 ★	£249.95
Philips CD150	£229.95
Philips CD204 ★	£309.95
Philips CD304 ★	£349.95
Pioneer PDX500	£299.95
Pioneer PDX700	£299.95
Pioneer PD7010	£349.95
Pioneer PD6010	£279.95
Pioneer PD5010 ★	£249.95
Sansui CV100	£299.95
Sony CDP30	£299.95
Sony CDP102	£399.95
Sony CDP302	£499.95
Sony CDP502	£699.95
Technics SLP3K	£449.95
Technics SLP2K	£399.95
Technics SLP1K	£349.95
Trio CD840	£279.95
Trio DP700	£329.95
Yamaha CDX2	£299.95
Yamaha CD2 ★	£349.95
Yamaha CD3	£399.95

Speakers



Present this advt to claim free stands and 6 metres OFD Cable with all Loudspeakers listed below except ★ (Suggested Systems excluded)

AR88X	£79.95
AR188X	£94.95
AR38.S ★	£139.95
AR19B	£119.95
AR20B	£149.95
AR30B	£199.95
A&R Arcam Two	£199.95
Boston A40	£99.95
B & W DM100	£99.95
B & W DM110	£119.95
B & W DM220	£199.95
Celestion 100II ★	£59.95
CelestionDL4	£99.95
CelestionDL6	£129.95
Celestion DL8	£179.95
Celestion SL6	£279.95
Heybrook HB1	£139.95
Heybrook HB2	£199.95
JPW P1	£99.95
JPW AP2	£119.95
Kef Chorale III ★	£49.95
Kef Coda III ★	£68.95
Kef Cantor III ★	£99.95
Kef Carina ★	£114.95
Kef Caprice ★	£129.95
Kef Carlton III ★	£159.95
Kef C New Series	P.O.A.
Kef R103 2	£299.95
Kef R104 2	£699.95
Kef R105 2	£999.95
Mission 70II	£99.95
Mission 700-2	£119.95
Mission 707	£149.95
Mission 737 R	£199.95
Mission 770 F	£379.95
Mission 780 A	£599.95
Monitor Audio R100	£109.95
Monitor Audio R252v	£129.95
Monitor Audio R352	£199.95
Monitor Audio R152	£299.95
Monitor Audio R552	£344.95
Mordaunt Short MS10	£79.95
Mordaunt Short MS15	£98.95
Mordaunt Short MS20	£109.95
Mordaunt Short MS30	£129.95
Mordaunt Short MS40	£179.95
Mordaunt Short MS100	£159.95
Mordaunt Short MS300	£299.95
Quad ELS 63	P.O.A.
Rogers LS2	£129.95
Rogers LS3/5A	£239.95
Rogers LS6	£199.95
Rogers LS7	£314.95
Rogers Studio 1	£439.95
Rotel RL850	£99.95
Spendor Prelude	£245.95
Spendor SP1	£540.95
Spendor SP2	£360.95
Tannoy Titan	£99.95
Tannoy Mercury	£145.95
Tannoy M20 Gold	£199.95
Tannoy Venus	£249.95
Wharfedale Diamond II ★	£84.95
Wharfedale 506	£119.95
Wharfedale 508	£159.95
Wharfedale 708	£299.95

Midi Systems

Akai	P.O.A.
Aiwa V150	£349.95
Aiwa V250 ex spks	£349.95
Aiwa V200 ex spks	£299.95
Aiwa V350 ex spks	£479.95
Aiwa V900L ex spks	£499.95
Aiwa V900 ex spks	£629.95
Aiwa V1100 ex spks	£799.95
JVC E3	P.O.A.
JVC E5	P.O.A.
JVC E22	£419.95
Pioneer S110	£249.95
Pioneer S330	£349.95
Pioneer S550	£499.95
Pioneer S770	£759.95
Sony Compact 44	£399.95
Sony Compact 55	£589.95
Sony New Models	P.O.A.
Technics New Models	P.O.A.
Technics 315/15	£269.95
Technics 315/25A	£319.95
Technics 315/25W	£364.95
Technics 315/35A	£429.95
Technics 315/45A	£499.95
Technics 315/55A	£649.95

Speakers included unless stated

Specials

ARBLS ★	£59.95
JVC E50System	£649.95
Kef Chorale ★	£49.95
Marantz CD63B	£219.95
Pioneer In-Car	Crazy P.O.A.
Pink Triangle S/H	£299.95
Sinclair Spectrum +	£99.95
Syrinx PU2 S/H	£199.95
BBC Micro B	£249.95

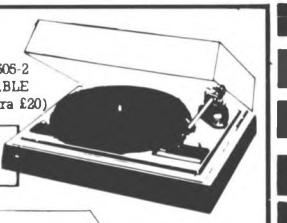
Prices include VAT and were correct at time of preparation (approximately 5 weeks before publication) but are subject to change without notice E&OE

Each component has been acclaimed "Best Buy" in the UK Hi-Fi Press, and as a system offers unbeatable value for money

This is an unrepeatable chance to purchase an excellent quality hi-fi at a bargain price

Kef Chorale III (or JPW P1 extra £15) SPEAKERS

Dual CS505-2 TURNTABLE (deluxe extra £20)



£229.95 inc. Cartridge & leads

Rotel RA820 AMPLIFIER

Carriage and insurance £8.00 per system UK mainland
N.B. Mail Order Sevenoaks branch only

Mail order to **Sevenoaks Hi-Fi, 109/113 London Rd, Sevenoaks, Kent. 0732 459555**

Please Send me _____

I enclose cheque/cash/card no. including p. & p.

Name _____

Address _____

NHFS 11/85

All goods fully insured against loss or damage in transit. Please allow up to 10 days for delivery, although it should normally be much less. Carriage and insurance £8.00 per item UK mainland
N.B. - Mail Order Sevenoaks branch only

Tests on many machines using a high quality BASF speed accuracy and stability test cassette (these are recorded on open-reel industrial recorders and then the pancake tape is packaged in a cassette shell) showed that their replay-only wow and flutter 'signature' affects cassette reproduction almost as much as when recording and then replaying. This is shown in *Figure 2.* We have published one overall record/replay speed stability figure, which is DIN weighted total wow and flutter. The figure for replay only was always slightly smaller than this result, but gave a very similar picture.

We have here a situation much like that experienced in other fields of high-fidelity. For example, some engineers question how the low distortion of amplifiers can be heard through high distortion loudspeakers. We are, in practice, talking about complex but distinctive 'signatures' of equipment when reproducing music, where one signature can be discerned through another. The steady and distinctive wow and flutter signature of a cassette deck substantially affects sound quality from pre-recorded cassettes, especially now that their quality is improving in leaps and bounds. More detailed information on this phenomena and its affect upon sound quality is provided later.

Replay speed accuracy

Speed accuracy only relates to performance when replaying pre-recorded cassettes, or cassettes recorded on other decks — as I explained above: it does not affect recording performance. The standard is 4.75cms/sec and we used a BASF test cassette to establish this parameter.

How much absolute speed accuracy affects a listener depends much upon certain conditions. Musicians are the hardest people to please, often being acutely aware of correct pitch and tempo. However, any listener will pick up relative speed error between cassette and another source, when the reference used is familiar. If, for example, a piece of music on LP has been listened to a lot — and we assume it is running at correct speed — then around 0.5% speed error may be just detectable.

We took 1% error as the limit of acceptability, and most people wouldn't notice this error, we feel. Speed accuracy figures are included in the test results though, and critical listeners may like to consult them. Only one deck was quartz-locked for complete and consistent speed accuracy and long term stability — Technics RS-B100, tested in the 1984 edition. Nakamichi do pay attention to this sort of detail though.

As if to throw a spoke into the whole matter of speed accuracy, it is only a valid concern if all the studio recording equipment runs with consistent speed. When master tapes are transferred from one machine to another, as between, say, a studio and transcription house, then speed error can creep in. The only way to combat this is to get a deck with variable speed, and there was only one — Nakamichi's BX-300.

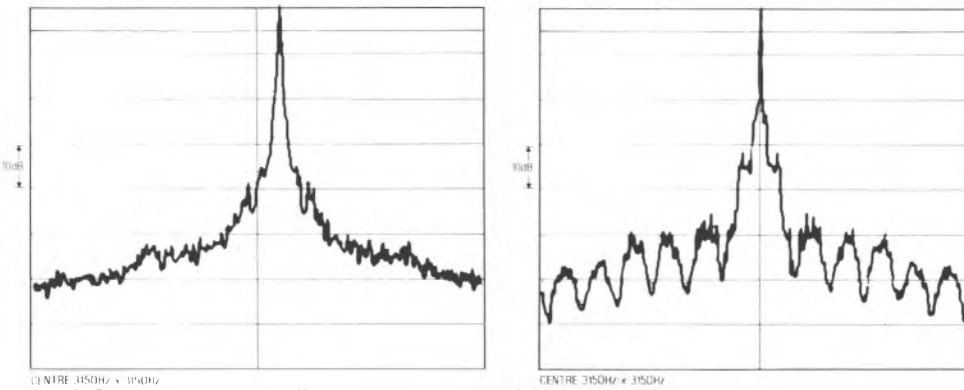


Figure 2. Speed stability as it affects musicassettes (left) and when recording and replaying on a blank tape, showing 0.1% and 0.18% flutter respectively — the two tape transport operations of recording and replaying have nearly doubled the flutter, seen as pronounced 'shoulders' around the 3.15kHz test tone (slightly higher frequency on replay-only is due to incorrect replay speed)

'CHOICE' RECOMMENDED AND BEST BUYS COME WITH FREE CARRIAGE AND A 2-YEAR GUARANTEE FROM BARTLETTS

COMPACT DISC PLAYERS
Marantz CD54 ☐
Marantz CD74 ☐
Marantz CD84 ☐
Mission DAD7000R ☐
Phillips CD104 ☐
Yamaha CDX2 ☐
Yamaha CD3 ☐

TURNTABLES
Acoustic Research AEB101 ☐
Aristan RD40 ☐
Aristan RD80SL ☐
Dual CS505/2 ☐
Dual CS505/2 Delux ☐
Lux PD300 ☐
Mission Cambridge 775 ☐
NAD 5120 ☐
QED R232 ☐
Revolver ☐
Rotel RP850 ☐
Thorens 321 ☐
Thorens 318 ☐

PICK-UP ARMS
Audio Technica AT1120 ☐
Audio Technica AT1100 ☐
Mission 774LC ☐
Mission 774SM ☐
SME SHS ☐
SME Series V ☐

CARTRIDGES
A&R C77 ☐
A&R P77 ☐
Audio Technica AT31E ☐
Audio Technica AT33E ☐
Audio Technica AT110E ☐
Audio Technica AT33ML ☐
Coral MC88E ☐
Denon 103 ☐
Goldring G920 1GC ☐
Goldring G910 1GC ☐
Goldring Epic ☐
Grado GT Super ☐
Mission 773HC ☐
NAD 9100 ☐
Nagaoka MP10 ☐
Ortofon OM10 ☐
Ortofon OM20 ☐
Ortofon MC10 Super ☐
Shure MP2E ☐
Shure ML140HE ☐

£5 OFF VOUCHER
ON PURCHASES OF £99 OR OVER
Just present this voucher* with your order and get an extra £5 discount off our competitive prices
*If you do not want to cut this issue a photocopy will be sufficient
Offer valid until 31.12.86

AMPLIFIERS
AR P35 ☐
Hafler DH110/DH220 ☐
Harman Kardon PM650 ☐
Mission Cyrus 1 ☐
Mission Cyrus 2 ☐
NAD 3020B ☐
NAD 3120 ☐
Nytech CA202 ☐
Proton 520 ☐
QED A230 ☐
Rotel RA820 ☐
Rotel RA870 ☐
Rotel RA820BX ☐
Rotel RC870/RB870 ☐
Sondex S230 ☐
Yamaha A320 ☐

SPEAKERS
A&R Arcam 1 ☐
B&W DM100 ☐
B&W DM110 ☐
BBC LS35A ☐
Celestion DL4 ☐
Celestion DL6 ☐
Celestion DL8 ☐
Celestion SL6/SL600 ☐
KEF 104.2 ☐
Marantz LD20 ☐
Mission 70 Mk 2 ☐
Mission 770 Freedom ☐
Monitor Audio R252 ☐
Monitor Audio R100 ☐
Monitor Audio R352 ☐
Mordaunt Short MS20 ☐
Quad ESL63 ☐
Rogers LS2 ☐
Rogers LS6 ☐
Rogers LS7 ☐
Rotel RL850 ☐
Spendor Prelude ☐
Tannoy Mercury ☐
Tannoy Venus ☐
Wharfedale 506 ☐
Wharfedale 508 ☐
Wharfedale 708 ☐
Wharfedale Diamond ☐
Yamaha NS1000 ☐

TUNERS
Denon TU710 ☐
Harman Kardon TU610 ☐
NAD 4020 ☐
Quad FM4 ☐

CASSETTE DECKS
Aiwa ADR450 ☐
Aiwa ADR550 ☐
Aiwa ADR990 ☐
Denon DRM22 ☐
Denon DRM33HX ☐
Denon DRM44 ☐
Harman-Kardon CD491 ☐
Marantz SD152 ☐
NAD 6155 ☐
Nakamichi BX100E ☐
Nakamichi BX125 ☐
Nakamichi BX150 ☐
Nakamichi BX300 ☐
Nakamichi ZX9 ☐
Nakamichi Dragon ☐
Technics RB215 ☐
Yamaha K320 ☐

- Free carriage on all orders.
- 2 year guarantee on all items (ex. styli).
- Access & Barclaycard gladly accepted – 'phone your order.

Large range of other products stocked – if you don't see what you require please phone or send SAE for a quotation.

Bartletts

175 Holloway Rd, London N7 8JB.
01-607 2296/2148.
Open 9.30-6 Mon-Sat (Cl. Thur).
19 High Street North, East Ham E6 1HS.
01-552 2716. Open 9.30-7 Mon-Sat.
Mail Orders: 01-552 2716.

Finally, we have the specific problems of auto-reverse decks. Most have slightly different forward and reverse speeds. The optical fast change systems they now employ ensure that when one tape side ends you hear the other start nearly immediately. The pitch change is therefore sudden. With rock music cassettes, different sides have different songs, so tempo and pitch changes are disguised by this unless speed differences are large — at least 1%.

Classical music has compositional continuity throughout and so is far more sensitive to pitch and tempo change. We recommend care in choosing auto-reverse decks if you expect to enjoy classical music played at the same pitch and tempo on both cassette sides. Our test results give forward and reverse speed accuracy and we warn of this problem where differences are 1% or more.

Head azimuth and reverse azimuth error

The fine vertical gap in a record head sets up a vertically aligned flux pattern on tape. When replayed, this flux pattern must perfectly match the vertical alignment of the replay head gap. If it doesn't, high frequencies will not be read from the tape, so treble output will fall and recordings will sound dull.

If a deck had only to replay its own recordings, the exact angle of the head would matter little. Because compatibility is needed between decks and duplicating equipment though, azimuth error must not occur.

Correct azimuth is a flux pattern that is at perfect right angles to the edges of the tape. In other words, the record head must be perfectly upright, assuming the tape travels past it on a perfect horizontal path.

If a deck has incorrect head azimuth — its head is tilted to one side — then high frequencies will be lost and the replay response will display sudden falling treble, usually above about 6kHz. Our general policy was to not adjust decks suspected of head azimuth error, even though this is a simple and quick adjustment to make.

Auto-reverse decks have peculiar problems with head azimuth. Most now have both the record/replay head and the erase head mounted on a rotating platform, shown in *Figure 3*. If this platform doesn't locate exactly, in both directions, head azimuth will be in error in one direction or another. This produces forward or reverse azimuth error and we assessed this by turning over our IEC Replay Response test cassette and measuring the reverse frequency response.

An unknown and controversial feature of all auto-reverse decks is their wear characteristics. We could not assess this, since it would take months of tests on banks of machines all working night and day! We can, however, quote some interesting product information on this subject.

Hitachi say: 'Conventionally, the head's rotating force is stopped by a hard buffer material which is meant to increase rigidity; unfortunately as this buffer wears with use, distortion (azimuth error) is also generated. Hitachi research has developed a better way — a shock absorber system which utilises a spring plate located in front of the azimuth adjustment screw — to more effectively absorb the rotating force. After the rotating force has been neutralised, the head is held firmly in place for optimum performance.'

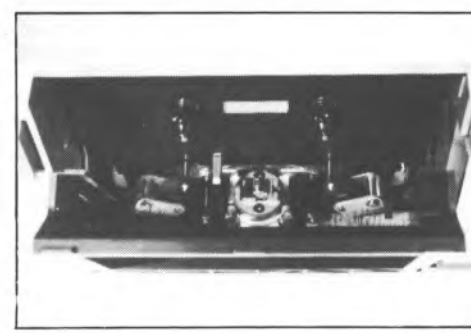


Figure 3. Typical rotating head platform for fast auto-reverse (Akai HX-R44), carrying the record/replay and erase heads. It spins through 180° as the tape changes direction, keeping the erase head 'in front' of the record head and scanning the alternate tracks on the tape. Current models are similar

Akai say: 'Akai's unique accurate reverse rotary head design is built to overcome the lack of durability and the tendency to misalignment in conventional head designs. Take the head design for example. It's made of beryllium-alloyed die-cast zinc, so tough that head rotation shocks leave no mark. Instead of fluid lubricants, solid Teflon is employed, together with a special temperature-resistant polyamide resin, achieving a service life of two million rotation cycles. Diamond-class extra hard fine ceramic head stoppers cushion the head with impact resistance rated at 22,000kg/square cm.

Tempered stainless steel azimuth screws maintain exactly the correct head gap-to-tape angle (azimuth) in both directions.'

We include these excerpts not to suggest that Hitachi and Akai are the only ones paying attention to wear, but to show that wear is a problem that exists with rotating head auto-reverse decks, and needs to be carefully tackled. Head gaps must be aligned to within small fractions of a degree (Akai say 4 minutes of arc) in both directions if treble output is to be maintained.

We found few decks that had a serious problem in achieving this. Generally, output at 10kHz varied by 1dB to 2dB between forward and reverse, which proved subjectively acceptable providing replay response was fairly accurate in the first place. If, however, the best result was – 2dB at 10kHz and the worst was – 4dB, the latter response would be considered unacceptable. In this case, reverse azimuth error can be a problem.

Another source of azimuth error in auto-reverse decks, not associated with head positioning, is change in tape skew across the replay head with change in tape direction. This can only be combatted by accurate tape guidance. Nakamichi decided that this tape skew problem and wear in rotating heads, with the current crop of auto-reverse decks, were intolerable. They consequently developed auto-reverse decks that physically turn the cassette around in fractions of a second, so that tape travels in the same direction all the time and the heads don't have to move. The result is a cassette that spins like a ballerina — something guaranteed to keep onlookers captivated.

CASSETTE DECK RECORDING PERFORMANCE

IEC Primary Reference tapes

The single most important development in cassette recording has been the comparatively recent introduction, by the IEC, of standardised tapes known as Primary Reference Tapes. Prior to their appearance, matching tapes to decks was a hit-or-miss affair that kept everyone guessing — and journalists like me busy trying to determine what matched what.

Interestingly, the whole tape/deck matching problem became so chaotic, as the number and variety of tapes available increased, that Japanese deck manufacturers veered almost unconsciously to setting up their machines to suit one brand of tapes. By popular consent, this brand was TDK and they effectively became references, of a sort. Needless to say, this did much to promote the company's name and products, but since they were chosen, in the first place, for their good performance, this was not misguided promotion.

It was a bold step by the IEC (again) to decide that properly agreed reference tapes were needed. These were chosen after industry-wide discussion that embraced the world's largest companies working in the field. They effectively provide a benchmark standard for frequency response and sensitivity, and their appearance has had a riveting affect upon both the cassette tape and the cassette deck industry.

The idea behind the IEC Primary Reference Tapes is this: if decks are set up to give flat recorded frequency response with them, and if cassette tapes are formulated to be 'identical' to them (I will explain this word more fully, later) then cassette decks will match cassette tapes. Many people thought this would never happen, but it has!

In fact, the IEC drew up a tape standard (IEC94) and could only hope that it would be followed by tape manufacturers. Manufacturers could have made disimilar tapes and specified them relative to the References. In practice nearly every tape manufacturer now issues ferric, chrome and metal tapes that are virtually identical to the References in terms of frequency response and sensitivity, measured under conditions laid down by the IEC.

This has obliged deck manufacturers to follow suit, adjusting their decks to give a flat frequency response with IEC tapes and, therefore, their commercial equivalents. If they didn't do this, their products wouldn't match anything.

IEC frequency response

The IEC Primary Reference Tapes were used to measure the frequency response of all the decks tested in this book. These tapes are shown in *Figure 4*. The IEC I reference is ferric tape, and it is made by BASF. The IEC II Reference is chrome tape and, again, it is made by BASF. The IEC IV Primary Reference is metal tape and made by TDK. As I understand it, Japanese manufacturers were not too pleased that the IEC should give a European company two Reference tapes to make, because there is a lot of prestige and commercial benefit to be had from this task. It does seem somewhat unbalanced to me, consider-

Figure 4. IEC Primary Reference tapes, shown here with the Nakamichi ZX-9 used as a 'reference' cassette deck in this book. Chosen by international agreement, these tapes have electrical characteristics which other tape manufacturers have accepted as a standard. The Primary References are BASF ferric, BASF Chrom II chrome, and TDK Metal, and have been used for all deck frequency response measurements in this book

ing there are plenty of other competent tape companies.

There are a number of benefits behind using these tapes. They are broadly accepted as a working standard, so cassette decks should give a flat frequency response with them. In other words, our graphs should show a reasonably flat line from around 100Hz up to at least 10kHz, within a few dB. We quote frequency response in the performance tables using limits of ±2dB.

Flat frequency response, here, means that recordings will possess even tonal balance. If the trace rises at high frequencies, treble output is excessive and recordings will sound bright or even shrill. If it falls at high frequencies, then they will sound dull, muffled and enclosed.

If cassette decks have a flat frequency response with the IEC Tapes, then they will match most blank cassette tapes well, because tape manufacturers have now ensured that their products have very similar frequency response characteristics and sensitivity (IEC II sensitivity excluded).

Because we tested tapes relative to these IEC Primary Reference Tapes as well, their frequency responses show the performance they will give with the decks. This is another substantial benefit of using IEC Primary Reference Tapes in all tests — the test results are directly comparable and therefore meaningful. Let me illustrate this point with an example.

Akai's budget HX-201 has flat frequency response with IEC I, II and IV — see the graphs in its report. Maxell XL-I tape also has a flat frequency response — see the graph in its report. Use Maxell XL-I with the Akai '201 and the end result should be perfect matching. Recordings will sound evenly balanced tonally, lacking undue treble brightness or dullness.

Now look at Maxell XL-IS tape. Its frequency response displays rising treble: use it on the '201 and it will sound bright. However, if you use this tape on a deck with a falling treble response it will cancel out the fall and result in a balanced sound.

IEC problems

Now I must explain some minor problems in this affair. First and most obvious is the low sensitivity of the IEC II Primary Reference Tape. It is based on BASF's chrome tape that is least −2dB less sensitive than typical Japanese pseudo-chromes (cobalt modified ferric tapes for use at chrome bias level). Japanese deck manufacturers don't intend to adjust their decks for BASF tape, nor do Japanese tape manufacturers intend to copy it in this respect either. Because nearly all decks now come from Japan, this part of the IEC Standard has, due to broad industry dissension, been ditched. I understand that there are moves afoot to do something about this.

We measured sensitivity of every deck with the IEC II Primary Reference and most give a figure of around −2dB. The results are published with every deck within the Sensitivity figures. What this means is that a signal replays −2dB lower than when it was recorded. This error affects Dolby tracking and frequency response at low recording levels when Dolby is in action.

If a deck has a −2dB sensitivity with the IEC II Primary Reference Tape in our test results, then a chrome tape with a +2dB sensitivity must be used with it for perfect Dolby tracking. In our tape tests we measured the sensitivity of every tape against the respective IEC Reference, so such comparisons can be made easily.

The second problem with the IEC 94 Standard is more fundamental, and threatens its usefulness for matching tapes to decks. IEC

bias levels specified for cassette tapes are too high for ordinary cassette decks. They relate to use with special IEC heads designed for open-reel industrial recorders. Domestic cassette decks cannot achieve these bias levels and still get a reasonable treble overload performance out of cassette tapes. Consequently manufacturers don't bother, and bias is therefore set all over the place (IEC 94 is a tape standard and not a deck standard, in any case).

Our 315Hz Maximum Output Level (MOL) figures with the IEC Primary Reference Tapes illustrate this, because they show effective bias level. Bias level is measured, by the way, by its ability to produce an effect on tape, not by a voltage across the recording head or anything similar; IEC quote the MOLs relative to IEC reference Level of 250nWb/m. The problem is that cassette tapes tested at IEC bias give a different performance from that achieved on ordinary cassette decks, which always have lower bias.

In our tape tests we deliberately chose test bias levels that were like those found on a typical deck, and avoided using IEC bias. Bias levels used were defined as giving 315Hz MOL's of +3dB for ferric tape, +1dB for chrome tape and +4dB for metal tape. Decks that have bias settings similar to this and give a flat frequency response with the IEC Primary Reference Tapes will give a frequency response just like the ones published in our tape tests. Decks biased differently won't necessarily give results quite like those published though, because of the varying degrees of 'bias tolerance' tapes have.

Generally, discrepancies will be small, but I feel the point is worth mentioning because it caused me some concern. This does also mean that tape performance figures gathered at IEC bias, by tape manufacturers, or anybody else, don't always relate to the experience of ordinary users.

Put bluntly, IEC tape performance figures can be unreliable as guides to performance on ordinary cassette decks. Our tape performance figures are more accurate, because they are made at more representative bias levels — but they cannot be perfect.

Bias

What a thorny subject this can be! It is possible to waffle on interminably about the inter-related effects of bias, so I will try and explain some of the most important effects bias level can have upon recordings without the whole thing becoming too obscure due to an over-abundance of MOLs, SOLs, Sats and the like.

As the consumer introduction explains, bias is a high frequency signal that conditions tape to allow it to record music without excessive distortion. It also greatly affects tape properties and performance, so its precise value is of some importance.

Deck manufacturers should set bias to give balanced low and high frequency overload figures from tape, otherwise sound quality will suffer unduly.

The low frequency (315Hz) overload value is known as Maximum Output Level, or MOL.

The high frequency (10kHz) overload level is known as the Saturation limit, or sometimes the Saturation Output Limit (SOL).

These values must be balanced against each other, because high bias increases MOL, but decreases SOL. In other words, it gives good low frequency headroom but poor high frequency headroom.

Conversely, low bias increases SOL but decreases MOL. It gives good high frequency headroom, but decreases low frequency headroom.

The question is — and this is where controversy creeps in — what balance between MOL and SOL do you go for when setting bias?

The IEC suggest a MOL 12dB higher than SOL with ferric and chrome tape, but 6dB higher with metal tape. This is based on dated ideas about the energy balance of music. It is an appropriate balance to strike for classical music, but hopelessly unbalanced for close-miked rock music that has fiercely high treble levels on LP and, especially, Compact Disc.

In our listening tests we used songs like Joan Armatrading's 'Down to Zero' from her Compact Disc 'Track Record' to check for saturation in recordings. A look at its energy balance will show how high the average treble level is, compared with that from a classical excerpt taken from the Denon test Compact Disc that we also used.

These high HF energy levels rapidly overload tape at high frequencies, causing it to saturate like a wet sponge that is full of water and cannot take any more. The subjective outcome is lack of fine treble detail, blurring triangles into cymbals and generally causing confusion. There is also loss of treble level if the effect is severe, introducing dullness and fluffiness. Saturation rarely sounds overtly nasty, but it does make everything sound flat, indistinct

ONKYO

SPECIALIST HIGH FIDELITY

You'll be hearing a lot more from us.

In a world of corporate diversification, one specialist HiFi manufacturer stays ahead by concentrating all their efforts into producing High Fidelity equipment of outstanding quality and performance.

The Japanese word 'Onkyo' means HiFi, and that's what Onkyo is all about. Truly 'Digital Ready' the Onkyo range of Receivers, Amplifiers, Tuners, Cassette Decks, Compact Disc players plus an equaliser and turntable will be adding new terminology to the HiFi enthusiasts vocabulary. Delta Power, Super Servo and Real Phase are just some of the Onkyo circuitry systems you should be finding out about. Tasteful styling, such as the solid aluminium front panels is combined with high quality engineering.

As one of the specialist HiFi equipment brand leaders in the USA and Europe and now available here, we are confident that you'll be hearing a lot more from Onkyo. Contact your nearest dealer and discover the Onkyo sound.

KYO

SWITCH ON FOR HI-FI PERFORMANCE

DISTRIBUTED BY GOODMANS LOUDSPEAKERS LIMITED
2 MARPLES WAY, KINGSCROFT CENTRE
HAVANT, HAMPSHIRE PO9 1JS
TEL: 0705 486344

THE FIRST EXCLUSIVE ONKYO DEALERS: BRYANTS HI FI, 81 High Street, ALDERSHOT. Tel: 0252 20728. **CLEARTONE HI FI**, 156/158 Blackburn Road, BOLTON. Tel: 0204 31423. **ERRICKS**, Fotosonic House, Rawson Square, BRADFORD. Tel: 0274 31423. **RADFORD HI FI**, 52/54 Gloucester Road, BRISTOL. Tel: 0272 422709. **HI FI MARKETS**, 36 Union Street, BRISTOL. Tel: 0272 294183. **RUSH HI FI**, 5/6 Cornhill, CHELMSFORD. Tel: 0245 57593. **HIVOLTAGE**, 53/59 High Street, CROYDON. Tel: 01-681-3022. **ASHTONS**, 6 High Street South, DUNSTABLE. Tel: 0582 608003. **GULLIFORD HI FI**, 28 Cowick Street, St. Thomas's, EXETER. Tel: 0392 218895. **MARTINS HI FI**, 2 Broadrow, GREAT YARMOUTH. Tel: 0493 855044. **SUPER FI**, 71 Castergate, GRIMSBY. Tel: 0472 43539. **ERRICKS**, 38 Cavendish Street, KEIGHLEY. Tel: 0535 602933. **MARTINS HI FI**, 5 High Street, KINGS LYNN. Tel: 0553 761683. **SUPER FI**, 34-36 Queen Victoria Street, LEEDS. Tel: 0532 449075. **SUPER FI** 271A High Street, LINCOLN. Tel: 0522 20265. **HI FI EXPERIENCE**, 227 Tottenham Court Road, LONDON W1. Tel: 01-580-7383. **SPI SOUNDVISION**, 359 Green Lanes, Palmers Green, LONDON. Tel: 01-882 5882. **CLEARTONE HI FI**, 62 King Street, MANCHESTER. Tel: 061 224 4215. **JVC HI FI & VIDEO**, Dukes Drive, Bletchley, MILTON KEYNES. Tel: 0908 367341. **MARTINS HI FI**, 85/91 Bee Street, NORWICH. Tel: 0603 627010. **NOTTINGHAM HI FI**, 116-118 Alfreton Road, NOTTINGHAM. Tel: 0602 784015. **SUPER FI**, 15 Market Street, NOTTINGHAM. Tel: 0602 412132. **McKENNA & BROWN**, 135/137 High Street, REDCAR. Tel: 0642 477356. **SUPER FI**, 1 Rockingham Gate, The Mall, SHEFFIELD. Tel: 0742 23768. **JCV HI FI & VIDEO**, Units 7/8 Wharfe Street, WARWICK. Tel: 0926 493796. **WOODS AUDIO VISUAL**, 1 Upper High Street, WEDNESBURY. Tel: 021-556 0473. **RADFORD HI FI**, 43 King Edward Street, WINDSOR. Tel: 0753 56931. **WOODS AUDIO VISUAL**, 39 Victoria Street, WOLVERHAMPTON. Tel: 0902 772901. **NORTHERN IRELAND AUDIO TIMES**, 85 Roya Avenue, BELFAST. Tel: 0232 29907. **SCOTLAND HI FI CORNER**, 121 Rose Street, EDINBURGH. Tel: 031-225 9535. **HI FI CORNER**, 1 Haddington Place, EDINBURGH. Tel: 031-556 7901. **HI FI CORNER**, 44 Cowwynd, FALKIRK. Tel: 0324 29011. **HI FI CORNER**, 52 Gordon Street, GLASGOW. Tel: 041-248 2840. **HI FI CORNER**, 75 Murray Place, STIRLING. Tel: 0786 79053.

and lacking in differentiation.

Rock music requires high saturation levels then, and because there is usually some overload headroom to spare at low frequencies when good tape is used on a good machine, it is more sensible to use low-ish bias levels.

We tested all the decks for Maximum Output Level at 315Hz and Saturation at 10kHz, with the IEC Primary Reference Tapes, and quote the figures in our test results. These are probably unique and give a good insight into what the manufacturers are doing with their decks.

Look at the 315Hz MOL figures for all three tape types for the decks we tested, and you will see that they are always +dB values, especially with IEC I ferric and IEC IV metal Primary Reference Tapes. This means that the Maximum Output limit was this amount above IEC 0dB Reference level. Now, IEC 0dB Reference Level is a very high tape flux of 250nWB/m, and that is about + 2dB higher than the 0VU level of most modern decks. Add 2dB to the MOL figures we quote and you get some idea of how much 0VU peak record level the Maximum Output Level limit is of most decks, using good tapes. If a deck has a MOL of + 3dB with ferric tape, then recordings can be made to + 5dB above 0VU at low frequencies before 3% distortion occurs. There is obviously plenty of headroom at low frequencies, so some can be sacrificed by lowering bias.

And lowering bias is necessary. Look at the high frequency saturation figures of most decks and you can see that overload is occurring at something like – 6dB below 0VU. This is too low for rock music. A figure more like – 2dB (that is, 0VU) is more appropriate, so bias does need lowering in order to bring up the typical – 6dB figure.

As always, Nakamichi have thought about this and seem to 'under-bias'. They don't, in fact, under-bias, because bias level is shown by MOL values and theirs are no lower than anybody else's. Instead their high performance heads allow them to use high bias and yet retain a high saturation limit more appropriate for rock music. Some people call this 'under-biasing' because it results in a different MOL/SAT balance to usual, but one that I certainly believe is much more appropriate for modern recordings, where high treble levels have to be captured.

Now look at other 'cooking' Japanese cassette decks and you will see that bias is often set at a point that gives rotten treble overload levels of – 8dB or less with ferric and chrome tapes. Don't expect to get much treble clarity out of these decks: they will give the woolly, vague 'cassette sound' that everybody is used to. It can be combatted to some extent by choosing a tape with a high saturation limit.

Metal tape scores here, super-chromes are next best and then high quality ferrics. Be aware that super-chromes and super-ferrics often have a rising treble response compared with the IEC References (look at the BASF SuperChromdioxid and the Maxell XL-IS tape tests), so they almost always give a bright sound too.

Dolby HX Pro is designed to combat precisely this problem, giving ferric and chrome tape performance equal to metal in this area (more of this later).

As a general rule, then, look for a deck that has high saturation figures, if you want good treble clarity. Don't worry about MOL figures too much. If they are as low as 0dB they are still + 2dB above the commonly used peak record level, and overload should not be a serious problem.

Bias and frequency response

There's no end to this bias story. As I explained above, bias should be set to give balanced overload figures, but often you will find it is varied to give a flat frequency response! Many decks we tested had variable bias, Aiwa in particular, being keen on this idea, but Nakamichi are in this ball-park too.

The subjective impact of frequency response errors is greater than that of MOL/SAT balance differences, so it is not only valid to vary bias to alter frequency response; it is a valuable feature. We rated the provision of user-variable bias very highly. It allows a deck to be fine-tuned for any tape, in order to give a perfectly flat response and, therefore, even tonal balance. It was disappointing that variable bias is often only available with ferric and chrome tapes, not with metals.

If a tape gives excessive coarse treble, increasing bias gets rid of it. If a tape sounds dull, decreasing bias brightens it up. Bias variation range should be adequate to ensure a flat response with super-chromes. Some variable bias decks barely managed this.

But varying bias alters the MOL/SAT balance and, to some extent, destroys the potential benefit of super-chromes and super-ferrics. Because they have rising treble, bias must be increased to 'flatten' it, which also reduces

their high treble overload (saturation) limit.

Ideally, bias should be set to give a sensible MOL/SAT balance and the amount of treble put onto a tape during the recording process varied to give a flat frequency response. The technical way of stating this is that record-equalisation (treble boost) should be adjusted for flat frequency response. Expensive decks like the Revox B710 MkII and Nakamichi ZX-9 do have adjustable bias and record equalisation. Bias is adjusted to get a good MOL/SAT balance, and then record equalisation is adjusted for flat frequency response.

You have to pay around £1000 to get a deck with these features, and then you need to buy test equipment to know what you are doing when setting it up. An easier way has been devised by (some) Japanese deck manufacturers, like Aiwa (AD-F990) and Pioneer (CT-A9). They include automatic tape tuning systems on their top decks, and these do the whole thing for you.

The snag with these is that *they* decide on a MOL/SAT balance, unless options are built in. Some of the auto-tuning decks we tested did allow under- and over-bias options to be selected in the tuning process so *you* can decide on MOL/SAT balance. If you record rock music choose low bias; if you record classical choose high bias.

Another problem is that some systems don't set bias by assessing MOL/SAT performance, but use quicker, simpler methods such as relying on midband sensitivity. This results in unpredictable MOL/SAT performance, we found, and such systems were rejected by us.

A third problem with auto-tuning systems is that they don't always give a perfectly flat frequency response. One earlier 'auto' system had to be tuned five times before it could make any sense out of BASF Super-Chromdioxid tape.

Manual bias adjustment systems are simpler and can provide the tonal balance that you want, not what some microprocessor — often erratically — decides upon. We preferred them. If treble saturation is felt to be a problem with such a deck, then using better tape (metal?) is a way of combatting it.

Speed stability

It would be easy to dismiss speed instability as responsible for a bit of wow, that speeding up and slowing down that could be described as making the sound 'drunken', due to slow random pitch changes. I was sitting in a local restaurant the other day where the background music supplied by cassette was slowing and then speeding up, pitch slurring all over the place. The sensation made me feel vaguely ill (I hadn't eaten anything at this stage!).

This is the sort of effect most people attribute to unstable speed and, indeed, we found cassette decks in our tests that produced a similar effect — but to a lesser extent. There is a problem in trying to describe the relative annoyance value of this sort of

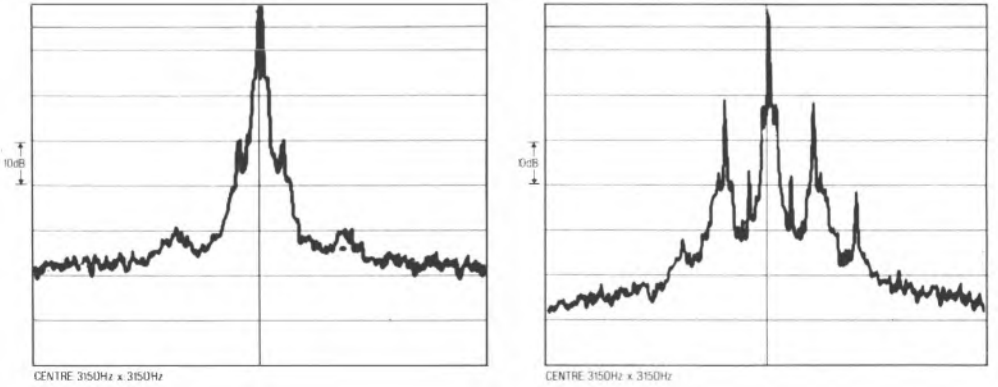


Figure 5. Wow and flutter spectra for (left) Nakamichi BX150 and (right) for the Sony TC-FX705, showing wow and flutter as sidebands around the 3150Hz test signal. The BX150 has a low flutter energy level (between the two vertical dotted lines) of −32dB. TC-FX705 has flutter at 38Hz, seen as twin 'spikes' 38Hz away from the main signal. Band flutter level here is −19dB. Flutter readings from a wow and flutter meter were 0.15 and 0.3% respectively

The Sound Organisation use these with Linns, Naims and Regas.

The two Dual cassette decks shown here are very simple machines, they're not very pretty, have no fancy features and they're not even the cheapest machines money can buy.

Why then does one of Englands most innovative and successful HiFi dealers supply Dual as their basic Cassette Deck.

For one reason and one reason only.

THEY SOUND GOOD

In fact, in the opinion of the S.O. they not only sound better than any similarly priced product but are more musical and pleasant to listen to than all but the most expensive Japanese wonderdecks.

If you own or are thinking of buying a good record playing system and you want to add cassette capability without breaking the bank, go and listen to one of these.
You will be surprised how good they are and you'll probably buy one!

Hayden Laboratories Ltd. FREEPOST. (No stamp required),
Chiltern Hill, Chalfont St. Peter, Bucks. SL9 9BS.
Tel: Gerrards Cross (0753) 888447.

The Sound Organisation are at 1 Cathedral Street, London, S.E.1. 01-403 2255 36 Gillygate, York. YO3 7EQ Tel: (0904) 27108.

For your free Dual Colour Catalogue
Please cut out this coupon and send it to:

Hayden Laboratories Ltd.
FREEPOST. (No stamp required),
Chiltern Hill,
Chalfont St. Peter,
Bucks. SL9 9BS.
Tel: Gerrards Cross (0753) 888447.

*Name*_____

*Address*_____

thing though. One person might not notice wow, or at least not be upset by it. Another may find it unbearable.

Serious lovers of organ and piano music are warned that speed variations of all types are likely to be upsetting, especially to those people used to the wonderful steadiness of pitch and 'solidity' of sound that Compact Disc (usually) possesses. My assistant in this project listens to a lot of classical music and it was he that proved most upset by speed variations of all kinds. Our observations about their subjective impact are based largely upon his extreme sensitivity to the problem. They are critical observations; we basically expected the same performance from cassette as Compact Disc — and with some decks we got it!

Cassette can outperform disc by a comfortable margin in this respect. Disc players always suffer drift and off-centre records only add to it. So does arm/cartridge resonance, which results in continuous vertical oscillation around 8Hz that frequency modulates the sound at this frequency. All this sort of thing can, in theory, be eliminated from cassette. At present only the best machines can achieve remarkable speed stability, but this may change. A quick explanation of speed instability is helpful before discussing how we measured it and its subjective impact.

Tape should pass over the replay head at a constant speed of 4.75cms/sec. It is pulled past by the capstan, and held against it by the pinch wheel. If the capstan is bent or not perfectly round, the tape will speed up and slow down slightly, roughly six times per second because capstans complete approximately six revolutions every second (that is, they turn at 6Hz). Frequency is increasing and decreasing at this rate, so the signal is being frequency modulated; it is the same as FM radio!

Frequency modulation is quite a complex process, producing multiple sidebands around a signal that, in theory, fade out at infinity, (unlike amplitude modulation sidebands, that are finite). In practice, 6Hz modulation results in significant sidebands 6Hz either side of a signal. These can be clearly identified by spectral analysis.

Alternatively, a test signal can be demodulated in a wow and flutter meter and the spectrum from 0Hz upward analysed, whereupon a spike at 6Hz is seen, often accompanied by harmonics at 12Hz, 18Hz, and so on. We used both analysis techniques, and recorded the results for every player. The information is fascinating, but too complex and space consuming to be published. Consequently, the sort of spectrums we obtained for good and bad players are shown in *Figure 5*, together with explanations.

So far I have mentioned only wow, which produces 'drunkeness' in the sound. In practice speed variations have various subjective effects, as follows:-

Speed variations of different rates have quite different subjective consequences, so they are conveniently split up into three categories: drift, wow and flutter. Drift describes slow variations of speed, at a rate of below 1Hz (one cycle per second). Wow is the descriptive term often applied to variations between 1Hz and 10Hz. Flutter is the term used to describe variations above 10Hz.

But there is a complication to this categorisation: speed variations can be regular or random. Their annoyance value is high if they are regular, but often low if random. Unfortunately, measurement with a wow and flutter meter doesn't adequately take this into account. Decks with low amounts of regular wow could be annoying to listen to, because the problem would always be there to corrupt the pitch-steadiness of sustained notes, when they occured. Random wow will not necessarily occur during sustained notes though, and we often had quite a difficult job trying to hear it even though measurement warned of its existence. Consequently, wow and flutter figures don't really tell the full story about these phenomena.

We chose to publish just one total, DIN weighted, wow and flutter figure, for the sake of clarity. This gives some indication of goodness, but with every machine we additionally gathered two spectral analyses, separate wow, flutter and drift figures, and conducted various listening tests in order to fully quantify the problem, so pervasive was it. The text therefore gives a better description of speed stability than the published W&F figure. As it is a generalisation, what lies behind a single test result is too complex for that result to describe, thereby invalidating it. This is an inherent problem with published performance figures of all sorts.

Speed variations of all types turned out to be a greater problem than I had properly realised. Subjectively, their effect is as follows:

Low rate drift and wow, up to 2Hz.

This produces pitch meandering. Music never

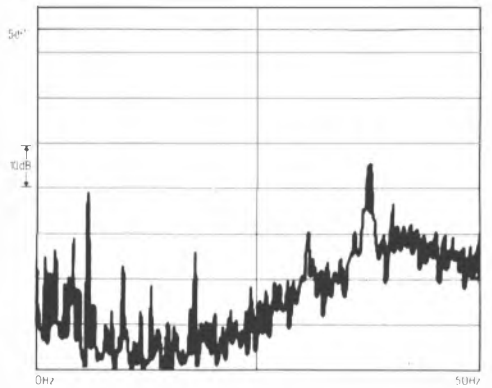


Figure 6. Wow and flutter spectrum (Sony TC-FX705), this time obtained by demodulating the signal from a wow and flutter meter. The horizontal scale is 0-50Hz, and the 38Hz peak (seen as a sideband in Figure 5b) is to the right of the cursor line. Wow originating from the capstan can be seen as a spike at 6Hz

quite seems to know what is is doing pitch-wise and appears 'uncertain'.

Medium rate wow, 2Hz-4Hz.

This often has a random nature and adds pitch 'shakiness' to notes. Sometimes, piano can seem 'jelly like', as if the notes are wobbling.

High rate wow, 4Hz-10Hz.

This is where capstan irregularity usually stains the picture. It is regular and produces a nasty warbling effect to notes.

Low rate flutter, 10Hz-15Hz.

This is heard as a fast warble or flutter to notes. They may seem pitch stable, but essentially have their character altered or 'dirtied'.

Flutter above 15Hz.

High rate flutter proved an enormous problem with most decks. It produces diffuse sounding notes and adds harshness and muck into a performance. Dirty, diffuse sounding cymbals that 'schhhh were our cue for the presence of high levels of high rate flutter.

Flutter distortion

Severe flutter takes energy out of a signal and distributes it as high level additional unwanted or spurious signals — known as sidebands. This is similar in effect to the production of harmonic and intermodulation distortion. Furthermore, all three forms of 'rubbish' (rubbish being that which is not wanted in this argument) can be quantified in the same way — as the level of unwanted energy relative to the level of energy in the wanted signal, quoted as a percentage figure. Seen in this fashion, flutter can be quoted as a distortion figure, and I often do this in the reviews to draw attention to its relative severity.

Flutter sidebands are often far removed from the main signal and are not heard as a pitch change of that signal, but as a separate effect. This is what distinguishes them from wow. We measured the amount of energy distributed into flutter sidebands over a region stretching from 3kHz to 3.3kHz. The equivalent band level value is quoted as a −dB value in the test results. Often, sidebands had an equivalent energy level higher than −20dB, as seen in

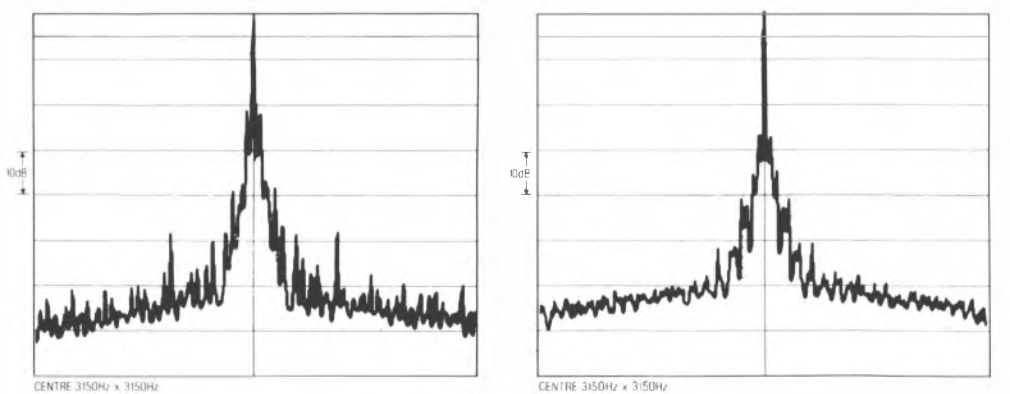


Figure 7. Wow and flutter spectra of Nakamichi ZX-9 (left) and Revox B710 Mk II. Both have a very low flutter band energy of −37dB and provide exceptionally good speed stability. The flutter components rise only slightly above the level of the underlying broad-band modulation noise

Figure 6, equivalent to 10% distortion or more. This accounts for much of the lack of clarity and general paperiness in cassette recordings. At its worst it can result in spitching on vocals and that 'schhh' quality to everything, that cassette recordings sometimes have.

Yet again, Nakamichi have identified this problem and seek to tackle it in all their recorders. The most effective way, though, is undoubtedly use of dual-capstan, closed-loop drive. After a while we realised that these were almost the only type of recorder that could deliver a really clear, open sound from cassette. Single capstan types can do well, but in general they are inferior. Flutter spectograms are shown for the Revox B710 MkII (now replaced by the B215) and the Nakamichi ZX-9, two of the best dual-capstan decks, in *Figure 7*.

In a dual capstan drive there are two capstans and two pinch wheels. Controlled back tension is applied by the left hand capstan, which rotates at a fractionally lower speed than the right hand 'drive' capstan. The tape between these capstans is said to be in a 'closed-loop', isolated from the drive hubs and cassette mechanics.

In theory this system reduces the effect of the cassette shell upon flutter performance. In practice we found that dual-capstan recorders were so good in getting rid of inherent machine-generated flutter that cassette mechanics had quite a lot of affect upon performance. Our test on the Nakamichi ZX-9 illustrates this by comparing its flutter performance with TDK SA and with BASF Superchromdioxid Special Mechanics. We always had to use BASF cassettes for definitively low flutter from dual-capstan decks, although Maxell cassettes usually approached their performance in this respect, and golden ears would be needed to hear differences.

Modulation noise

Modulation noise turned out to be the problem that isn't a problem in cassette recorders. At least not much of one, compared with flutter.

It is noise caused by random AM and FM modulation. Jerky tape motion at a microscropically small level and very high rate, caused by tape surface roughness and head and guide roughness, is the reason for modulation noise. We measured the modulation noise of every recorder when using

TDK SA tape.

You may have noticed that flutter and modulation noise are similar effects. Where one is low, the other is usually low too. This is fortunate because we found that combining a low flutter/mod-noise deck with a low flutter/mod-noise tape was like finding the key to fidelity. It resulted in such a reduction of rubbish in recordings that a sense of clarity was, finally, obtained with cassette.

Dolby HX Pro

The dynamic range between tape hiss and overload distortion is limited mainly by the performance of cassette tapes, rather than cassette recorders (see *Cassette Tapes Introduction*).

To a large extent, there is little that can be done by tape deck manufacturers to overcome cassette limitations. Better head design can get more treble onto tape before overload occurs, as saturation figures for Nakamichi decks clearly show. But until the cassette treble overload ceiling can be raised significantly, to match MOLs, the commonly used OVU level cannot be raised and dynamic range will remain much as it is.

Metal tape does provide much improved treble headroom, but at a price people appear not to want to pay. Metal tape accounts for 1% of total tape sales — and this share is declining.

Another facility that improves saturation headroom is Dolby HX Pro. This is not at all like Dolby B or C noise reduction systems. It is a method of automatically varying bias during recording to get more treble headroom out of tape. In the section entitled 'Bias' I explained that lowering bias raises treble overload headroom. Dolby HX Pro does just this when a signal with a high treble content comes along. Some measure of its efficacy can be gained from the saturation figures quoted for the few decks fitted with this system — see Aiwa AD-F990 and B&O reviews.

Dolby HX Pro challenges the use of fixed bias as the correct way to bias tape. It is therefore quite a controversial system. Varying bias alters a complete range of tape properties, including HF sensitivity, drop-out performance, maximum output at low frequencies, sensitivity, and more. This is compensated for by self-biasing, where the treble content of a signal behaves much like bias. Tape either exhibits stable performance with constant bias, or with constant HF energy (that is, with Dolby HX Pro).

Listening tests show that Dolby HX Pro does get more treble onto tape and so it does work in a practical sense. Like noise reduction systems (Dolby B/C or dbx), Dolby HX Pro is preferable to tape saturation, even if it isn't perfect. I note that both Nakamichi and Tandberg have objections to its use, though, and that there has been no rush by manufacturers to adopt it (possibly due to licensing fees).

However, tape transcription houses are apparently interested, because it appears to give ferric tape the overload performance of metal tape. Note that recordings made with Dolby HX Pro can be replayed properly on any deck. They don't have to be replayed on a deck fitted with the system, since it operates during recording only.

I specifically tried to prove whether HX Pro does or doesn't have a net resultant effect upon tape properties, just for the sake of this explanation of it. White noise and pink noise, each representing different kinds of music, were recorded on the B&O 5000 and then replayed. A spectrum analyser was configured to mathematically subtract the input signal from the recorded output to give a resultant frequency response. Changes in this response would then show that HX Pro was altering tape properties, according to the relative energy balance of music being recorded. This means, for example, that frequency response would be different when recording classical music, with little treble energy, to that when recording rock music with a lot of treble energy.

I expected to see quite a lot of change, but in fact could identify only a small change in extreme treble level on tape. This suggests that HX Pro does not have a major affect on tape properties, other than its intended function of increasing treble overload (saturation) headroom. This analysis and listening tests currently conclude that, on balance, HX Pro is worth having. However, I did hear a very small amount of noise modulation or pumping, on B&O's 5000, that may or may not be due to HX Pro, and I am still not perfectly convinced that HX Pro is quite what the doctor ordered.

Dolby noise reduction

The Consumer Introduction explains Dolby action in simple terms, so I will not repeat the explanation here. However so many people blame Dolby for ruining tape performance that some explanation of its weakness is

appropriate. Basically, let me say that Dolby does work incredibly well, but also that it is very critical — perhaps over-critical — of system performance.

At London's hi-fi show, held in the Penta Hotel near Heathrow Airport, many people told me that they prefer not to use Dolby when recording. I have heard this observation many times and have taken some time to carefully investigate the subjective impact of Dolby under ideal and non-ideal conditions. I never know of course, whether such criticisms are validly aimed at Dolby or just its effect in an imperfect system. Perhaps it doesn't matter. If people don't like it, for whatever reason, then it is an existential fact that it is bad. But so is tape hiss. One has to choose between the lesser of two evils.

As the tape introduction clearly explains, Dolby B and — to a greater extent — Dolby C magnify frequency response errors in a tape recorder. If treble rises by +2dB at 10kHz, Dolby C will take this to around +4dB, so making a bright sounding tape brighter. Conversely, it makes a dull sounding tape sound duller. I feel certain that this is the problem most people hear and find objectionable.

The other commonly expressed observation is that 'Dolby cassettes sound better without Dolby'. In other words, cassettes that are Dolby B encoded sound better when played without Dolby B decoding. This means they sound brighter or less muffled. I have heard this many times myself, but know that it is due to the fact that cassettes often have falling treble due to severe saturation and self-erasure, dirty heads, and falling replay frequency response caused by incorrect equalisation and head azimuth. In fact, the general tendency of wear and error in cassette decks is to reduce treble.

Dolby unfortunately emphasises treble losses — as I explained at some length in the section on Replay Performance in this introduction. It makes dull tapes sound duller, unless it is switched off during replay, whereupon they suddenly sound bright or 'normal'.

If a deck is perfectly set up to have a flat frequency response and no sensitivity error with any one tape, then Dolby has little effect upon recording quality other than to reduce tape hiss. We have listened at length to recordings with and without Dolby B and C, made on the Nakamichi ZX-9 after it has been perfectly set up.

Even under the most critical conditions, Dolby does not produce noise pumping, unlike dbx; this is Dolby's great strength. Both Dolby B and C slightly soften the edge of fast transients, but the effect is very small and not unpleasant. For most users, fast transients are never captured in any case, because of tape saturation. This becomes noticeable only with metal tape.

In reality, few decks give a perfectly flat frequency response when recording, and our replay graphs show that few give a flat replay response either. Consequently, it can be argued that Dolby is just too critical of system performance. There are some things the average owner can do to improve Dolby tracking with recordings though, as explained in the next section.

Improving Dolby action

Matching a tape to a deck results in accurate Dolby tracking and will improve its behaviour no end. Here are some practical tips for ensuring correct tape matching, so that Dolby works properly. Before trying them though, ensure the tape heads are clean, preferably by inspection, and the use of a head cleaning kit if they are dirty.

Firstly, a tape has to be chosen that gives a flat frequency response with the deck in question, *with Dolby switched out*. The easiest way of doing this is to use the noise that a tuner generates between stations. Its noise muting must be switched out, usually achieved by pressing the mono button. Then smooth, even-sounding noise without interference must be found by tuning between stations, preferably without an aerial connected. Record this noise at −10dB below OVU, or a bit less, and then replay it. Compare the noise from tape with that from tuner using the tape monitor button on the amplifier.

If the noise from tape sounds 'warmer', 'softer' or more muffled than that from tuner, then treble response with that tape is falling. It is possible to check this simply by listening to music of course. Record music with plenty of treble from disc, and then play both the disc and the tape at the same time, switching between them with the monitor button again. This will also tell you whether your recordings have more or less treble.

Having established that there is either too little or too much treble on the recording, the next move is to choose a tape that gives better matching, where treble level sounds much like

that of the original signal. This can be done by looking at the tape frequency response graphs published with the tape tests, in this book.

If, say, Sony UCX gives a dull sound, then UCX-S will sound brighter. Similarly, if BASF Chrom II sounds dull, then BASF Chrom Super II will give a bright sound. If you are using a cheap ferric tape and it sounds dull, try a more expensive ferric tape, because they usually sound brighter. The same goes for chromes. Experiment with tapes, using the graphs we publish as a guide, until even treble output level is achieved.

Next, sensitivity matching can be checked, but this time steady noise is vital as a test signal. Set recording level so that the – 10dB (or lower) LED on the record level display *just* lights. Record some noise, then replay it: the – 10dB led should just light again. If it doesn't light at all, you need a tape with higher sensitivity and you can find one from our tape test results, which show relative sensitivity. If the LED lights strongly then you need a tape with lower sensitivity. Again, the tape test results show which ones are likely to be appropriate.

If you cannot find a tape with even treble and correct sensitivity, forget sensitivity matching and go for even treble: this is usually more important.

Having selected a tape using these methods, now try making a recording at low level, peaking around – 10dB maximum, with Dolby switched in. It should now sound much like the original. If it doesn't, progressively choose brighter or duller sounding tapes, using the tape frequency responses we publish, until the sound becomes subjectively even.

The only way to improve Dolby B performance with pre-recorded musicassettes is to ensure that your heads are spotlessly clean, by using a head cleaning kit. The other important factor is head azimuth adjustment. This must be spot on, which means head adjustment, preferably using the latest IEC test tapes (made by BASF). Older tapes have different recorded azimuth and may result in small errors.

It is usually necessary to get a tape service department to adjust head azimuth but, as you will find out, tape service departments virtually don't exist. BASF are currently thinking of setting up cassette deck 'service stations' by equipping key dealers with the necessary test tapes and some simple test equipment. This would be welcome. Alternatively, try contacting the manufacturer of your product, using the addresses and phone numbers published with our reviews, and ask whether they can check head cleanliness and head azimuth. It is a simple business and should not cost much, unless head replacement is necessary due to excessive wear.

dbx

The presence of this rival noise reduction system is usually heralded on cassette decks by banners proclaiming '115dB dynamic range' (Akai) and the like — a nasty means of introduction. It is impossible to reproduce such range via the electronic circuits of cassette decks, let alone in the home. Such claims trivialise the system.

When recording to OVU, something like 76dB of dynamic range is available with dbx — an apparently worthwhile improvement on Dolby C's 70dB, but nowhere near commonly claimed figures of 90dB to 115dB. There is more to dbx than just this, though.

This noise reduction system works right across the frequency range, so it suppresses all noise inside the companding loop, including hum. In addition — and this is significant — dbx prevents tape overload. Up to a point, it peak-compands. That is, music peaks above OVU are compressed downward during recording and then expanded back up again during replay, thus avoiding tape overload. Dolby C only does this at high frequencies; dbx does it at all frequencies.

Past a certain level, about + 5dB above OVU, peaks are compressed downward by dbx, but not expanded back up again. In other words it acts as a peak compressor, in order to prevent tape overload. If recordings are made right up to the idiot-proof companding limit of dbx, well over 76dB dynamic range can, theoretically, be had from it.

Since improvements were made to this companding system, it emphasises frequency response errors no more than Dolby C, whilst giving greater noise reduction. This fact, taken with its ability to totally prevent tape overload, appears to guarantee superiority over Dolby, but in practice we never preferred dbx for two reasons — noise pumping and a peculiar form of character or colouration it adds to sound.

With continuous high level rock music, noise pumping is not audible. Directly single piano notes are struck though, or any such discrete sound occurs, a massive swishing noise is heard in accompaniment with dbx. This so

offended our sensibilities that we dismissed it completely. However, for less critical users of cassette, I wonder whether dbx is not the best noise reduction system. It totally eliminates ordinary tape hiss, it totally prevents tape overload and it is idiot proof.

Tape hiss and distortion

You may be surprised to find less mention than usual of hiss and distortion in the reviews. This is largely because there is little that can be done about either, in the face of tape limitations.

Record to high levels, in order to minimise hiss, and distortion occurs, taking the form of treble confusion or general muddle. Keep level down to avoid distortion and hiss can be heard. The trick is to get the correct level so neither prevails.

Most cassette recorders now have their 0VU peak record level set to Dolby level (this is a convenient tape flux reference level of 200nWb/m, not to be confused with IEC reference level of 250nWb/m). They also use LED record-level displays that accurately read peak levels. The result is to keep average recording levels sensibly down, to a point where severe treble overload does not occur with ferric or chrome tapes. Dolby C also helps prevent severe treble overload, due to its mild peak-companding action.

Distortion should generally be low if 0VU is not exceeded when recording. We measured distortion at low frequencies (0VU) to assess head saturation, in the mid-band (0VU), and at high frequencies (intermodulation at −5dB), using metal tape. The balance between mid-range and treble distortion is determined much by bias adjustment. If bias is high, mid-band distortion will be low but treble distortion high, and vice-versa.

Distortion is quoted as a single figure to avoid confusion, this being an average of the three results.

The amount of distortion a recording suffers in practice will be determined mostly by the tape and the recording levels used. To take into account recording level, we measured distortion on a signal recorded at 0VU. Where 0VU was set low (Yamaha K320), this clearly shows that distortion is low.

Often, for academic reasons, both distortion and noise are measured at specific tape flux levels. We deliberately avoided this approach: both were measured at 0VU when recording, to accurately reflect the sort of performance achieved in conditions or ordinary use.

With low 0VU recording level, tape hiss figures are high, around −67dB. With 0VU set at Dolby level this should fall to around −70dB. All machines were tested for noise with TDK AD-X ferric, SA chrome and MA metal tapes, for the sake of comparability and because this is the single largest selling brand in the UK. Our results are, therefore, representative of what will be achieved in ordinary use.

However, if quieter tapes are used, lower noise figures will be achieved. In other words, hiss depends upon the tape and the maximum recording level used, not usually upon the machine itself. Listeners annoyed by hiss, with Dolby C in action, must choose low noise tape — BASF Chrom II being the quietest available. Note that it cannot accept high recording levels though. Maxell XL-IIS is a good alternative, or Sony ES metal. If these are not good enough, consider dbx noise reduction.

Sensitivities and matching

Matching should not be a problem with cassette decks these days. Providing line phono sockets are used, input sensitivity is almost always adequate.

The 'Rec Input' usually goes straight to the record-level controls, so input overload is impossible. We tested every deck up to 3V input on their line sockets and not one overloaded.

Output is always adequate to drive amplifiers, typically ranging from 300mV to 500mV: there are rarely problems here.

The DIN record/play socket is, electrically, an anachronistic curse. It does, however, have the great advantage of requiring one cable with one plug at either end for interconnection to an amplifier. This is a lot easier to use and a lot neater than line cables.

To confuse matters, some decks with DIN sockets, like B&O, now have a DIN socket with line input sensitivity (or DIN standard "voltage fed" sensitivity). This would be amazingly sensible if only amplifiers had a DIN "voltage fed" output socket. Some British models in fact do, and so can be connected directly, using a DIN record/replay lead, to decks like the B&O's.

We also tested microphone inputs for noise, frequency response and input overload. Most worked well, but sensitivities vary widely and so microphones have to be chosen with regard to this parameter.

Aiwa AD-R450

Aiwa UK Ltd, Unit 2, Dukes Estate, Western Avenue, London W3 0SY
Tel 01-993 1672

This machine is Aiwa's least expensive auto-reverse deck, being in effect a simplified *AD-R550*. Although Aiwa have omitted some gadgets, the deck still has fast-auto reverse and the ability to record on reverse.

These attributes allow the *R450* to provide a full 90 minutes uninterrupted recording time from a C90 cassette, in addition to the uninterrupted playing of a complete pre-recorded musicassette. Fast-reverse means that the machine doesn't attempt to play or record a cassette's leader tape — it reverses immediately upon 'seeing' it. Auto-start from an external timer is provided too.

Aiwa put the transport control buttons on a flat ledge at the front of the machine; though attractive, this layout does make the machine virtually unusable on high shelves and it also collects dust. The review sample *AD-R450* also had extremely dim indicator lights and record level meters — so dim they were difficult to see in fact. I suspect this was non-standard or Aiwa will do something about it.

The deck retains automatic tape type sensing — a facility useful to the point of being vital in my opinion. It also has adjustable bias for fine tuning the performance of ferric and chrome tapes so they match properly, but the 'metal' bias setting remains fixed, unfortunately. Tape counter is mechanical and without a zero-stop. Both Dolby B and C noise reduction systems are fitted, but not HX Pro as on the *R550*.

Transport control buttons are large and linked in with logic. They were very easy to use and the machine in general worked smoothly and silently and felt well built.

Lab report

Freedom from reverse azimuth error allowed the *R450* to give full treble output up to 10kHz from a replay test tape, in forward or reverse. Above 10kHz output falls away slowly, as the replay frequency response graph shows. Dolby B replay tracking was correct in both directions too. Pre-recorded musicassettes should not, therefore, sound dull and muffled on this deck, when played in either direction.

Speed was correct in both directions too, but replay-only speed stability deteriorated from very good forward (0.07% wow) to average in reverse (0.12% wow). Much the same effect occurred when recording, the transport exhibiting more low rate wow, primarily at 2Hz and 6Hz, in reverse than when going forward. Generally though, flutter was low, as was modulation noise, and in essence this is a high quality transport.

Low noise and very low hum figures (especially at 100Hz and 150Hz) were measured in the replay amplifiers, enabling musicassettes to be played without interference from this source. Similarly, bias and record amp noise proved low so recordings will not suffer from machine-generated hiss. Chrome tape gave a low −73dB hiss level with Dolby C in action, but Aiwa fix OVU a bit low (−3dB below 200nWb/m)

so chrome recordings made to OVU will have about −70dB hiss with Dolby C, in practice.

Tape overload figures were, surprisingly, almost as good at 10kHz as those for the HX Pro-equipped *R550*. Frequency response for metal tape had rising treble (see graph), an effect emphasised by Dolby. Metals like TDK *MA* and Sony *ES* will sound distinctly bright on this deck.

Bias adjustment was sufficient with ferric and chrome tapes to match the machine to awkward high performance tapes like Maxell *XL-IS* and BASF *CR-M-II*, in addition to all other makes, so tape compatibility is excellent.

Sound quality

Bright tonal balance with metal tape (TDK *MA*) emphasised, as usual, other small problems such as HF distortion and flutter, which combined to produce gritty high level treble. This was judged to be wearing after a while. Speed stability was fine for critical programme.

TDK *SA* gave very neutral tonal balance, with slightly fluffy HF due to saturation. Speed stability was again fine. There was enough bias adjustment range for BASF *CR-MII*; it was preferred for low hiss and excellent speed stability — even for critical organ programme.

Ferric tape (TDK *AD*) gave little distortion and even tonal balance, with well differentiated treble. It was very enjoyable. The auto-reverse system proved extremely fast — less than a crochet beat I am told!

Only slight contamination of high-rate wow was discerned with musicassettes. Otherwise, tonal balance proved even and low level fine detail was retrieved with unusual effectiveness. Imaging was a bit one-dimensional but we still felt the machine made compelling listening.

Summary

The *AD-R450* is a gadget-free auto-reverse deck of excellent basic specification. In addition to its 'fast-reverse' and reverse recording, there are numerous other useful features, such as automatic tape-type sensing, plus fine bias tuning for perfect tape matching with ferrics and chromes — even the most awkward! There is no fine bias adjustment for metals though, which unfortunately didn't match too well on the review machine, sounding very bright.

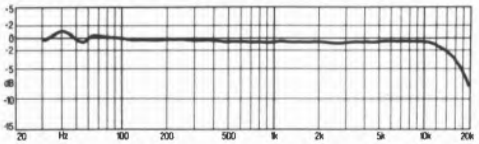
Fidelity with pre-recorded musicassettes was fine in both directions of play. Recordings on ferric and chrome tape reached a high standard too, variable bias being a boon here. We felt this was an excellent machine.

BEST BUY

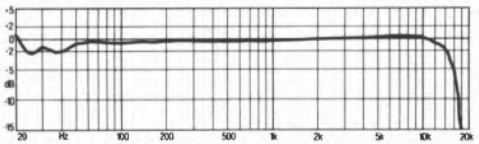
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	24Hz-15.0kHz	very good
Speed accuracy	+0.2%	very good
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-14.0kHz	good
Frequency response, chrome	20Hz-15.0kHz	very good
Frequency response, metal	20Hz-16.0kHz	very good
Stereo separation	−45dB	average
Distortion	0.8%	good
Noise	−53dB	good
Speed variation	0.06%	good
Modulation noise	−40dB	good
Flutter energy (band level)	−35dB	very good
MOL, ferric, 315Hz/10kHz	+3.8dB/−6.0dB	good
MOL, chrome, 315Hz/10kHz	−1.0dB/−7.0dB	poor
MOL, metal, 315Hz/10kHz	+4.2dB/−1.5dB	very poor
Input/output performance		
Line in sensitivity/overload	50mV/>3V	
Mic input sensitivity/overload	—/—	
Output	450mV	
Typical price inc VAT	£160	

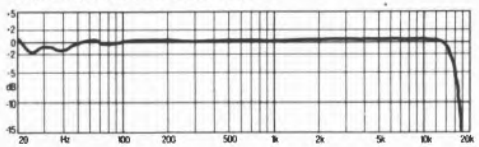
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



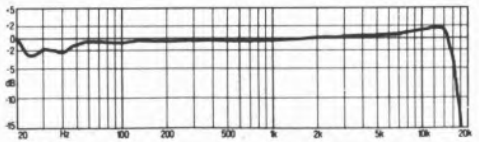
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Aiwa ADR550

Aiwa UK Ltd, Unit 2, Dukes Estate, Western Avenue, London W3 0SY
Tel 01-993 1672

Aiwa's auto-reverse AD-R550 has a black finish and possesses a colourful array of lights, legends and displays. It is distinguished by having Dolby HX-Pro headroom expansion in addition to the more usual Dolby B and C systems. HX-Pro is not a noise reduction system like Dolby B and C; instead it allows high frequencies to be recorded to higher maximum levels on tape, before overload occurs.

Tape types, ferric, chrome and metal, are automatically selected, which is a valuable feature. However, there's no manual over-ride so old metals without sensing slots are incorrectly seen as chrome and cannot be used. A fine tune bias control provides tape matching with ferric and chrome — always a very useful feature. As new tapes appear, the deck can be adjusted to suit them.

Tape position is indicated by a four-digit flourescent tape counter and a music search facility is included. Unfortunately, the tape counter reverts to zero when the machine is turned off and on again. The auto-reverse system can be set to allow once-only or continuous play of one side of the tape followed by the other. This facility also works in record mode.

Record level is adjusted with a horizontal stereo fader with a separate balance control above it. Meters are fluorescent bargraph type of −20dB to 8dB range and reasonable resolution. Tests showed they gave accurate readings of peak levels on transients.

A rear-lit cassette compartment allows the position of the tape to be seen easily. Our only reservation concerning styling was that it is necessary to operate the deck from above because the tape transport controls were situated on the protruding platform. Over a period of time, platforms like this collect dust too, making them unsightly. The deck felt solidly built and operated quietly and smoothly.

Lab report

Aiwa have set peak record level (OVU) to —3dB below Dolby, which is too low for modern tape and peak-read meters. This results in higher tape hiss but low distortion. Our test results bear this out, with hiss around —66dB and average distortion at 0.7%. Other tests showed that the deck is inherently no noisier than usual and that bias has been set sensibly to give balanced maximum output levels at middle and high frequencies. However, Dolby HX-Pro gave less treble improvement on this deck than it did on the AD-F990.

All record sensitivities were 1dB out using IEC Primary Reference Tapes. Ferric and metal settings could usefully have been better in this respect. Dolby affected frequency response

BEST BUY

badly at low levels with IEC-type ferric tapes, producing a curve humped at 300Hz and falling treble and bass either side. Low level musical passages will sound dull as a result. Results were much better with chrome and metal tapes, although slight treble lift will make high level programme a bit bright. In spite of these observations though, all record/replay responses were considered good.

Replay frequency response, Dolby B tracking and speed accuracy were all well set, allowing this deck to give good fidelity with modern pre-recorded cassettes. This is something we considered valuable.

Speed stability in the form of wow was good, but an equivalent level of −21dB (9% distortion) for flutter sidebands suggests audible muddle and was not impressive.

Sound quality

Metal tape gave a neutral tonal balance, apart from 'woofy' bass — probably caused by a sub-sonic peak on this deck. A degree of thinness on saxophone and male voice was audible too. These effects were minor though. There was a sense of pitch 'diffusion' to sustained organ notes, due to low-rate speed variation (drift/wow). Additionally, some roughness due to flutter sidebands, which had an equivalent level of −21dB, was noticed.

Using TDK SA chrome-bias tape, the AD-R550 sounded 'thin and cold'. Treble roughness and splash on sibilants was again detected — probably due to flutter distortion (9%). Diffuse pitch was also evident. Increasing bias usefully resulted in a warmer sound.

Ferric tape again had a 'woofy' bass quality and sounded dull at normal bias. This robbed music of a sense of articulation. Again, decreasing bias improved matters.

Replay quality was bright, detailed and open. Few decks veered in this direction, so we were pleasantly surprised. Tonal balance was a bit artificially forward, but this did result in an excellent sense of attack when playing pre-recorded cassettes. Imagery was good too.

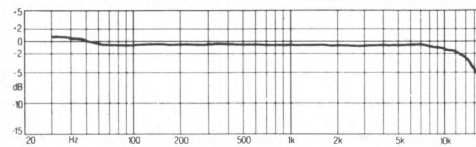
Conclusion

As auto-reverse cassette decks go, the AD-R550 has some substantial strengths. Dolby HX-Pro, variable bias for accurate tape matching and excellent replay performance combined to eclipse the performance of potential competitors.

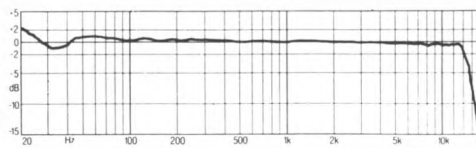
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-12kHz	good
Speed accuracy	+ 0.3%	very good
Record/replay using blank tape		
Frequency response, ferric	20Hz-15kHz	very good
Frequency response, chrome	20Hz-17kHz	very good
Frequency response, metal	20Hz-17kHz	very good
Stereo separation	− 51dB	good
Distortion	0.76%	good
Tape hiss, ferric	− 65dB	poor
Tape hiss, chrome	− 66dB	average
Tape hiss, metal	− 66dB	average
Speed variations (wow and flutter)	0.07%	good
Modulation noise	− 39dB	average
Flutter energy (band level)	− 24dB	average
MOL, ferric, 315Hz/10kHz	+ 4.5dB/ − 10dB	average
MOL, chrome, 315Hz/10kHz	+ 0.5dB/ − 7dB	average
MOL, metal, 315Hz/10kHz	+ 4.5/ − 0.5dB	average
Input/output performance		
Line in sensitivity/overload	50mV/—V	
Mic input sensitivity/overload	0.25mV/32mV	
Output level	380mV	
Typical price inc VAT	£220	

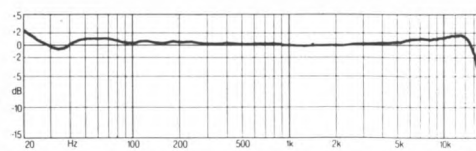
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



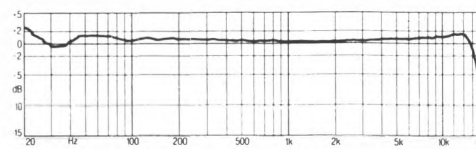
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Aiwa AD-F770

Aiwa UK Ltd, Unit 2, Dukes Estate, Western Avenue, London W3 0SY
Tel 01-993 1672

Although moderately expensive, the *F770* is packed with features, most of which are really useful. There is the inevitable sprinkling of extra facilities such as music search, intro play and the like, but these don't push aside the more worthy assets of a dual capstan transport with full logic control, automatic tape tuning ('DATA' system in Aiwa's terminology), independent record and replay heads (siamesed) for off-tape monitoring whilst recording and Dolby HX Pro.

This is quite a line up; the dual capstan transport reduces flutter to give improved clarity, logic control makes its operation easier, the 'DATA' system ensures perfect compatibility with all blank tapes, off-tape monitoring allows recording quality to be checked whilst the recording is actually being made and Dolby HX Pro gives cleaner, less confused treble.

Though the front panel looks 'busy', it is less so than the *AD-F990* and much of the effect is due to numerous indicators. Use of automatic tape type selection proved central to rendering the *F770* relatively easy and foolproof to use. DATA information is retained in memories (one for each tape type) for roughly 24 hours after power is switched off. Retention is shown by a 'Ready' legend, otherwise re-turning is necessary but this only takes 16 seconds.

Aiwa fit a large, four-digit tape counter with zero-stop and time indication, plus very long record indicators with good range and resolution.

This machine is well built and proved easy to use, the only point worth mentioning being the horizontal front control ledge which is not practicable on high shelves and collects dust.

Lab report

The electronic circuits of this machine curiously have +1dB plateau low frequency boost. The DATA system consistently gives +1dB treble lift with all tapes, resulting in the curious 1kHz dip just visible in the record frequency response graphs. Dolby C emphasised the effect below about −10dB, especially around 300Hz where up to +2dB lift appeared. This will be a just-audible effect.

Otherwise the DATA system, which laudably adjusts bias, record gain and then record equalisation, using a comprehensive set of test tones, produced very consistent results. It has enough adjustment range to compensate for all tapes, including awkward ones like BASF *CR-MII* and Maxell *XL-IS*. Exceptional resolution got record-gain right every time, within a fraction of a dB.

Bias was set a bit high in my opinion, favouring low mid-band/bass distortion (0.4% and 0.2%!) at the expense of treble overload which, in spite of HX Pro, was on the low side — especially for metal tape (−2dB). I suggest the use of high-saturation metals (see tape tests) like TDK *MA* and Sony *ES*, since the *770* will tune them in accurately.

The transport had little flutter and not a lot of wow either. Test tones sounded quite stable, although spectral analysis showed that some audible 'pitch indecision' was due to numerous

low-level wow components clustered around 5Hz.

I was disappointed that Aiwa couldn't ensure a flat replay frequency response; falling treble (–2dB at 12kHz) will make musicassettes sound dulled, Dolby B magnifying the problem. Replay hiss was very low, and replay speed spot-on. At –59dB, hum should have been lower.

Aiwa know how to design a good cassette deck, but on the evidence of this deck are still not setting replay response to IEC standards.

Sound quality

Recordings with Sony *ES* metal (Data tuned) had an 'itchy' high treble, sounding fine and over-busy. Otherwise, an even tonal balance and an excellent sense of clarity made recordings much like the original. Speed stability was excellent, notes having fine steadiness and treble being free of the coarseness which results from flutter.

BASF *CR-MII* had an over-large bass sound due to a small tune error with this tape. Transient edges were slightly softened too. Otherwise, it was metal-like and considered excellent. TDK *SA* was, in comparison, smooth, but in a 'creamy' and opaque sense. It was pleasant, but less revealing than *CR-MII*; bass was lighter though.

Ferric (TDK *AD*) was grainy at high frequencies, a bit smeared and coarse. There was plenty of treble level though, and we felt that *AD* performed well on this deck.

Musicassettes had boomy bass, but plenty of bass impact. Treble was smeared and 'grey'. The *770* was neither sweet nor explicit in this area. Low level detail was largely lost and treble leaden. Imaging was vague by Nakamichi standards, but pitch stability of sustained notes obviously excellent.

Summary

The *AD-F770* is a high performance machine, well built and finished. Although daunting because of its apparently complex front panel, in practice it is easy to use. There are just more indicator lights than usual, to show what the numerous automatic systems are doing.

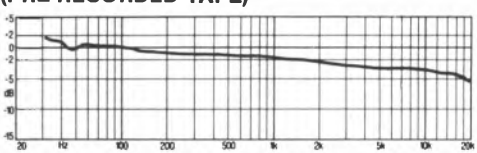
Main features of interest are a dual capstan logic controlled transport, automatic tape type sensing, independent record and replay heads for immediate off-tape monitoring, Dolby B and C and HX Pro.

Recording quality reached a very high standard with all tape types. Replay quality with musicassettes was marred by poor adjustment, resulting in a somewhat bland sound with leaden treble. It is a pity that such a fine deck should be compromised by this important detail.

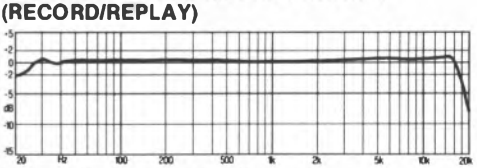
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	25Hz-12.0kHz	good
Speed accuracy	+0.0%	excellent
Noise	–61dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-17.0kHz	very good
Frequency response, chrome	20Hz-18.0kHz	very good
Frequency response, metal	20Hz-18.0kHz	very good
Stereo separation	–46dB	average
Distortion	0.3%	very good
Noise	–55dB	very good
Speed variations	0.06%	good
Modulation noise	–40dB	good
Flutter energy (band level)	–33dB	very good
MOL, ferric, 315Hz/10kHz	+4.0dB/–7.5dB	good
MOL, chrome, 315Hz/10kHz	+0.0dB/–8.0dB	average
MOL, metal, 315Hz/10kHz	+5.0dB/–2.0dB	very poor
Input/output performance		
Line in sensitivity/overload		60mV/>3V
Mic input sensitivity/overload		0.3mV/30mV
Output		360mV
Typical price Inc VAT		£300

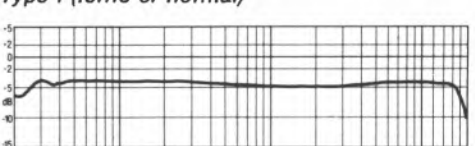
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



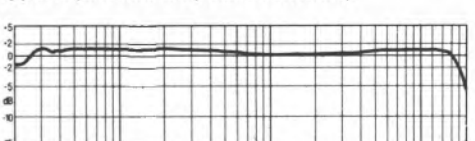
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Aiwa ADF990

Aiwa UK Ltd, Unit 2, Dukes Estate, Western Avenue, London W3 0SY
Tel 01-993 1672

Currently Aiwa's top-of-the-range model, the AD-F990 incorporates Dolby HX-Pro 'headroom expansion' as well as the usual B and C noise reduction systems. HX-Pro allows higher treble recording levels by dynamic variation of bias. In addition to this, the 990 has an automatic tape calibration system that records a short sequence of tones on to tape; the machine monitors these and makes a series of internal adjustments which allow it to give its best results with a wide variety of tape formulations.

Tape selection is automatic, catering for ferric, chrome and metal tape types. The auto tape matching system successfully accepted old metal tapes (without sensing slots) in the chrome position, giving perfect results. The adjustment range of this system is obviously very wide. Dolby selection is also automatic but this can be manually over-ridden.

Tape transport controls are positioned on a dust-collecting platform which protrudes from the bottom edge of the fascia panel. Associated logic allowed 'punch-in' recording from play mode and immediate fast reverse from record mode. Cue/review was also incorporated.

Record level is adjusted automatically but it is also possible to adjust the level manually using an electronically stepped attenuator which clicks (literally!) up, or down, in 2dB steps.

This is a stylish, well-built machine. It has an excellent tape counter which also displays time remaining on tape. Bright blue fluorescent record level meters have good resolution and tests showed that they accurately indicate transients and low and high frequency signals. The multiplicity of buttons and lights were a bit confusing at times, but Aiwa seem to have forgotten nothing on this flagship product.

Lab report

Replay frequency response, Dolby B tracking head height and speed were all accurately set, guaranteeing good fidelity with pre-recorded cassettes.

Speed stability was excellent in all areas, except for the presence of 5Hz wow sidebands at −19dB. The ear/brain is very sensitive to wow at this frequency and it is the sort of thing that is audible on organ and piano in particular. Otherwise, little energy was lost into flutter, equivalent level measuring −31dB, or 3% distortion. This is far lower than most decks and results in improved clarity by reducing mush. Conventional distortion was otherwise extremely low at all frequencies, with an average value of just 0.6%.

Peak record level (OVU) has been set −3dB below Dolby flux, even though the meters accurately peak read. Our noise figures, being relative to OVU, are therefore poor. Aiwa put advisory peak level legends on the record display though and if these are followod, noise levels will be no different from those of other good decks.

Due to DATA tape tuning and Dolby HX-Pro,

maximum output level values in the mid-band and at high frequencies were very high. For example, the IEC I (ferric) Primary Reference Tape had +4dB extra treble headroom than is usual, with no loss in mid-band headroom. Record/replay frequency responses were extremely flat with all tape types, as the graphs show. Identical results were obtained with either Dolby B or C switched in, which is a very impressive result.

The AD-F990 had an exemplary measured performance, except for 5Hz wow with a sideband level of −19dB. This was one niggling blemish.

Sound quality

On high level programme without sustained piano notes, it was difficult to tell the difference between the AD-F990 and Compact Disc, when using metal tape (TDK MA). The sound was generally clean and open, with excellent tonal balance. Some harshness, due to flutter sidebands, was occasionally detected. Sustained piano notes were heard to wobble too, due to 5Hz wow. In spite of these effects though, we had to be impressed by reproduction from this machine.

Type II 'chrome' tapes also gave good results, but sounded 'softer' than metal and treble compression was occasionally detected as softening 'top'. The sound was a bit less hard than that of metal and was liked.

Ferric tape sounded a bit brittle, like metal, and noise was higher, but performance was still excellent.

Replay quality with pre-recorded cassettes was excellent, but again we noticed the 'jelly-like' quality to pitch that slow-rate wow produces. Otherwise, there was good imagery, plenty of attack on transients and even tonal balance. No degradation occured at low levels with Dolby B engaged.

Finally, a faint rumble was heard, which analysis defined as 1f energy around 20Hz. This should rarely be annoying, but is strange for a cassette deck.

Conclusion

The AD-F990 gave impressive sound quality for the cassette medium, with all tape types and with pre-recorded musicassettes. It is an impressive deck. But though the '990 benefits from its dual capstan drive, Aiwa could further hone the speed stability performance to keep this deck up with the leaders.

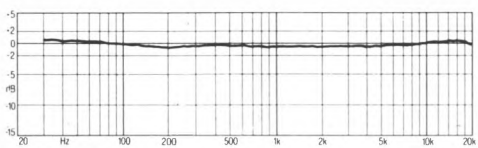
BEST BUY

TEST RESULTS

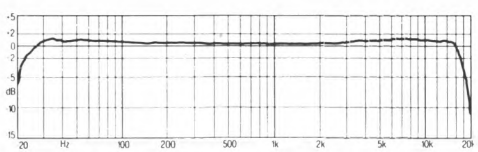
Replay of pre-recorded musicassettes		
Frequency response	20Hz-20kHz	very good
Speed accuracy	0.15%	very good
Record/replay using blank tapes		
Frequency response, ferric	22Hz-18kHz	very good
Frequency response, chrome	21Hz-18kHz	very good
Frequency response, metal	25Hz-16kHz	very good
Stereo separation	−52dB	good
Distortion	0.6%	good
Tape hiss, ferric	−65dB	poor
Tape hiss, chrome	−69dB	good
Tape hiss, metal	−66dB	average
Speed variations (wow and flutter)	0.1%	good
Modulation noise	−41dB	good
Flutter energy (band level)	−34dB	very good
MOL, ferric, 315Hz/10kHz	+4dB/−6dB	very good
MOL, chrome, 315Hz/10kHz	+1dB/−6dB	good
MOL, metal, 315Hz/10kHz	+4.4/−1dB	good
Input/output performance		
Line in sensitivity/overload	52mV/—V	
Mic input sensitivity/overload	1mV/65mV	
Output level	330mV	

Typical price inc VAT £350

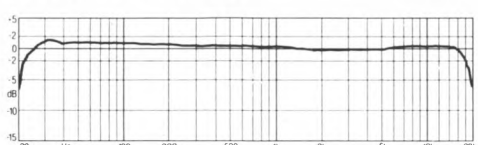
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



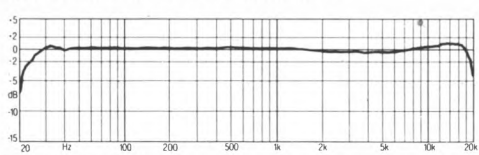
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Akai HX-A201

Akai (UK) Ltd, Unit 12, Haslemere Heathrow Estate, Silver Jubilee Way, Hounslow, Middlesex
Tel 01-897 6388

This new budget deck from Akai has Dolby C noise reduction, but not the logic controlled transport of the *'A3*, nor its attractive blue fluorescent displays. Instead, the transport buttons are mechanically interlinked, enabling fast reverse to be selected from fast forward for example. However, more awkward changes, like fast reverse from recording mode are not possible and, as on most mechanical systems, the buttons were a bit stiff and clanky. They were poorly identified too, having symbols impressed directly into the grey plastic surface without any distinguishing colour.

Simple record level meters have three green and two red LEDs on each channel to cover a recording range of −15dB to +3dB. Because of adjustment, the maximum +3dB LED was in fact about equivalent to +6dB on most machines, which is needed to show the upper recording limit for metal tapes.

Tape type selection is manual, while the counter is an unlit mechanical type without a zero stop function. Akai do fit a headphone socket though, plus twin microphone inputs. Auto-start from an external timer is also possible.

Lab report

Head azimuth of the review sample had been perfectly set, which is rare at these price levels. As a result of this — and absolutely correct replay equalisation in the machine's electrical circuits — replay frequency response was virtually ruler-flat from 100Hz right up to 18kHz!

Akai's most expensive machines, tested in the last issue of *Hi-Fi Choice: Cassette Decks* couldn't manage this, so it was a pleasant surprise. Previously only Nakamichi could be relied upon for this sort of performance. Some bass boost occurs below 100Hz.

The replay amplifiers were very quiet and relatively hum-free. Head height had been set accurately enough for good track alignment, resulting in low crosstalk.

Speed accuracy was adequate and replay speed stability respectable at the price. Regular but slight speed warble was obvious and this was shown by spectral analysis to be due to capstan eccentricity (7Hz). Flutter was also seen, but both were relatively low.

Record/replay speed stability, where transport defects become additive (record plus replay) amplified the capstan wow phenomena a little and brought up flutter to a band spectral analysis level of −28dB, which is still fairly respectable for a budget single-capstan unit.

The head suffered no more distortion than usual (1.2% overall) with the high bias and signal levels required for metal tape and record bias noise was low. Dolby C didn't quite manage −20dB of noise reduction, so record bias noise was sub-optimal by +2dB at −71dB, with chrome (BASF *CR-EII*) tape. This is a small and acceptable degradation though. Basically, the *HX-A201* does give low noise with quiet tapes.

Tape overload figures (MOL's/SAT's) showed well-set bias and reasonable head performance

again. Chrome sensitivity was set (−2.2dB) for Japanese pseudo-chrome tapes such as Sony *UCX*, and record equalisation was set for them too. Such tapes should be used for best results with Dolby operative. Frequency response was flat for commonly available ferric and metal tapes, and so was sensitivity. As a result, Dolby tracking proved perfect.

The Akai *HX-A201* measured unusually well in all areas — I really could not fault it at the price.

Sound quality

Strong, deep bass gave musicassette reproduction a feeling of dimension or weight not common to the medium. There was obvious treble extension and a fine sense of detailing with good recordings. Loss of precision and depth was noted — but only against a Nakamichi *Dragon*! Low level musical passages were not dulled appreciably. Slight hum was noticed.

With Sony *ES* the *HX-A201* gave first class recordings, reasonably free of wiriness and other vices. Slight pitch corruption was detected with violin and piano on occasion, introducing a 'broken' sound, as is to be expected with budget machines. There was the usual small loss of clarity too. Otherwise, the sound was beyond serious criticism in all respects. Hum was again evident.

Chrome tape (Sony *UCX*) gave a softer, more rounded presentation than metal, with suppressed treble and some obvious coarseness of pitch. It has a slightly wiry quality.

As usual, ferric tape (TDK *AD*) sounded similarly muted and vague in its upper registers but on balance it gave very respectable results in this Akai.

Summary

The *HX-A201* is a budget deck with an absolute minimum of frills, although retaining Dolby C noise reduction. It has a fairly attractive appearance, free from the gaudy 'lights and legends' look so common on budget products.

Measured performance of this deck was exemplary in all areas and proved quite beyond what is normally expected at the price. It was capable of getting the best out of pre-recorded musicassettes, lacking the usual dull, muddled and imprecise sound common to budget decks.

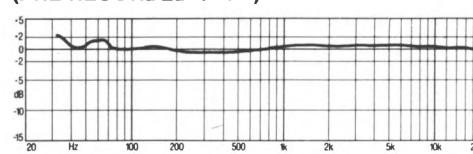
Similarly, recordings reached a very good standard with ferric, chrome and metal tapes. If Akai can maintain this performance in production, the *HX-A201* will be an almost unbeatable bargain for those with a strictly limited budget.

BEST BUY

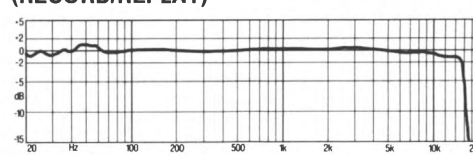
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	32Hz-20.0kHz	very good
Speed accuracy	+0.7%	good
Noise	−59dB	average
Record/replay using blank tape		
Frequency response, ferric	20Hz-16.0kHz	very good
Frequency response, chrome	20Hz-15.0kHz	very good
Frequency response, metal	20Hz-15.0kHz	very good
Stereo separation	−51dB	good
Distortion	1.2%	average
Noise	−53dB	good
Speed variation	0.10%	good
Modulation noise	−38dB	average
Flutter energy (band level)	−28dB	good
MOL, ferric, 315Hz/10kHz	+3.0dB/−7.0dB	good
MOL, chrome, 315Hz/10kHz	−1.5dB/−7.0dB	very poor
MOL, metal, 315Hz/10kHz	+2.0dB/+0.0dB	poor
Input/output performance		
Line in sensitivity/overload	80mV/>3V	
Mic input sensitivity/overload	0.3mV/30mV	
Output	420mV	
Typical price inc VAT	£110	

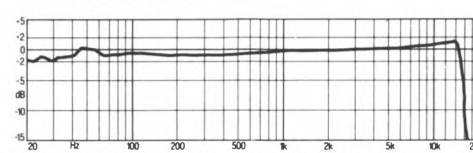
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



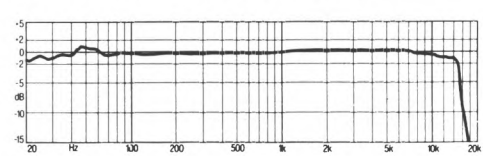
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Akai HX-A3X

Akai (UK) Ltd, Unit 12, Haslemere Heathrow Estate, Silver Jubilee Way, Hounslow, Middlesex
Tel 01-897 6388

Tested in its first set of clothes last year, Akai's *HX-3* model has since been visually updated as the *HX-A3*, and is now supplemented by the dbx-equipped *HX-A3X* tested here. The *HX-A3X* still has Dolby B and C noise reduction as well, of course. The dbx system does give more noise reduction than Dolby C plus overload prevention, but this is achieved at the expense of sometimes being audible in operation. It modulates noise, producing swishing effects.

The *HX-A3X* can also be used as a decoder to replay dbx-encoded discs — but really this is a useless ability in the UK, where dbx discs hardly exist.

The deck keeps many of the features that originally made the *HX-3* popular, such as automatic tape-type selection with excellent confirmation via bright, easily-read legends on a blue fluorescent display. This display also shows clearly which noise reduction system is in use, and incorporates the record level meters, plus bright, four-digit tape counter.

Gone are such conveniences as a zero-stop memory, but the excellent logic controlled transport remains. It accepts all commands, including 'punch-in' record.

Lab report

Like previous *A3*s I have tested, this one had substantially falling treble output (−3dB at 10kHz) in its replay response, a problem accentuated by the Dolby mistracking it introduces. The transport ran +2% fast and track alignment was poor, introducing crosstalk with musicassettes. Replay hiss and hum were, however, very low. Replay speed stability proved adequate. It seemed strange, though, that the *HX-A3X* replay frequency response should compare so poorly with the *HX-A201* in its measured replay performance (which affects musicassette quality).

Bias had been set with some emphasis in favour of low midband distortion at the expense of early treble overload with all three tape types. This makes the use of metal tape more crucial to obtain clean, well differentiated treble. Midband overload values were relatively high with all tape types.

Frequency response with ferric and metal tapes measured flat (see graphs), but the rising characteristic of chrome will cause brightness. Again, the machine appears to have been adjusted to suit the US and Japanese markets, rather than European IEC requirements (even though these are officially world standards ratified by Japan). Sony *UCX* tape is therefore best used in these circumstances.

Speed stability on recordings was fair, in that irregular wow and flutter components were well suppressed. However, there was the common warble, in this instance a slow one, of an eccentric capstan. Spectral analysis showed the problem occurred at 5Hz.

Separation and distortion figures were low, as was bias noise (hiss) and noise from the record amps. The machine allows the full benefit of low noise tapes to be realised, giving −74dB noise

with Dolby C and −78dB with dbx.

Dolby and dbx tracking were good, but the latter introduced a permanent +2dB treble peak at 14kHz on low level signals, plus steep bass roll-off below 50Hz at all levels. Overall, measured recording performance of the *HX-A3X* was respectable, but musicassettes (play-only) performance was poor.

Sound quality

With *IEC*-type metal tapes, such as Memorex *Metal IV*, with Dolby C, we noted a pleasant tonal balance — actually due to a recessed midband. The mid-lift given by the TDK *MA* corrected this, improving 'presence'.

Rising treble with TDK *SA*, emphasised by Dolby C, didn't sound very pleasant and brought out some grittiness. The deck was particularly poorly matched to chrome — and this was audible.

Ferric tape (TDK *AD*) gave slurred transients and when using dbx, we were aware of the unnatural 'pumping' sound with instruments like piano. This is our objection to dbx. Using Dolby C, ferric tape gave respectable results, all the same.

Lack of attack and a muffled sound affected musicassettes, but there was little trace of speed instability, even with critical programme. The slow wow noted in lab tests proved difficult to detect in practice. However, the speed error was audible as raised pitch. Separation was poor, but stereo images had depth and stability.

Summary

The *HX-A3X* is a supplementary guise for a budget cassette deck that has been very popular for some years now. In this form it has dbx tape and disc noise reduction systems, in addition to the Dolby B and C available on the *HX-A3*. dbx discs are not available in Europe, so this option is useless.

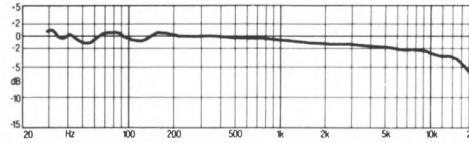
There's little point in adding dbx to Dolby C because it introduces 'pumping' effects, whilst the noise improvement is barely discernible and of little subjective consequence. So, although the *A3X* has another noise reduction system it is no better off for it.

Fidelity with pre-recorded musicassettes was rather poor, we felt. The deck sounded disappointingly dull and music ran too fast! Recordings on metal and ferric tape reached a very acceptable sound quality level. Chrome sounded bright and unpleasant. This is a good deck in many respects, but we felt that the *HX-A3* without dbx is better value and would be a Best Buy.

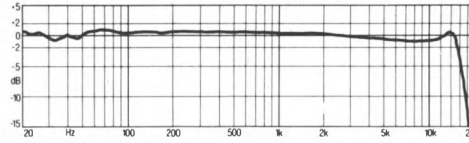
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	25Hz-9.0kHz	average
Speed accuracy	+2.0%	very poor
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-16.0kHz	very good
Frequency response, chrome	20Hz-15.0kHz	very good
Frequency response, metal	20Hz-17.0kHz	very good
Stereo separation	−52dB	good
Distortion	1.0%	good
Noise	−55dB	very good
Speed variation	0.12%	average
Modulation noise	−39dB	average
Flutter energy (band level)	−30dB	very good
MOL, ferric, 315Hz/10kHz	+4.5dB/−8.0dB	good
MOL, chrome, 315Hz/10kHz	+1.0dB/−9.0dB	average
MOL, metal, 315Hz/10kHz	+5.0dB/−2.0dB	very poor
Input/output performance		
Line in sensitivity/overload	110mV/>3V	
Mic input sensitivity/overload	0.4mV/45mV	
Output	500mV	
Typical price inc VAT	£140	

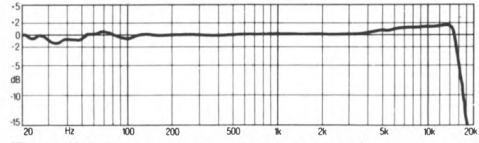
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



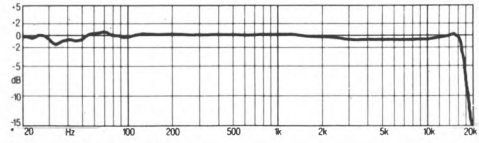
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Akai GX-R66

Akai (UK) Ltd, Unit 12, Hastemere Heathrow Estate, Silver Jubilee Way, Hounslow, Middlesex
Tel 01-897 6388

In addition to Dolby B and C noise reduction. Akai's GX-R66 incorporates dBx. This system offers a higher performance specification than Dolby, although it works on a similar compressing/expanding (companding) principle. High level signals that could overload tape are compressed down too, a feature that Dolby lacks, except at high frequencies on the C system. Because of its greater upward and downward compression range on incoming signals, dBx offers at least 30dB of noise reduction and Akai claim 115dB dynamic range for the GX-R66. This is where all the silliness associated with dBx starts to creep in!

A dynamic range of 115dB is useless. The best current source is Compact Disc and it manages (only in theory) a 90dB dynamic range. Akai's 115dB figure is therefore just misleading specsmanship, concocted to entice purchasers, as this sort of range has no practical use. Our approach to dBx is this; do the benefits of its excessive companding action outweigh any disadvantages in degraded sound quality. We use both listening tests and measurements to assess this.

Apart from dbx, the GX-R66 is much like the now discontinued HX-R44, which had the same fast-reverse transport, with excellent logic and ligh-touch controls. But additionally the GX-R66 has a twin-gap glass ferrite head which is guaranteed for ten years to the original purchaser, plus an mpx filter and random play system that relies upon gap detection between recordings. Finished in satin black, the GX-R66 looks neat, was easy to use and felt well built.

Lab report

On test, the recording performance of this deck was worse than the budget HX-3. Ferric tape had falling treble and will sound dull (like the HX-R44). Slight differences between the IEC II chrome Primary Reference Tape and European (IEC normalised) TDK SA were enough to give very different frequency responses on this GX-R66, which is unusual. TDK SA gives seriously rising treble and will sound bright. IEC II chrome and, therefore, BASF Chrom II, give a perfectly flat response and are compatible. Metal tape gives the common rising treble characteristic which, being emphasised by Dolby, ensures a bright sound. By the standards of their own cheaper decks, Akai have not managed too well here. We did note, by the way, that dBx now does not magnify response errors any more than Dolby C, which is one major weakness cured in this system.

Bias had been set a bit more sensibly than on the HX-R44, but treble saturation was still worse on chrome than ferric, which is a nonsense. Surprisingly, even with OVU below Dolby flux and bias set high, mid-band distortion was two or three times higher than usual, measuring 1.7%. I suspect the ferrite head here. Low frequency and high frequency distortion were high too (4% and 1.7%), resulting in a poor overall figure of 2.4%.

Recording to OVU gave a noise figure of −77dB with dBx, hiss being from electronic circuits outside the dBx loop. Because dBx has peak compression, record levels well above OVU can be used and a best result of −83dB of hiss was possible. However, dBx can still be heard to noise-pump with piano, whereas Dolby C cannot, so quality degrades a bit.

The transport mechanism was not very speed stable for an expensive product. It suffered speed 'jerks', just like the GX-R99, and these took flutter to 0.5%, which is excessive. Flutter sidebands were high, having an equivalent level of −20dB, i.e. 10% flutter distortion. There was wow too, with strong 3Hz and 4Hz variation rate components. Wow destabilises pitch and flutter adds grittiness to the sound.

A large 1% speed change occurred, between forward and reverse, which may upset some listeners. Fast auto-reverse highlights such errors.

Replay frequency response fell away slowly at high frequencies — an effect magnified by Dolby B action. The problem was minor though.

Sound quality

A 'thin' tonal balance was heard with metal tape, but high definition and good attack too. Wow produced a rapid burbling on piano and organ. With dBx in action fidelity was little impaired until certain critical programme — mainly solo piano — came along. Then its noise swishing was very obvious and 'accompanied' the piano notes like another musical instrument.

Pseudo-chrome tapes like TDK SA sounded bright and so appeared to give plenty of treble, disguising early saturation. BASF Chrom II gave an even sound and was most appropriate, we found.

Ferric tape sounded dull and lifeless. Its performance was poor and not liked.

Pre-recorded cassettes sounded clean and bright. A firm quality with good imaging was noticed, but so was fast speed +0.8% in error when cassette was compared with its equivalent Compact Disc. Speed jerks were heard too.

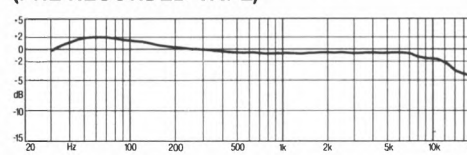
Conclusion

This deck put up a fair performance in most areas, but did nothing really well. It failed to impress us, considering its apparent market niche where high quality is expected.

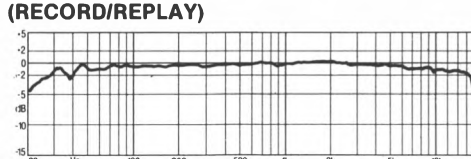
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	22Hz-12kHz	good
Speed accuracy	+0.8%	good
Record/replay using blank tape		
Frequency response, ferric	40Hz-14kHz	good
Frequency response, chrome	40Hz-10kHz	good
Frequency response, metal	25Hz-20kHz	very good
Stereo separation	−52dB	good
Distortion	2.4%	poor
Tape hiss, ferric	−68dB	good
Tape hiss, chrome	−72dB	very good
Tape hiss, metal	−70dB	very good
Speed variations (wow and flutter)	0.15%	poor
Modulation noise	−37dB	poor
Flutter energy (band level)	−23dB	average
MOL, ferric, 315Hz/10kHz	+4.2dB/−7dB	good
MOL, chrome, 315Hz/10kHz	+1.8dB/−8dB	good
MOL, metal, 315Hz/10kHz	+3.5/−1dB	poor
Input/output performance		
Line in sensitivity/overload	116mV/—V	
Mic input sensitivity/overload	0.4mV/19mV	
Output level	600mV	
Typical price inc VAT	£270	

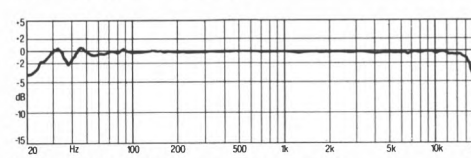
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



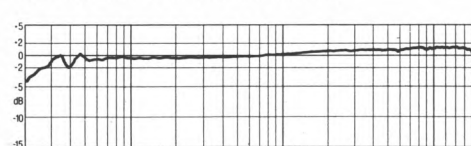
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

B&O 5000

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

B&O have their own ideas about everything, with results both good and bad. They are capable of both innovation and (in our view) silliness. The dictates of styling and so-called 'logic' on this deck seem to have made it awkward to operate — like a lot of B&O equipment in my experience.

Incredibly, the whole body of the 5000 slides forward out of the cabinet under power when part of the fascia plate is pressed. Only play and stop modes can be operated without the 'drawer' open.

Another nuisance was lack of status warning for the Dolby system (Dolby B and C are fitted) and for the auto-tape select system. If a metal tape without sensing slots, like JVC ME, is used it is seen as chrome.

Good points were a sensible tape position marker and auto-return system, a large illuminated tape counter and inclusion of Dolby HX-Pro. B&O were partially responsible for development of this system. It reduces bias when high level treble signals occur, resulting in much higher maximum treble recording levels.

Connection is via a five pin DIN plug on a flying lead. This has normal line input sensitivity/impedance, so can be connected via a DIN-phono to phono sockets.

Lab report

B&O are very consistent in their ability to comprehend and adhere closely to European (IEC) standards. This is a great strength and proved to be the making of this deck.

It meets the IEC replay response within 1dB from 60Hz up to 18kHz. However, a – 1dB dip unfortunately positioned right in the Dolby B operating range of 2kHz-10kHz was emphasised by Dolby too, at low levels. This effect results in dulled treble with low level signals from pre-recorded cassettes. Replay speed was sufficiently accurate.

The handbook states that the deck has been adjusted to be compatible with IEC Reference Tapes. B&O now recommend TDK MA metal, TDK SA pseudo-chrome and BASF LH-1 ferric, all of which are close to IEC Primary Reference Tapes.

We had trouble getting correlation between subjective tonal balance and measured frequency response with this deck. Listening tests initially contradicted swept response graphs. Ultimately, red noise (sloped pink noise) analysis showed a slight downward trend up to 10kHz with IEC IV, and then treble lift up to 20kHz. IEC II chrome was flat and so was IEC I ferric. The graphs show this fairly well. Rising treble with IEC IV is not a good idea, as we were to find out. Otherwise, these results were good.

Although the tape transport didn't look, feel or sound (it clanked) very sophisticated, measurement showed flutter sidebands were well suppressed. Analysis showed many wow components, but at a fairly low level.

RECOMMENDED

Modulation noise with TDK SA was high at −36dB. Better than −40dB is possible with this tape.

Dolby HX-Pro resulted in amazingly high measured tape overload levels (that is, MOL). Our IEC I Primary Reference Tape (ferric) gave metal performance, chrome was almost as good and metal tape was +4dB better than usual in treble saturation headroom!

Maximum record level (OVU) is set to Dolby flux, giving −70dB tape hiss with TDK SA. The meters read after record equalisation, helping to compensate for music with a strong treble content. Distortion levels were reasonably low, resulting in an overall average value of 1.1%.

Sound quality

Maxell MX metal tape sounded very smooth in the 5000, though new MA sounded brighter. Bass sounded dry. Clarity was excellent, as was differentiation of fine treble information. Pitch stability was unusually good, except for the occasional sudden waver in a note.

What did surprise us was the audibility of modulation noise on this machine. Individual piano notes were accompanied by a 'pssss', which had a phantom-like quality to it — was always in the background, unlike the swishing of dBx, which is much more obvious.

Chrome tape (TDK SA) had some bass emphasis, heard as a 'whoomph', and it had a dull quality that, for example, removed sibilance from speech. There was some fluffiness and loss of clarity around vocals, compared with metal.

Ferric tape also sounded fluffy or woolly around vocals, but had exceptional differentiation of fine treble information. Large, ponderous bass was again noted. The performance was very good though.

Replay quality of Dolby B pre-recorded tapes was 'soft' at low levels, lacking bite or attack, but not perceived treble. It was better at high levels, but still a bit ill defined compared with our ZX-9 reference. Imaging was satisfactory.

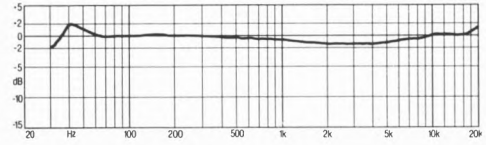
Conclusion

The 5000 was quirky to use and not without its frustrations. It offers good recording quality with modern tapes. Fidelity with pre-recorded cassettes reached a high standard too. A good machine, compromised by the dictates of B&O styling, the 5000 can be recommended.

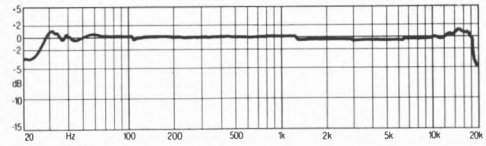
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	40Hz-20kHz	very good
Speed accuracy	−0.4%	very good
Record/replay using blank tape		
Frequency response, ferric	20Hz-18kHz	very good
Frequency response, chrome	20Hz-5kHz	see text
Frequency response, metal	20Hz-5kHz	see text
Stereo separation	−52dB	good
Distortion	1.1%	average
Tape hiss, ferric	−68dB	good
Tape hiss, chrome	−70dB	very good
Tape hiss, metal	−69dB	good
Speed variations (wow and flutter)	0.05%	very good
Modulation noise	−36dB	poor
Flutter energy (band level)	−28dB	good
MOL, ferric, 315Hz/10kHz	+5.6dB/−2.7dB	very good
MOL, chrome, 315Hz/10kHz	+2.6dB/−3.6dB	very good
MOL, metal, 315Hz/10kHz	+3/+3.4dB	very good
Input/output performance		
Line in sensitivity/overload	65mV/—V	
Mic input sensitivity/overload	0.13mV/30mV	
Output level	520mV	
Typical price inc VAT	£370	

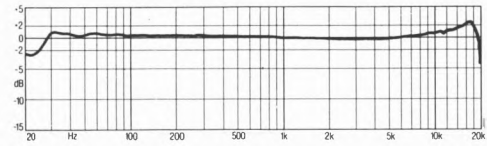
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



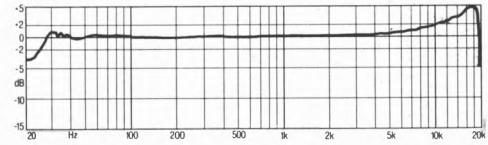
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



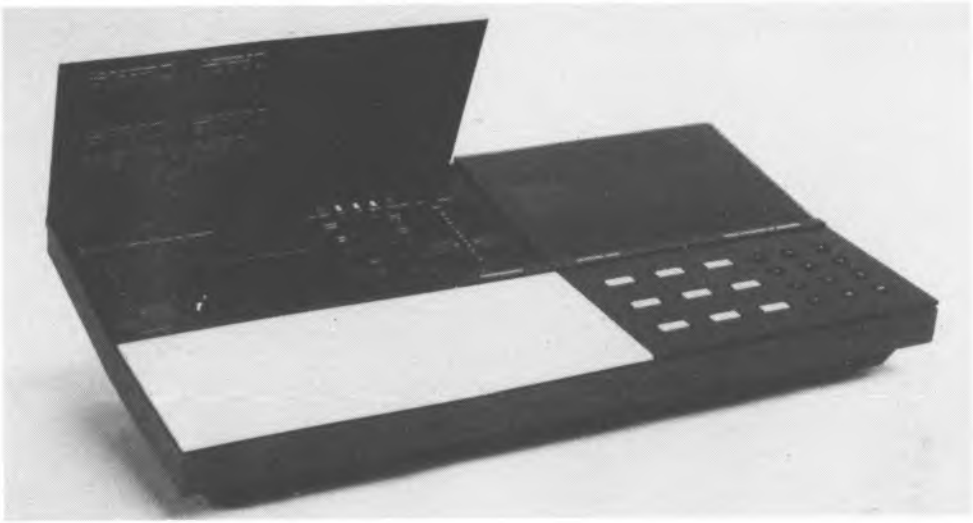
Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

B&O 9000

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



Like other B&O products the Beocord 9000 has received a good deal of attention in view of its styling and unusual features. Press a bar marked 'eject', sited between two blank aluminium panels and the rear one magically swings upward to reveal the cassette compartment. An array of minor facilities, like Dolby B and C, tape and timer functions beside the compartment are also revealed.

Transport control buttons are on the right hand side of the deck, next to a calculator type keypad. The 9000's tape counter reads time, after a frustratingly long calibration period of 1.5 minutes. The keypad allows wanted programme position to be entered in terms of time, whereupon the deck will fast wind to that point. Various other search features are available too. Logic rejects punch-in recording, but allows rewind direct from record mode.

Dolby HX-Pro is fitted; it allows higher treble levels to be recorded onto tape (see technical introduction). Dolby B and C noise reduction are also included, selection being made by a three way switch (Dolby out, B and C). We feel this system is preferable to the two mutually-dependent buttons which are recommended by Dolby laboratories.

Tape selection is automatic but this can be over-ridden to accept ferrichromes and metal tape without sensing slots. Automatic tape tuning is also fitted.

Record level meters read the input signal after record equalisation (the signal that is actually going onto tape). This gives accurate indication of treble levels.

Lab report

Sadly the IEC replay response was not as good on this machine as on the Beocord 5000. It is flat within 1dB only as far as 2kHz, after which there is shelf loss of treble. This effect will be exaggerated by Dolby action and a dull sound is all that can be expected from musicassettes. Replay speed was accurate.

Broadband noise was used to measure record-reply frequency responses, in addition to the swept tone responses, to ensure accurate results in the face of HX Pro. Generally, the tuning system ensured a flat response to 20kHz, as the published graphs show. Sometimes tuning error occured, resulting in excessive treble lift or fall. Re-tuning was then necessary.

A small amount of extreme treble lift was investigated with wideband red noise (flat to 40kHz). The peak reached around +3dB at 25kHz with all tape types and probably contributed to coarseness heard in listening tests. These peaks were exaggerated by Dolby action.

Factory bias and sensitivity were well set for ferric and chrome tapes. Metal tape was under biased and there was a sensitivity error of 3dB. The tape tuning system worked well in

correcting this and, after calibration, 315Hz maximum output levels and 10kHz saturations were well set.

Speed stability measured quite well and band level flutter energy was low. However spectral analysis revealed wow components at 1.1Hz, 2.2Hz, 3.3Hz and capstan wow at 6Hz. Measured flutter deviation was not low for an expensive deck, measuring 0.2%. This is the most expensive single-capstan recorder we tested, and possibly the most expensive one available.

B&O have set OVU at Dolby flux level and this, plus falling treble in the relay response, helped toward a very low noise level of −74dB with TDK SA tape. On the other hand the overall average distortion figure was high at 2.3% and this could account for a gritty, harsh tonal character that was noticed during listening tests.

Sound quality

Initially we found the B&O 9000 gave disappointing results with all tape types. Consistently, the music was accompanied by a low-level distortion with a gritty, blasting character that was unpleasant and wearing. This effect was probably due to a combination of speed instability, distortion and the presence of a degree of extreme-treble lift. We found the use of BASF tapes with special mechanics helped slightly.

Using metal tape, tonal balance was neutral in the midrange, but some coarseness in the sound was noticed. Wow was heard as a slight warble but this was not serious.

TDK SA gave a neutral tonal balance but, again, there was a papery, lifeless sound. BASF Chromdioxid II gave better results all round. The sound was cleaner and reached a high standard.

Distortion was heard with ferric tape, but tonal balance was subjectively even.

Musicassettes reproduction suffered from the falling replay response; it sounded dull and had muted detail. Stereo imaging was stable and well defined.

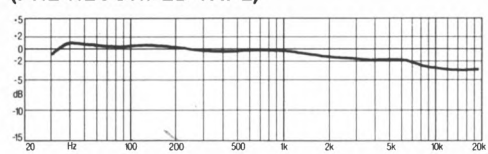
Conclusion

We were somewhat disappointed by the performance of the Beocord 9000. Sound quality using BASF Chromdioxid II was good but, in general, results were thought mediocre. Considering its high price it offers poor value for money.

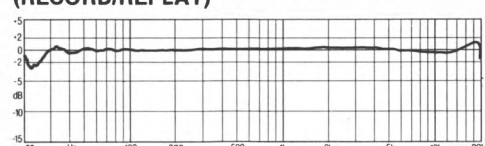
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-7kHz	average
Speed accuracy	0%	excellent
Record/replay using blank tape		
Frequency response, ferric	30Hz-3kHz	see text
Frequency response, chrome	30Hz-3kHz	see text
Frequency response, metal	30Hz-3kHz	see text
Stereo separation	−52dB	good
Distortion	2.3%	average
Tape hiss, ferric	−66dB	good
Tape hiss, chrome	−74dB	very good
Tape hiss, metal	−72dB	very good
Speed variations (wow and flutter)	0.05%	very good
Modulation noise	−38dB	good
Flutter energy (band level)	−27dB	good
MOL, ferric, 315Hz/10kHz	+4dB/−5.5dB	very good
MOL, chrome, 315Hz/10kHz	+1.2dB/−7.0dB	good
MOL, metal, 315Hz/10kHz	+3.4/+0.5dB	average
Input/output performance		
Line in sensitivity/overload	44mV/—V	
Mic input sensitivity/overload	0.2mV/100mV	
Output level	800mV	
Typical price inc VAT	£735	

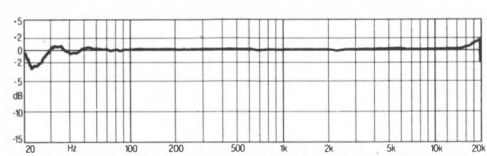
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



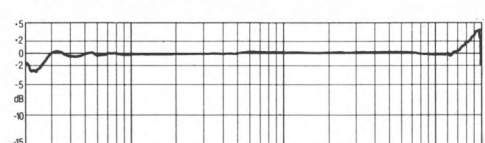
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Denon DR-M22

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

This deck I felt was very like a Nakamichi in design philosophy. None of the gadgets or multiple music search systems that currently adorn nearly all Japanese decks — instead, certain key features that provide better sound quality, most notably closed-loop, dual capstan drive, user-adjustable bias and three heads (like the Nakamichi BX-300). The DR-M22 also resembles a Nakamichi in having a satin-black fascia too and no microphone inputs.

Denon have very usefully incorporated automatic tape selection, but without any over-ride to accommodate old metal tapes without sensing slots. This simply means they cannot be recorded properly, but they can be replayed. The transport buttons are very neatly laid out in a horizontal row and clearly identified with big symbols. Full logic allows the transport to punch-in record and to rewind straight from play mode. It worked quickly and smoothly when changing mode like this.

Double-Dolby B and C noise reduction has been fitted, plus a bright fluorescent tape counter with allied zero stop memory and bright, fluorescent record level indicators. The latter read music peaks accurately and have OVU set to Dolby flux level — a good position. Double-Dolby is needed with three-head decks so that the off-tape monitor signal can be decoded whilst another Dolby section is encoding the record signal.

The DR-M22 was easy and satisfying to use. It is a rarity amongst Japanese decks, being clearly designed to sound good rather than look good.

Lab report

Replay frequency response, shown in the graph, had slowly but steadily falling treble, which can marginally detract from the perceived attack and definition in music from pre-recorded cassettes. The fall at 10kHz was – 2.5dB. Replay speed was fast at + 1.2%, an amount that is just noticeable when a cassette has previously been played at the right speed.

Closed loop, dual capstan drive wasn't quite as effective on this machine as it was on Pioneer's CT-A9 or the expensive Nakamichi's, but it did still eliminate sharp flutter peaks, as it should. Denon DXM metal tape introduced its own flutter, measuring – 23dB on the DR-M22 which is poor, but TDK SA took the figure down to – 30dB band level, which is relatively good. BASF Chrom IIS would have been even better. Some wow was measurable too but, on the whole, Denon's transport was superior to the

BEST BUY

usual standard expected.

Bias had been set to give conventional overload ceilings in the centre position of the control. Increasing bias gave rather poor treble saturation figures with ferric and chrome of −12dB or worse. As usual, there was little change in metal performance, because of its insensitivity to bias changes.

Record/replay frequency responses were very flat with IEC Primary Reference tapes, bias being set at its centre detent position. Bias change had virtually no effect upon metal tape frequency response, but because metal tapes are all much alike in frequency dependent sensitivity, this doesn't matter much. All Denon tapes gave wide, flat responses, like those shown here, using just fine bias adjustment.

BASF Chrom IIS needed full bias, whereupon treble rose above 10kHz to +2dB at 20kHz. This will reduce its treble saturation ceiling to some extent, because centre-position bias gave IEC tape MOL's where treble saturation is fairly low to start with.

Sound quality

Using Denon DXM metal tape, treble had a slightly rough quality with normal bias, so full bias was used. Sound quality was particularly clear, relaxed and unfatiguing. There was plenty of insight into a performance and fine stereo imagery. Treble quality did, however, show itself tinged with flutter distortion. We felt TDK MA gave a slightly cleaner sound than Denon DXM tape, because of lower flutter.

Denon DX-8 'chrome' tape had a relaxed tonal balance, but sounded slightly smeared and lacking in attack. It was a bit dirty sounding. Reducing bias improved attack at the expense of treble smoothness. TDK SA sounded smoother and had plenty of detail.

Ferric DX-3 had neutral tonal balance but lacked real incision to attack. However, as with the other tapes, overall quality was very good and listening was pleasureable.

Replay performance wasn't as well defined as possible, muddying of strings and loss of immediacy being heard. Imagery and speed stability were good though.

Conclusion

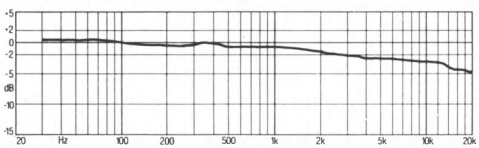
Because of the very clean sound this deck gave, we heard flutter, but still felt the DR-M22 to be a fine machine. Replay-only performance could have been better, though.

TEST RESULTS

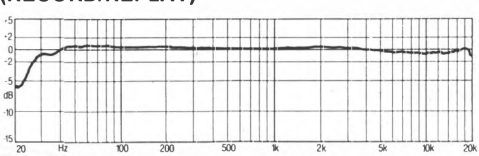
Replay of pre-recorded musicassettes		
Frequency response	20Hz-7kHz	average
Speed accuracy	+1.2%	average
Record/replay using blank tape		
Frequency response, ferric	25Hz-20kHz	very good
Frequency response, chrome	25Hz-20kHz	very good
Frequency response, metal	25Hz-20kHz	very good
Stereo separation	−51dB	good
Distortion	4.5%	very poor
Tape hiss, ferric	−70dB	very good
Tape hiss, chrome	−72dB	very good
Tape hiss, metal	−71dB	very good
Speed variations (wow and flutter)	0.1%	good
Modulation noise	−35dB	poor
Flutter energy (band level)	−30dB	very good
MOL, ferric, 315Hz/10kHz	+3.7dB/−9.8dB	average
MOL, chrome, 315Hz/10kHz	+0.2dB/−8.8dB	average
MOL, metal, 315Hz/10kHz	+3.6/−1.2dB	poor
Input/output performance		
Line in sensitivity/overload	85mV/—V	
Mic input sensitivity/overload	NONE	
Output level	750mV	

Typical price inc VAT £245

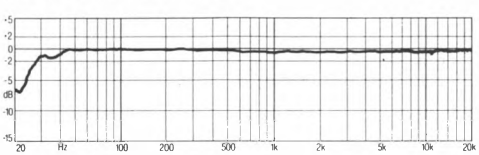
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



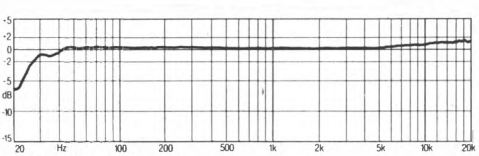
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Denon DR-M33HX

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

Not surprisingly, the *DR M33HX* sits in Denon's range between the *DR-M22* and *DR-M44HX*, borrowing features from each. It uses the dual capstan drive of the *'22*, that is without the *'44*'s direct drive motor. The independent but siamesed record and replay heads seen on both the *'22* and *'44HX* are employed here to good effect and like the more expensive deck, the *'33HX* has Dolby HX Pro, to enhance recording quality, as well as Dolby B and C noise reduction. The HX Pro circuit modulates bias according to signal conditions, in theory to increase treble overload headroom. However, manufacturers have a lot of leeway to determine what they want this system to achieve and it appears that Denon have increased standing bias to improve midband headroom too, trading off some potential treble benefits in the process. Bias is also user-adjustable, as on the *DR-M22*.

The cassette compartment is usefully back-lit and tape type selection remains automatic, the latter facility, along with logic control, makes this deck very easy to use.

Denon include their familiar bright blue fluorescent display panel, with its warning and status legends, long record-level indicators and a tape counter, which reads elapsed time and has a zero-stop. Microphone inputs are not fitted.

Lab report

This year's Denons have more accurate replay frequency response, giving better sound quality with musicassettes as a result. The graph for the *'33HX* shows treble output level up to 10kHz, after which a roll-off occurs.

Hiss in the replay amplifiers was adequately low at −58dB, or −68dB with Dolby B. There was negligible hum, which is an unusually good result. Replay speed was correct and speed stability fine, being similar to the record. replay characteristic.

A small amount of wow (0.07%) affected recordings, analysis showing equal 4Hz and 6Hz components. A small flutter peak exists at 40Hz too, but there was little energy in it, flutter band energy level measuring −29dB, which is a good result. There was not the low rate flutter found on the *'44HX*, consequently level was lower at 0.07%. The analysis spectra clearly showed this transport to possess the usual low-flutter benefits of twin capstan drive. At a low value of −43dB, modulation noise further confirmed the value of dual capstan drive on this series of decks.

Denon have obviously set up the *'33HX* to accurately meet IEC requirements, including the unconventionally low IEC II chrome tape sensitivity value. As a result, the *'33HX* has accurate Dolby tracking with BASF *CR-EII* chrome and low sensitivity (IEC normalised) pseudo-chromes like TDK *SA*. It is not suited to high sensitivity chromes like TDK *HX-S, SA-X*, Maxell *XL-IIS* and the like (see tape tests). Metal and ferric sensitivities were exactly to IEC II and IEC IV specification.

The graphs clearly show perfectly flat frequency response with IEC-type blank tapes, at centre-bias. Bias adjustment range was just suffi-

BEST BUY

cient to accommodate very awkward tapes like BASF *LH-MI* (ferric) and *CR-MII* (super-chrome), both needing full bias for flat response. Dolby tracking was excellent with all tape types.

Midrange overload levels, especially on chrome, were very high. For treble, they were good, if not exceptional (see the MOLs in the test results). Coupled with low hiss and hum, these characteristics gave the *'33HX* an excellent dynamic range.

Sound quality

Sound quality with musicassettes was extremely good, a rigid grip being kept on tempo. Piano had slight 'wateriness', but this *was* slight. Rock and classical musicassettes benefited equally, displaying little of the rhythmic vagueness so common with cassette generally. Upper treble softness was noted and lost the sense of razor sharp definition from images and transients.

Maxell *MX* metal gave very smooth and clear recordings, again with near perfect pitch stability. There was a small loss of inner detail on such instruments as maraccas and the delivery was just a trifle too mellifluous. Sony *ES* added some bite and verve, but with slight 'jumpiness' to treble, heard on cymbals and the like. Cymbals did however, ring strongly and clearly, undiluted by flutter.

BASF *CR-MII* super-chrome (bias set near maximum) retained inner and transient detail better than the metals, but had some bass emphasis and lost some of the solidity and sparkle of cymbals. Results were again superb though, and right up to metal standards. All recordings were made with Dolby B.

Hiss became a bit of a nuisance with ferrics (TDK *AD* and BASF *LH-MI*), so Dolby C was used here. Quality was outstanding for ferric tape, being clearer, easier and more stable to listen to than most decks with metal tape.

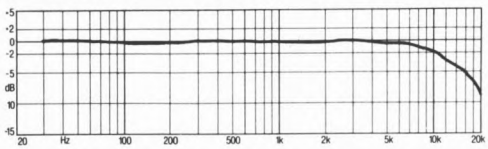
Summary

A high performance dual capstan deck, the *'33HX* has a few extras compared with the *DR-M22*, most notably Dolby HX Pro, which increases overload margins and dynamic range, putting it on a par with the *'44HX* in this respect. User adjustable bias gave the deck broad tape matching, and recording performance measured well in all areas. This deck delivered excellent record/replay sound quality and, equally, it played musicassettes unusually well, providing a pitch-stable, tightly defined sound better than most competitors by a significant margin. Since the *'33HX* is also a delight to use, it rates very highly indeed.

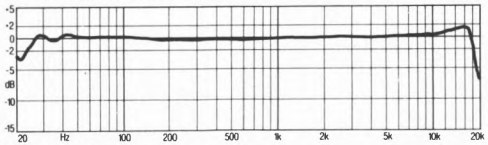
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-11.0kHz	good
Speed accuracy	+0.1%	very good
Noise	−58dB	average
Record/replay using blank tape		
Frequency response, ferric	22Hz-18.0kHz	very good
Frequency response, chrome	22Hz-18.0kHz	very good
Frequency response, metal	22Hz-19.0kHz	very good
Stereo separation	−50dB	good
Distortion	0.5%	very good
Noise	−53dB	good
Speed variation	0.07%	good
Modulation noise	−43dB	very good
Flutter energy (band level)	−29dB	good
MOL, ferric, 315Hz/10kHz	+4.7dB/−3.5dB	very good
MOL, chrome, 315Hz/10kHz	+3.0dB/−6.0dB	very good
MOL, metal, 315Hz/10kHz	+6.0dB/+0.5dB	average
Input/output performance		
Line in sensitivity/overload		80mV/>3V
Mic input sensitivity/overload		—mV/—mV
Output		700mV
Typical price inc VAT		£290

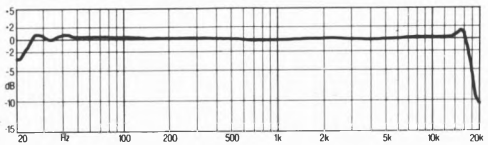
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



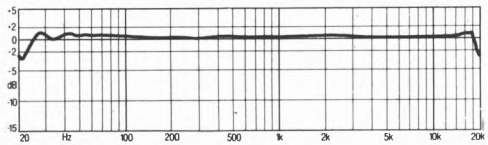
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Denon DR-M44HX

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

A Best Buy in the last issue, the Denon *DR-M44* has now been uprated by the inclusion of Dolby HX Pro, to become the *DR-M44HX*. Additionally, linear crystal, oxygen-free copper cable has been used to join the independent record and playback heads (siamesed) to the amps and there is an improved head block and positioning assembly. The counter now shows elapsed minutes and seconds, while both the range and resolution of the auto-tune circuits have been improved.

Otherwise, the *DR-M44HX* remains the same easy to use, gadget free, high-specification machine as before. It has automatic tape-type selection and high speed tape tuning to optimise performance for any blank tape.

A large fluorescent display panel houses the record level meters, the illuminated tape counter and a variety of warning legends. Dolby B and C are included, plus a switchable MPX filter to allow response to reach 20kHz with Dolby operating, if desired. Microphone inputs are absent, as is now common with expensive decks; their manufacturers expect specialised mics to be used, which usually have their own dedicated pre-amps.

Lab report

Denon's dual capstan drive, fitted with a direct drive motor on the *'44HX*, isn't of Nakamichi calibre, but it is clearly superior to single capstan types. Low rate flutter (0.08%), in the range 10Hz to 24Hz, and a trace of capstan wow (0.04%) at 6Hz did exist, but these effects were at a lowish level. Since the *DR-M44HX* is not expensive relative to its specification, Denon manage pretty well here, I feel. However, spectrum analysis clearly showed the *'44HX* to have more low rate flutter than the non-direct drive *'33HX*.

Modulation noise with BASF *CR-EII* chrome tape sank to an extremely low level of −45dB. This was due to freedom from high rate flutter and excellent tape-to-head contact.

Dolby HX Pro reduces bias in the presence of strong high frequency signals, in order to raise treble overload headroom. Certainly, it has improved them on the *'44HX*, but since chrome and metal MOL's have improved too, it appears (as we noted with the *'33HX*) that Denon have taken the opportunity to increase standing bias, improving matters all-round. The *'44HX* now has relatively high overload headroom right across the audio band which, together with low hiss and hum, gives it wide dynamic range.

The tape tuning system could now cope with BASF *CR-MII* — a new super-chrome tape with very high treble output — and gave an almost-flat frequency response (though with an inevitable extreme-treble peak due to the nature of the tape). All other 'difficult' tapes were successfully tuned in, frequency response being adjusted to flatness from 30Hz to 20kHz within very fine 1dB limits. Record-gain was adjusted too, giving perfect Dolby tracking. Bias altered little, if at all.

Possibly due to claimed improved head alignment, we found less to criticise in the replay-only frequency response this year. But the *DR-M44* is still no Nakamichi in this area; it gets the res-

ponse ruler flat to 8kHz, after which upper treble falls away to −6dB down at 18kHz. Replay noise and hum, and transport speed were all beyond serious criticism.

Sound quality

Maxell *MX* gave a wonderfully smooth, silky sound, free of the edginess so common to metals. Some loss of clarity and insight were noticed against digital originals. Piano was not as solid as hoped; there was some pitch diffuseness. Sony *ES* gave a clearer, more up-front sound but with some slight top-sizzle. Both metals gave impressive results, all the same.

BASF *CR-MII* reached 'metal standards' easily, except on crescendos, where slight muddying of the sound occurred. Otherwise, it combines the smoothness and confidence of *MX* with the clarity of Sony *ES*. Maxell *XL-IIS* was not too successful in comparison, having a warm and enclosed quality, with ponderous bass.

BASF *LH-MI* exhibited excellent clarity for a ferric tape, suffering mainly hiss and treble splash at high levels, if level was increased to minimise the hiss. Maxell *XL-IS* gave very similar results.

On musicassette a piano (Ashkenazy, Decca digital) didn't quite have the solidity and impact expected. Pitch 'diffusion' was again noted and felt to be the cause. Transients were softened out and imaging could have been better. Quite a lot of inner detail was lost too. The *'44HX* is now very good with musicassettes — much better than last year's *'44* — but there is still room for improvement. Actually, the *'44HX* was not better than the *'33HX* with musicassettes, but it still easily out-performs most cassette decks.

Summary

Denon have given the *DR-M44HX* a broad range of features available for good sound quality from cassette. Sensible design and layout make it easy to use as well.

Automatic tape type selection and tuning ensures perfect tape compatibility with all types, including the most awkward ones such as BASF *CR-MII*. Dual capstan drive, employing a direct-drive motor, successfully keeps wow, flutter and modulation noise down to low levels.

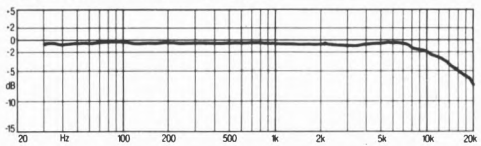
Recording quality was excellent, being tape-dependent as much as machine dependent. The tuning system matched in all tapes with a high degree of accuracy. Musicassette sound quality reached a very high overall standard too; there is still room for improvement here though, primarily in pitch stability and stereo imaging, but it was impressive by general standards.

BEST BUY

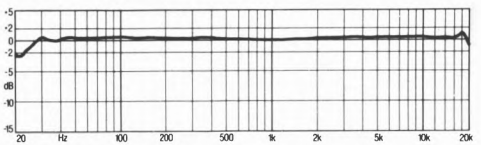
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-11.0kHz	good
Speed accuracy	+0.2%	very good
Noise	−58dB	average
Record/replay using blank tape		
Frequency response, ferric	20Hz-20.0kHz	very good
Frequency response, chrome	20Hz-18.0kHz	very good
Frequency response, metal	20Hz-20.0kHz	very good
Stereo separation	−51dB	good
Distortion	0.7%	good
Noise	−53dB	good
Speed variation	0.04%	very good
Modulation noise	−45dB	very good
Flutter energy (band level)	−31dB	very good
MOL, ferric, 315Hz/10kHz	+4.5dB/−4.5dB	very good
MOL, chrome, 315Hz/10kHz	+2.5dB/−7.0dB	good
MOL, metal, 315Hz/10kHz	+6.0dB/+0.5dB	average
Input/output performance		
Line in sensitivity/overload	80mV/>3V	
Mic input sensitivity/overload	—mV/—mV	
Output	700mV	
Typical price inc VAT	£350	

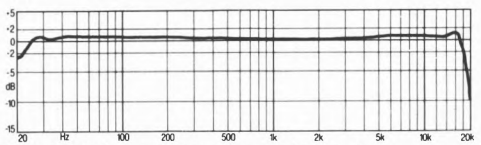
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



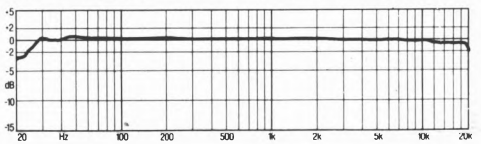
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Fisher CR-58

Fisher Sales UK Ltd, 113 Bushey Mill Lane, Watford, Herts
Tel (0923) 31974

The CR-58 has the appearance of being a standard Japanese cassette deck product: it is very much 'one of the herd' in styling terms. Fisher have fitted Dolby B and C noise reduction systems, but have omitted the usual headphone socket. Whilst this has probably been done to save cost, mic inputs have still been provided. The transport controls 'clanked', but have a very useful cue/review facility.

The record level meters possess five LEDs per channel, offering poor resolution and a small signal range of −10dB to +6dB. However, tests showed that these meters indicated music peaks very accurately at low and high frequencies and have been usefully set to Dolby level.

A small, unlit mechanical tape counter has no allied memory facility — always a frustrating omission. Tape selection is by mutually dependent push-buttons, enabling two buttons to be fitted instead of three, but making selection awkward and encouraging mistakes. The Dolby switching suffered the same problem, but this is not uncommon, because Dolby Labs recommend this awkward arrangement.

The tape compartment is unlit and the lid doesn't come off to make tape cleaning easier. In spite of this we note that Fisher still term the CR-58 a 'Studio-Standard' deck!

Lab report

The replay response of our review sample was poor, suffering plateau treble loss above 2kHz. Since this is much like the performance of Fisher's CR-W67 and CR-277 models, we assume that this is a common feature. It resulted in incorrect Dolby B replay tracking — as replay response errors always do — and the resultant sound was hazy and vague, becoming dull at low levels. Fisher should be able to adhere to IEC standards more closely than this, even on a budget product. Other manufacturers of budget decks do.

The tape transport looked identical to that of the CR-W67, but did not have its severe audible flutter. It still had substantial flutter sidebands though which had a total equivalent band level of −16dB relative to the main signal. This is equivalent to 16% distortion. Luckily, these sidebands are substantially masked by the main signal, but do result in muddle and murkiness on complex programme.

The record/replay response curves with IEC Primary Reference Tapes show steadily rising treble with metal and chrome, but a minor treble roll-off with ferric. These were all

fairly good results. Sensitivity has been adjusted to suit IEC I and IV, but not IEC II chrome. Fisher have set up this deck to match Japanese pseudo-chromes, which are generally more sensitive than IEC II chrome. However, TDK SA has now been 'de-sensitised' and the CR-58 doesn't match it well, giving rising treble at low levels. Bias was high for ferric tape, resulting in a low treble saturation level of – 9dB below OVU. Results with chrome and metal were about normal, being close to IEC requirements.

Distortion was not a problem at low, medium or high frequencies. Noise was low too, except for a faint buzz generated by the motor. This was most obvious on recordings made with microphones, especially with low output types needing a lot of gain.

Sound quality

Fisher recommend use of TDK and Maxell tape. We used TDK and Dolby C for recordings. The slight upward response trend toward high frequencies added some brighness to recordings made on metal (TDK MA) and chrome tape (TDK SA), but this was minor and not unpleasant.

Tonally, music sounded smooth and even. Clarity was good with simple programme, but the muddle caused by flutter sidebands tinged complex performances recorded well below tape saturation. Pitch stability was satisfactory for a budget deck.

TDK SA pseudo-chrome gave a slightly bright, feathery quality but again, fidelity was fair for a budget product.

TDK AD-X ferric tape sounded muddled and imprecise. It had a 'soft' sound, probably due to loss of high treble. Nevertheless, performance was fair.

Pre-recorded cassettes inevitably sounded vague and imprecise in imaging, due to replay response error and Dolby B mistracking. They also sounded dull, but weren't so badly affected as to have no treble. Most listeners would find the result acceptable, but it could easily have been better.

Conclusion

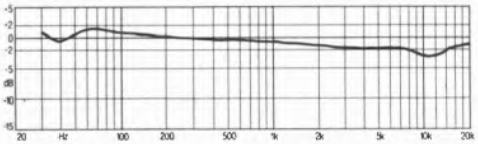
The CR-58 gave acceptable recordings, but should have sounded better with pre-recorded tapes. It is a fairly competent, but unexceptional budget product, compromised by unattractive styling and 'lightweight' construction quality.

TEST RESULTS

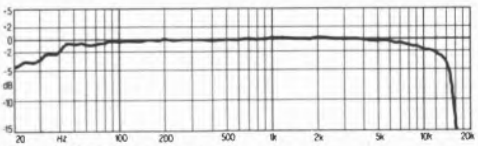
Replay of pre-recorded musicassettes		
Frequency response	30Hz-6kHz	poor
Speed accuracy	+ 0.7%	good
Record/replay using blank tape		
Frequency response, ferric	40Hz-12kHz	good
Frequency response, chrome	40Hz-12kHz	good
Frequency response, metal	40Hz-15kHz	very good
Stereo separation	– 46dB	average
Distortion	1.5%	average
Tape hiss, ferric	– 68dB	good
Tape hiss, chrome	– 68dB	good
Tape hiss, metal	– 69dB	good
Speed variations (wow and flutter)	0.1%	good
Modulation noise	– 39dB	average
Flutter energy (band level)	– 20dB	average
MOL, ferric, 315Hz/10kHz	+ 4.5dB/ – 11dB	poor
MOL, chrome, 315Hz/10kHz	+ 1dB/ – 8dB	good
MOL, metal, 315Hz/10kHz	+ 3.5/ – 3dB	poor
Input/output performance		
Line in sensitivity/overload		90mV/—V
Mic input sensitivity/overload		0.8mV/15mV
Output level		500mV

Typical price inc VAT £100

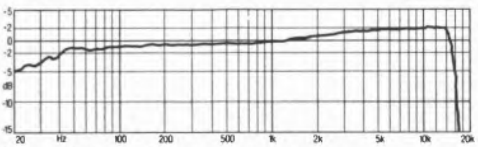
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



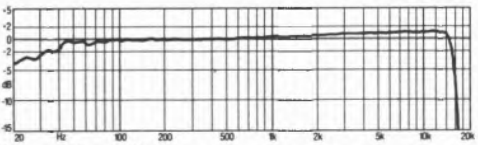
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



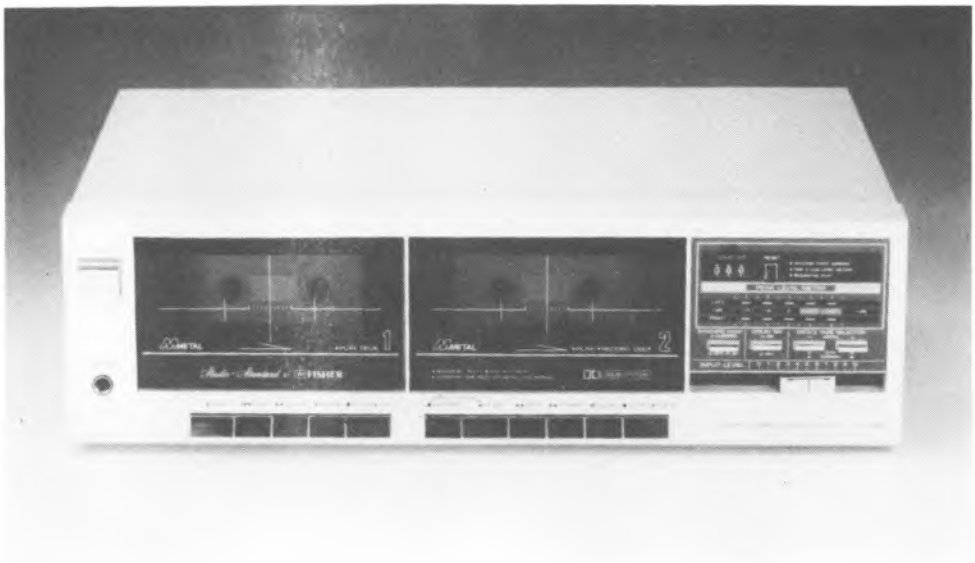
Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Fisher CR-W67

Fisher Sales UK Ltd, 113 Bushey Mill Lane, Watford, Herts
Tel (0923) 31974



The CR-W67 is a dubbing deck, with two tape transport mechanisms, allowing it to make a copy of a pre-recorded tape. One tape compartment can only play — not record. The other can make recordings as usual, as well as replaying. Dolby B is fitted, plus synchronous start of the dubbing process and sequential start of the decks when replaying. The latter is useful at parties, because it causes one tape to start when the other ends. Dolby C is not fitted — one of the cost penalties paid for having dubbing on a budget deck.

Contrary to the arrangement on the CR-58, a headphone socket is provided, but not microphone inputs. A three digit, unlit mechanical tape counter is fitted, but it has no memory system. Both tape compartments were unlit and their tinted acrylic covers made tape difficult to see.

Fisher use peak level recording indicators that have five LEDs per channel. They possess poor resolution and cover a narrow range of —10dB to +6dB relative to OVU, but gave accurate peak readings at all frequencies and were usefully calibrated to put OVU at Dolby level. Consequently it was possible to be certain that music peaks were not going beyond a reasonable maximum limit for cassette tape.

The transport buttons were somewhat stiff and clanked a bit. They were adequate though and both mechanisms possess cue – review facilities. One awkward point was that the tape counter worked with only the record – replay transport — not with the replay only one, which doesn't have a counter.

Styling was considered poor and build quality mediocre. The product felt lightweight and insubstantial.

Lab report

As the graphs show, frequency response with IEC ferric, chrome and metal tapes was relatively flat for a budget deck. Sensitivity matching was good too, resulting in even tonal balance at low levels with the Dolby system operating. This is a good performance. It means that the CR-W67 will match most modern tapes, which have all been re-aligned closely to IEC characteristics.

Bias settings were a bit erratic and 333Hz maximum output levels with ferric and metal tapes on the low side, being about −2dB worse than usual. However, if the OVU maximum recording level is adhered to, this should not be a problem. Both harmonic and intermodulation distortion figures were higher than usual, with an overall average value of 3.4% being similar to the amount of intermodulation suffered at high frequencies.

However, this distortion has to be kept in perspective. The IM figure was high due to sidebands close to the signal — and therefore masked by the signal. The potentially annoying difference product, always far removed from the stimulus, was not high.

In practice, it was the very poor flutter performance of this deck that dominated sound quality. Total flutter sideband energy had an equivalent level of 30% distortion. A far greater amount of energy was being distributed from music into flutter than into harmonic and intermodulation distortion.

Replay frequency response suffered the same plateau loss of treble as that of the CR-58, so pre-recorded cassettes will be accordingly affected. Both transports ran 1% fast — barely acceptable.

Sound quality

The flutter problem on this deck added terrible coarseness to recordings and caused piano notes to sound violently shaky and of 'cracked' purity. This caused us to seriously downrate the CR-W67, because problems like this, once identified by the listener, become pervasive and extremely annoying.

Slight background hum could be heard behind recordings made on the deck. The offending 100Hz component measured – 52dB below OVU, in contrast to noise at around – 60dB (Dolby B).

Replay performance suffered the same plateau loss of treble as the CR-58 which resulted in pre-recorded cassettes sounding soft and vague, rather than obviously lacking in treble.

Metal (TDK MA) tape gave a slightly bright, edgy tonal balance, but this was considered acceptable. Incomplete erasure was heard as burbling between recordings. Pseudo-chrome (TDK SA) was smoother but spitting on vocals peaks was occasionally obvious. Ferric tape (TDK AD-X) had some softness about it, but was again considered tonally acceptable.

Copy-recordings had speed instability and tonal balance errors magnified, so were not very impressive to listen to.

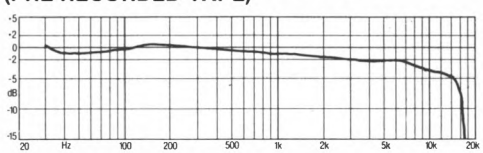
Conclusion

This deck basically suffers from the constructional compromises necessary to provide two tape transports at the price. It is not recommended for sound quality; the ability to dub is its chief asset.

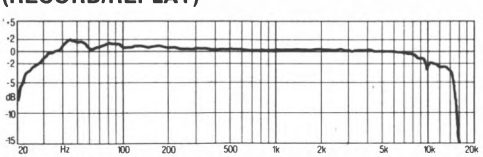
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-3kHz	very poor
Speed accuracy	+ 1.2%	average
Record/replay using blank tape		
Frequency response, ferric	30Hz-10kHz	good
Frequency response, chrome	25Hz-14kHz	good
Frequency response, metal	25Hz-15kHz	very good
Stereo separation	– 36dB	very poor
Distortion	3.4%	very poor
Tape hiss, ferric	– 62dB	poor
Tape hiss, chrome	– 62dB	poor
Tape hiss, metal	– 60dB	poor
Speed variations (wow and flutter)	0.08%	good
Modulation noise	– 39dB	average
Flutter energy (band level)	– 13dB	very poor
MOL, ferric, 315Hz/10kHz	+ 2.5dB/ – 8dB	average
MOL, chrome, 315Hz/10kHz	0dB/ – 6dB	poor
MOL, metal, 315Hz/10kHz	+ 2/ – 0dB	poor
Input/output performance		
Line in sensitivity/overload	95mV/—V	
Mic input sensitivity/overload	NONE	
Output level	500mV	
Typical price inc VAT	£110	

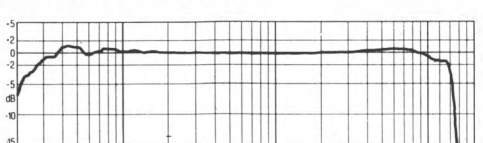
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



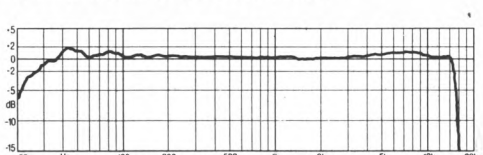
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Fisher CRW47

Fisher Sales UK Ltd, 113 Bushey Mill Lane, Watford, Herts
Tel (0923) 31974

This is a 'dubbing deck', designed for tape-to-tape copying. Only one of the two tape transports will record as well as play — the other, identified as '2' machine, only plays back.

A cunning alternative use for dubbing decks is sequential play of two cassettes to double total playing time — useful at parties or for background music. The *CR-W47* has this too.

Since a transport mechanism represents a substantial proportion of the cost of a cassette deck, fitting two means savings must be made in other areas. This machine has mechanical transport buttons that in our opinion weren't especially nice to use, and only Dolby B noise reduction is fitted.

Although the fascia looks busy, this complexity is largely an illusion given by liberal use of styling lines, legends and panels. Tape selection is by awkward twin inter-dependent push buttons. A simple mechanical tape counter is fitted, plus a headphone socket. There are no microphone inputs. Record level indicators use LEDs and cover a limited range, from −10dB up to +6dB, relatively to OVU.

Lab report

Both transports had falling treble, according to the official BASF IEC test tape. In this instance though, a Japanese IEC test tape suggested otherwise and, indeed, whilst some musicassettes did sound dull, others obviously had extended treble. The *CR-W47* appeared more sensitive than usual to recorded azimuth but, generally, we found that both transports performed reasonably well.

Transport '2' had more hiss than '1', but it was not enough to be intrusive. This was not the case with hum though, which measured −60dB at 100Hz — making it just discernible when playing at high volume.

Replay speed of both transports was fast, one by +2%, which is significant. However, both had good replay-only speed stability, with little wow but some fast flutter. Performance of the recording transport deteriorated in record/replay mode, as is usually the case, both wow and flutter rising slightly. The latter was most noticeable, coming over as a fast 'burr' on steady tones.

Dolby B suppressed hiss to −64dB with chrome tape, which is good performance for the system. Hum became more of a problem when recording and replaying than on replay of musicassettes, a 100Hz component measuring −55dB, which is definitely audible.

Bias has been set high, giving poor treble overload (saturation) figures with all tape types. Frequency responses were reasonably flat with ferric and chrome tapes, but low frequency emphasis affected metal. In spite of very inaccurate sensitivity setting for metal, Dolby tracking error didn't upset low level frequency response much, partly because the B system has less effect than C.

Dubbing performance was very good. A frequency response test sweep, recorded on to TDK *SA* by transport 1, replayed accurately on transport 2 and was transferred back to 1 with little degra-

dation in the dubbing process. Bass roll-off below 45Hz was steeper, due to cumulative losses, but that was all. Noise is added by dubbing too, depending upon the tapes used, a figure of around −60dB for hiss prevailing.

Sound quality

Slight hum was noticed immediately. Otherwise, metal tape (TDK *MA*) gave fine clarity and very clean transients. It was an impressive result, though the over-large bass billowed out. Speed stability proved excellent, piano having steady pitch, without the annoyance of 'cracked' sounding notes, and the like. A slight shimmer to cymbals indicated flutter.

TDK *SA* pseudo-chrome tape gave much the same result as metal, except that treble sounded a bit less solid and precise, plus being splashy. Otherwise, tonal balance and clarity were fine. The result was pleasant.

Lower recording levels for ferric, to avoid treble overload, made hiss and hum more noticeable. At this point, a slight wateriness was noted with piano, due to wow, but the effect was small. Fast flutter affected organ too. Good tonal balance and a nice open sound were again noted and liked.

Slight hum was obvious when playing musicassettes. There was more variation than usual in treble level between them, which was disconcerting. Some sounded dull, some bright, but on the whole treble proved adequate, giving a fairly open sound with good imaging and sharp transients.

Summary

The *CR-W47* is a budget dubbing deck with a minimum of facilities. It lacks Dolby C, but Dolby B can be effective enough these days when used with quiet tapes. Single-speed dubbing is provided along with the ability to play one tape after another automatically.

Transport controls needed a good push to make them latch down, but weren't unduly stiff. Build quality felt good by budget deck standards but we thought the fussy styling made the front look messy.

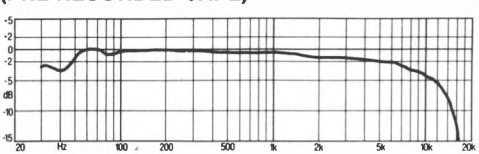
Measured performance was respectable, weak points being early treble overload and falling treble in the replay response. Recording quality on to ferric and chrome in particular was good, metal recordings being tinged by too much billowing bass. Slight hum was consistently obvious too, especially on dubbed copies. Dubbing quality was otherwise good. Musicassettes were handled well, generally sounding clear and stable.

TEST RESULTS

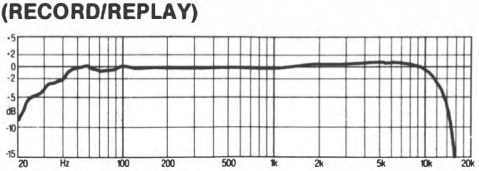
Replay of pre-recorded musicassettes		
Frequency response	48Hz-7.0kHz	poor
Speed accuracy	+2.0%	very poor
Noise	−59dB	average
Record/replay using blank tape		
Frequency response, ferric	30Hz-12.0kHz	good
Frequency response, chrome	30Hz-13.0kHz	good
Frequency response, metal	30Hz-14.0kHz	good
Stereo separation	−40dB	poor
Distortion	2.1%	very poor
Noise	−54dB	very good
Speed variation	0.10%	good
Modulation noise	−39dB	average
Flutter energy (band level)	−26dB	good
MOL, ferric, 315Hz/10kHz	+4.0dB/−11.0dB	poor
MOL, chrome, 315Hz/10kHz	+0.0dB/−9.0dB	average
MOL, metal, 315Hz/10kHz	+5.0dB/−2.0dB	very poor
Input/output performance		
Line in sensitivity/overload		100mV/>3V
Mic input sensitivity/overload		—mV/—mV
Output		500mV

Typical price inc VAT £120

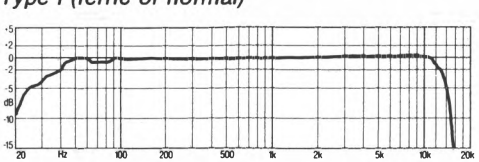
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



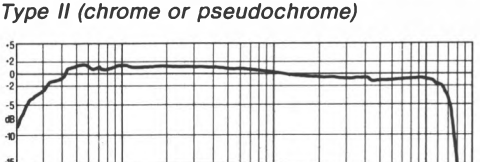
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Harman-Kardon CD491

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

Harman-Kardon's *'491* is a large, sophisticated and button-covered deck. The transport uses dual capstan drive for improved speed stability, whilst independent record and replay heads (siamesed) provide off-tape monitoring when recording. Manual bias adjustment is provided for tape tuning.

Although the styling of the *CD491* is fairly neat, it was awkward to use, delineation of function between the button groups being poor. Manual tape type selection only made things worse, as it should have been automatic at the price.

Dolby B and C are fitted for tape hiss reduction, plus Dolby HX Pro for improved high frequency overload headroom.

The transport buttons had a light action and operate through comprehensive logic that allowed all commands. Punch-in recording is available, plus instant forward-to-reverse direction changing. A variety of programme location aids are provided too. Mic inputs are at the rear.

The record level meters set OVU close to Dolby level and use two wide range LED displays covering −30dB to +10dB with good resolution. The meters also have selectable peak hold and treble equalisation emphasis options.

Lab report

Well set bias (detent position) and the presence of HX Pro ensured respectable tape overload figures at low/middle and high frequencies respectively, when recording. Metal tape in particular took a lot of level, at +6dB above OVU. This performance allows the *CD491* to minimise the muddling and dullness that occurs with high recording levels, especially with ferric tape. HX Pro gives a deck like this the overload margins of Nakamichi decks, which do not use the system.

Record equalisation wasn't quite right for IEC tapes, as the graphs show, necessitating a bias increase to suppress rising treble. This affected treble overload (saturation) little and successfully 'flattened' most tapes — but not awkward supertapes like Maxell *XL-IS* and BASF *CR-MII*, which still have excessive treble and are not really compatible. This is a drawback Harman Kardon could have foreseen.

Replay frequency response was flat to 10kHz and then shelved downward slightly at higher frequencies. Obviously, the latest (1981) replay characteristic has been used, resulting in even tonal balance and healthy treble from musicassettes. Some Dolby B replay tracking occurred, and this will dull low level music.

The replay amplifier had acceptably low hiss, but hum (and its harmonics) hovered around −60dB, which is not especially low. It was just audible at high gain with low level recordings. Although this affects musicassettes, their high recorded levels disguise the problem too. Dolby C gave −19dB noise reduction, taking chrome hiss down to −72dB on recordings — a low value, if not the lowest.

Speed accuracy was fine and speed stability excellent, on replay only and in record-replay.

Flutter was suppressed well by the dual capstan transport; spectral analysis revealed a trace of capstan wow at 6.5Hz.

Sound quality

Musicassettes had good definition and stable speed performance. On occasions, the slightest pitch tremble was audible. Plentiful treble brought out fine detail but slight low level treble loss was attributed to Dolby B replay tracking error. Stereo imaging had dimensionality and we felt that this, together with steady pitch, did a lot to make musicassettes enjoyable.

Choice of tapes for the *CD491* is more critical than usual, because of its record-equalisation peculiarities. Sony *ES* metal gave fine results without bias tuning, and was notable for strong, clear bass free from 'wallowing', a lucid midband and well-etched, stable treble. Very high recording levels can be used.

TDK *SA* and Maxell *XL-IIS* both proved compatible in the 'chrome' position, suffering very little treble softening compared to metal. Fine detail was well preserved. A non-Dolby recording on BASF *CR-EII* (chrome) tape proved quiet to the point where only slight and very even background hiss was audible and not annoying. Fine transient definition was obtained on tests carried out with noise reduction circuits switched out of the recording path.

Ferric tapes generally sounded brighter and less fluffy in treble quality than is common. They performed relatively well in subjective terms and we felt the *CD491* made unusually good use of them.

Summary

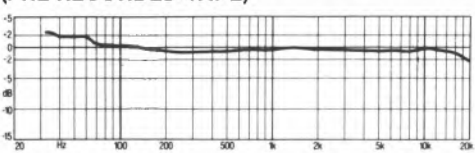
The *CD-491* is an up-market deck fitted with a dual capstan transport, independent record and replay heads, manual tape tuning and a variety of programme location gadgets. Fiddly to operate and at times a bit frustrating because of it, the *CD-491* nevertheless combines a good basic specification with a wide range of useful facilities.

Quality of musicassette reproduction and of recordings reached a very high standard, but some super-tapes are not compatible and most European IEC-aligned tapes need bias tuning before compatibility is achieved. Harman should take more notice of the impact IEC requirements have made on the tapes sold in Europe, even those made in Japan. Otherwise, thanks to its broad range of facilities, this deck balances flexibility in use with an impressive level of performance. It can most certainly be recommended.

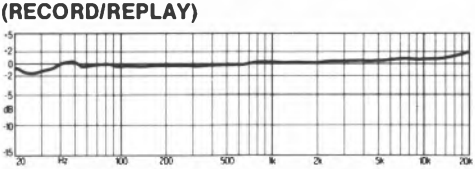
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	30Hz-20.0kHz	very good
Speed accuracy	+0.5%	good
Noise	−58dB	average
Record/replay using blank tape		
Frequency response, ferric	20Hz-20.0kHz	very good
Frequency response, chrome	20Hz-16.0kHz	very good
Frequency response, metal	20Hz-20.0kHz	very good
Stereo separation	−53dB	good
Distortion	1.0%	good
Noise	−53dB	good
Speed variation	0.04%	very good
Modulation noise	−41dB	good
Flutter energy (band level)	−32dB	very good
MOL, ferric, 315Hz/10kHz	+3.0dB/−1.0dB	good
MOL, chrome, 315Hz/10kHz	+1.0dB/−5.0dB	good
MOL, metal, 315Hz/10kHz	+6.0dB/+1.5dB	good
Input/output performance		
Line in sensitivity/overload	40mV/>3V	
Mic input sensitivity/overload	1.3mV/64mV	
Output	450mV	
Typical price inc VAT	£500	

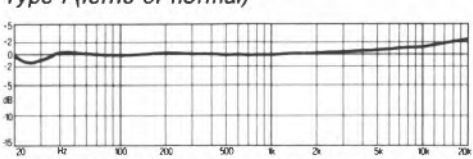
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)

Type IV (metal)

Hitachi DE27

Hitachi Sales (UK) Ltd, Hitachi House, Station Road, Hayes, Middlesex
Tel 01-848 8787

A basic budget deck, the *D-E27* has little in the way of embellishment. Hitachi have kept the styling reasonably clean, though there has been some attempt to make it look more complex than it really is, the meter display having a spurious lattice image with perspective. Also, Hitachi describe the mechanically-coupled transport buttons as 'soft touch', but we found them fairly stiff and clanky. On a shiny surface I found the deck, being light in weight, would skid backward if one of these buttons was pressed hard.

Both Dolby B and C noise reduction systems are fitted. Tape selector buttons are the annoying inter-dependent types, where two buttons are used to select all three tape types (ferric, chrome and metal). This saves the cost of a button, but is awkward to use without making an error — which could of course very well mean a ruined recording.

A single mic input socket is fitted which, by recording on to both channels, gives only mono recordings. The record level display uses bright LEDs, covering −10dB to +6dB, OVU being set at Dolby flux, as is now common.

Lab report

Replay frequency response had the same downward trait as the *DX6*, being −1.5dB at 10kHz on both channels. This was not due to azimuth error, but to replay equalisation error relative to the BASF IEC reference test tape which sets the standard. The *DE27* was fairly accurately adjusted as budget decks go and this downward trend should not have too much of a dulling affect upon musicassettes.

Replay hiss was a few dB higher than usual, but at −57dB it is still low enough to be below chrome tape hiss (bias noise) at −53dB. There was too much hum in the replay amps though, the most audible 150Hz harmonic being at −58dB. This level is just audible when replaying at high volume in quiet surroundings.

Replay speed was accurate and replay speed instability reasonable too, considering this is a budget deck.

A closer analysis of the effect of speed instability upon recordings, where the effect is cumulative (record plus replay) showed the transport suffered short term speed drift which, at 0.2% peak-to-peak was roughly twice as bad as usual. This random speed changing resulted in random wow and flutter, rather than the more common cyclic variety due to one specific effect, such as an eccentric capstan. Wow and flutter figures were poor as a result, yet subjectively the problem wasn't as bad — at least under test conditions — as, for example, the steady cyclic flutter of the *DX6*.

Head saturation occurred at low frequencies when recording with metal tape, producing no less than 10% distortion. Distortion levels of 1.4% in the midband and at high frequencies were higher than usual too, giving a very high overall average of 4.2%. This was indicative of a head barely able to cope with the high bias needed for metal, confirmation coming — as expected — in

a midband overload (MOL) value worse with metal at +2dB, than with ferric at +3.5dB. Metal tape did still give a good treble overload performance though, so its use is not without justification on this machine.

Both ferric (IEC I) and chrome (IEC II) tapes have reasonably flat frequency responses, as the graphs show. Metal exhibits a treble peak though, which Dolby C emphasised, probably leading to detectable 'sharpness' in the sound.

Sound quality

A recording (on TDK *MA* metal tape) of organ was pitch unstable to the point of sounding queasy. This was unpleasant and affected a piano recording too. Slight droning hum was consistently obvious. Tonal balance was acceptable, but bass a bit light. A 'zing' in the treble induced a rasping quality.

With TDK *SA* chrome, the speed drift/wow problem still prevailed, piano seemingly being unable to hit the right note, with a slightly drunken quality. However, tonal balance was even, treble smooth and the overall sound, wow and slight hum apart, pleasant.

Ferric tape (TDK *AD*) also had an amenable sound, wow and hum apart. Treble proved smooth and there was noticeably less saturation than usual — being heard as solid, well defined treble peaks.

Wow was less obvious with musicassettes, but still detectable — as was hum. There was good forward projection of vocals, but both deep bass and extreme treble were subdued. Imaging was fair.

Summary

This is a budget recorder fitted with Dolby B and C noise reduction systems. It has a simple transport operated by mechanically linked buttons that inevitably have a stiff and clanky action, even though Hitachi describe them as 'soft touch'!

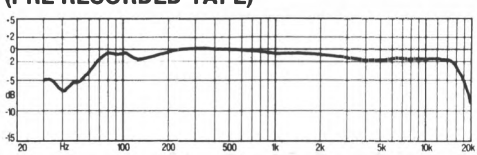
A simple mechanical tape counter is fitted, plus bright LED record level meters. The two interdependent tape selector buttons were thought difficult to use — the Dolby selector was similar, although there is justification for the method here. A single mic socket is provided, which automatically gives two-channel mono recordings from a single microphone.

There were some serious weaknesses with this deck. Speed drift and wow seriously compromised piano and organ recordings. Slight hum, a bright, fizzy treble with metal tape, and weak bass were all annoyances. Musicassette quality was reasonable.

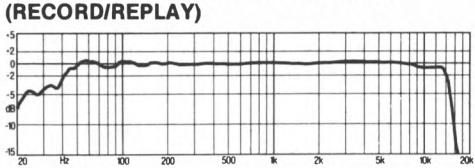
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	60Hz-16.0kHz	good
Speed accuracy	+0.4%	very good
Noise	−57dB	poor
Record/replay using blank tape		
Frequency response, ferric	40Hz-15.0kHz	very good
Frequency response, chrome	40Hz-13.0kHz	good
Frequency response, metal	40Hz-15.0kHz	very good
Stereo separation	−46dB	average
Distortion	4.2%	very poor
Noise	−54dB	very good
Speed variation	0.14%	average
Modulation noise	−37dB	poor
Flutter energy (band level)	−21dB	average
MOL, ferric, 315Hz/10kHz	+3.5dB/−6.0dB	good
MOL, chrome, 315Hz/10kHz	+0.5dB/−8.0dB	average
MOL, metal, 315Hz/10kHz	+2.0dB/+0.5dB	poor
Input/output performance		
Line in sensitivity/overload	110mV/>3V	
Mic input sensitivity/overload	1.5mV/30mV	
Output	500mV	
Typical price inc VAT	£100	

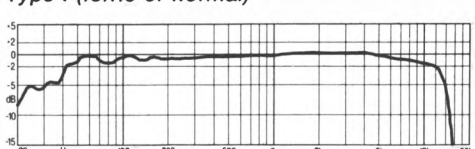
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



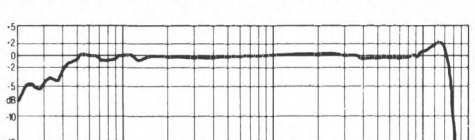
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



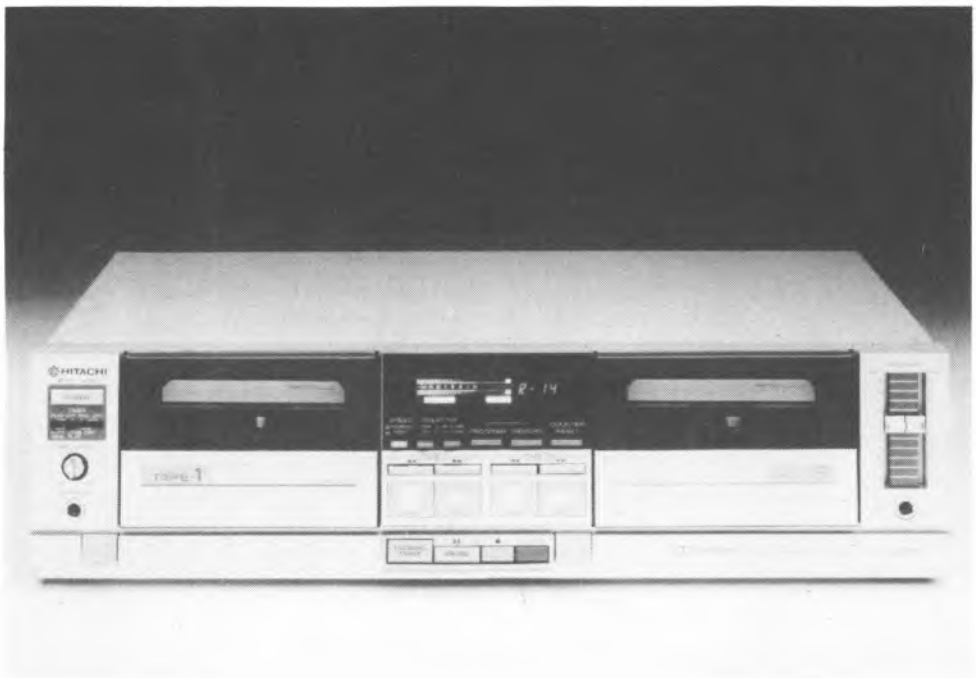
Type II (chrome or pseudochrome)



Type IV (metal)

Hitachi DW800

Hitachi Sales (UK) Ltd, Hitachi House, Station Road, Hayes, Middlesex
Tel 01-848 8787



Double-mechanism 'dubbing' decks will have an appeal of their own to some users. The Hitachi D-W800, as well as offering the basic facility of conveniently copying the contents of one cassette on to another, also incorporates various other functions. These include mixing line or microphone input with the pre-recorded tape and an editing facility so that the machine can be programmed to replay the pre-recorded cassette in any order, thus altering the track order on the copy. Dubbing can also be done at twice normal speed, with some loss in high frequencies.

Tape selection is automatic only (no manual over-ride) and the deck incorporates Dolby B and C noise reduction systems. Old Hitachi ME metal tapes without sensing slots cannot be recorded properly on this deck, due to auto-tape selection.

A long play function allows two tapes to be played back alternately, one playing while the other one rewinds. Record level controls only affect line and the (mono) microphone level, the output from the playback cassette being adjusted by the stereo ganged tape-level control which should be left in a centre 'click' position during normal dubbing.

Blue fluorescent record-level meters are set to approximately Dolby level. They purport to show peak levels, but low frequencies under read badly, drum at OVU indicating – 10dB on the display for example. This induces over-recording with bass heavy material.

Although the deck is housed in a metal case and seems robust enough the deck looks and feels a little 'plasticky'. Logic controls allow it to operate smoothly and quietly though, which was satisfying. Both tape compartments have back-lighting, but a single illuminated tape counter worked with the recording section only.

Lab report

The replay response of both sections of this deck was poor, suffering steadily falling treble above 1kHz and slow bass roll-off below 200Hz, culminating in sudden bass fall at 60Hz. This latter effect can be seen in the record/replay

frequency response graphs too. Dolby action magnified the treble error, as it always does, so the problem was worse at low levels. This will seriously dull the treble quality of pre-recorded cassettes and make them sound vague and hazy.

Both transports ran 1% fast, which is just acceptable. Speed stability was, however, very good for a budget product, total flutter sideband energy being equivalent to – 25dB on both sections.

Whilst mid-band and high frequency distortion figures were normal, under-reading on the record-level meters resulted in a massive 40% distortion on bass signals recorded at OVU, using metal or ferric tape. Obviously, the heads are not happy with high level, low frequency signals, this problem being compounded in practice by the under-reading meters.

Noise levels were low with all tape types. Erase noise was low and erase efficiency were unusually good with metal tape.

Bias levels were sensibly set to give a reasonable balance between mid-band and treble maximum output levels. Additionally, frequency response with ferric, 'chrome' and metal tapes proved reasonably flat, as the graphs show, and this was also the case with Hitachi ER (ferric), SX (chrome) and ME (metal) tapes.

Sound quality

Metal tape had a slightly dry, brittle sound and there was a lack of deep bass. However, piano and organ were reproduced without speed problems. Splashy sibilants were noticed on speech. We specifically listened for the subjective impact of bass distortion, but found it was not particularly annoying.

A rather brittle, thin quality was noticed on Hitachi SX 'chrome' tape too, plus sibilance splash. Results were otherwise acceptable. Ferric tape was also on the harsh side, but tonal balance sounded even though.

Replay quality was poor. There was lack of bass, haziness and lack of clarity at low levels. Vocals sounded muffled.

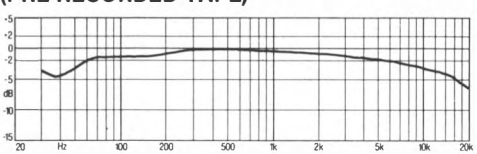
Conclusion

The D-W800 was a competent dubbing deck and would have received praise, but for its replay performance, which on our sample was in our view very poor. All tape copies are affected by this.

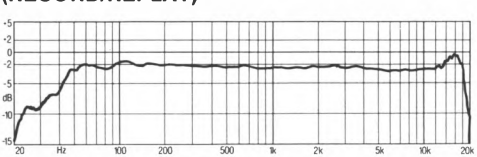
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	60Hz-6kHz	poor
Speed accuracy	+ 1.0%	average
Record/replay using blank tape		
Frequency response, ferric	40Hz-17kHz	very good
Frequency response, chrome	40Hz-17kHz	very good
Frequency response, metal	45Hz-18.5kHz	very good
Stereo separation	– 53dB	good
Distortion	15%	very poor
Tape hiss, ferric	– 69dB	good
Tape hiss, chrome	– 71dB	very good
Tape hiss, metal	– 69dB	good
Speed variations (wow and flutter)	0.06%	good
Modulation noise	– 38dB	average
Flutter energy (band level)	– 28dB	good
MOL, ferric, 315Hz/10kHz	+ 3dB/ – 10dB	average
MOL, chrome, 315Hz/10kHz	0dB/ – 8dB	average
MOL, metal, 315Hz/10kHz	+ 2/ – 3dB	poor
Input/output performance		
Line in sensitivity/overload		110mV/—V
Mic input sensitivity/overload		0.8mV/50mV
Output level		500mV
Typical price inc VAT		£240

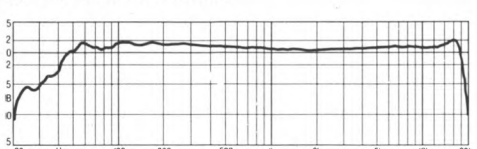
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')

Type IV ('metal')

Hitachi DX6

Hitachi Sales (UK) Ltd, Hitachi House, Station Road, Hayes, Middlesex
Tel 01-848 8787

Although bearing the same satin black finish as most other cassette decks, we felt that Hitachi's *DX-6* still managed, through neat styling, to look unusually attractive in a simple but practical manner.

The logic-controlled transport is an auto-reverse mechanism, allowing reverse recording and using fast-reverse to avoid playing or recording over the blank leader tape in a cassette.

Flat, flexible touch panels actuate the transport. Their markings weren't quite as clear as one might wish, but they had a light, pleasant action, and gave a fair sense of precision. The logic accepted all commands, including 'punch-in' record and going direct into reverse record from forward record.

Tape selection is manual (as always, an annoyance) and the fluorescent display panel offers no warning of which selection has been made. However, it does carry a very wide range record-level display, covering −40dB up to +10dB relative to OVU, which is set at Dolby flux. The illuminated, four-digit tape counter has no zero stop, and instead Hitachi fit one of the usual gap-detecting programming systems that will perform all sorts of tricks, provided you have the patience to use it.

Lab report

I was surprised at how inaccurate the bias/record-equalisation settings of this machine were. Bias was high for all three tape types, giving rather poor treble overload figures compared with other machines. There was too much high frequency gain in the record amplifiers for ferric and metal tapes, giving IEC I (ferric) and IEC IV (metal) Primary Reference Tapes the strongly rising treble shown in the frequency response graphs. A second sample was requested and displayed similar problems.

Few decks are so inaccurate these days and the error was too great to be fully compensated for by careful tape selection; as always, Dolby noise reduction magnifies the problem. Cheap ferrics and Maxell *MX* metal are the best choices for this deck.

With chrome, frequency response was flat on both samples, giving a good match to tapes like TDK *SA* and Maxell *XL-II*. BASF *CR-EII* will work as well, due to low sensitivity setting.

Replay frequency response displayed slowly falling treble on both channels, in both directions of play. This was not due to head azimuth, which was correct, but to replay equalisation not meeting the latest IEC requirement, according to BASF's test tape which is meant to set the standard. Hum in the replay amplifiers was high, the most audible 150Hz component measuring only −56dB. A figure of −60dB or lower is needed. Hiss was low enough, though.

Severe flutter was immediately audible when testing the transport for speed stability. This gave steady tones a fast whirring, buzzing sound, affecting replay-only performance (which relates to musicassettes) as much as it did record/replay performance. Measured level varied over minutes

from 0.2% up to 0.4%, spectral analysis revealing a flutter rate of 36Hz and flutter sidebands up to −15dB below the test tone — an appalling performance in my view, and worse than any other deck tested in this book. The problem existed in forward and reverse.

In contrast, wow was very low at 0.05%. The second review sample had similar spectral pattern, with more wow but less flutter. The flutter peak was still evident though and is obviously an inherent problem.

Sound quality

With metal tape (TDK *MA*) piano sounded 'jangly', cymbals 'jumped out' on us and there was strong sibilance on vocals — all caused by treble lift. A fast 'burring' quality was audible, due to speed instability, plus 'cracked' tone. Piano, recorded with Maxell *MX* tape, suffered severe fast 'burring' (flutter).

Chrome tape (TDK *SA*) had a much softer and more relaxed sound. Piano notes were unsteady and the fast 'burring', although not generally so noticeable, was heard on organ. Flutter again made itself immediately known on guitar with ferric (TDK *AD*). Treble was accentuated, thin and unpleasant.

Subjectively, hum was not a problem on replaying musicassettes. Imaging proved good and transients well maintained. Upper treble was obviously missing, introducing a somewhat rounded and plummy character. Flutter was not so obvious, but could be detected on piano.

Summary

Neatly styled, this auto-reverse machine benefits from an optical fast-reverse system. The flat, flexible transport control touch plates had a light action and were pleasant to use, if poorly identified, while the logic proved very comprehensive, and we found that they would respond to all commands.

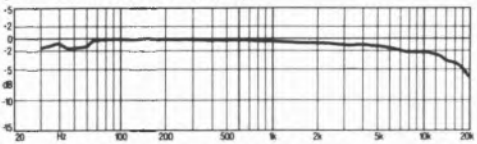
The eye-catching blue and red fluorescent display panel embraces record level meters, an illuminated tape counter and warning legends, including Dolby B and C indication. Tape type selection was manual unfortunately.

Measured performance of this deck was very poor in numerous areas, the problems recurring on two samples, and sound quality predictably suffered as a result. Severe flutter produced 'dirty' treble, high frequency emphasis on ferric and metal tapes unpleasantly emphasising the problem. Replay sound quality was somewhat lacklustre. A poor deck.

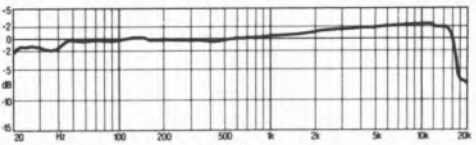
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-12.0kHz	good
Speed accuracy	+0.3%	very good
Noise	−59dB	average
Record/replay using blank tape		
Frequency response, ferric	20Hz-6.0kHz	poor
Frequency response, chrome	20Hz-17.0kHz	very good
Frequency response, metal	20Hz-14.0kHz	good
Stereo separation	−48dB	average
Distortion	1.6%	poor
Noise	−54dB	very good
Speed variation	0.06%	good
Modulation noise	−40dB	good
Flutter energy (band level)	−20dB	average
MOL, ferric, 315Hz/10kHz	+4.2dB/−8.0dB	good
MOL, chrome, 315H 10kHz	+0.5dB/−10.0dB	average
MOL, metal, 315H 10kHz	+4.3dB/−2.0dB	very poor
Input/output performance		
Line in sensitivity/overload		80mV/>3V
Mic input sensitivity/overload		0.45mV/36mV
Output		500mV
Typical price inc VAT		£200

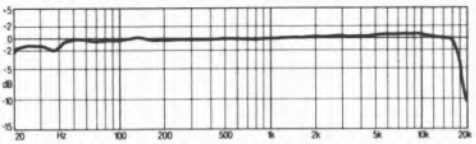
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



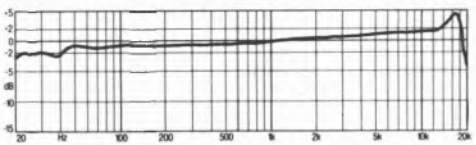
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

JVC KD-X2

JVC (UK) Ltd, JVC House, 12 Priestley Way, Eldonwall Trading Estate, Staples Corner, London NW2 7AF
Tel 01-450 3280

Outwardly, the JVC *KD-X2* looks very much like the *KD-V220*, also tested in this edition, and in fact it was a job for me to tell them apart! However, I believe that the slightly simpler *KD-X2* is the earlier design.

The record level meters use individual LEDs instead of the continuous-strip fluorescent display of the *V220*. Transport control buttons are a conventional mechanically linked array which JVC have called 'logic control', although there is no electronic logic at all, only cross-linked mechanical actions. Such mechanical arrangements are common and do allow certain awkward commands to be carried out, like fast forward from fast reverse. However I feel that calling them 'logic controls' is stretching the definition somewhat.

JVC also fit a 'music scan' system on this deck which works by searching for the gaps between tracks.

Dolby B and C noise reduction systems are provided, and are selected by a rather small lever switch, as is tape-type.

The *KD-X2* was fairly easy to use, but it was much like the *V220* in having a somewhat fussily styled fascia.

Lab report

The head contour of this deck proved inferior to that of the *V220*, with its frequency response undulations starting at 150Hz instead of 60Hz — as the recording graphs show. However, replay response was much the same between the two decks, displaying slight treble shelving to 10kHz, after which output falls away. The effect was slight though and by budget standards the *KD-X2* was well set-up to get correct tonal balance from musicassettes, without the extremely dull, vague sound that is so common.

Replay noise was adequately low, and produced just very slightly hissy recordings. Although the *KD-V220* improves on this performance (by 2.5dB), the *KD-X2* was still comparable to most decks and beyond serious criticism I feel.

Replay speed measured 2% fast, which is a discernible error if the programme has previously been heard at correct speed. Replay speed stability was adequate and identical to that of the *V220*.

Record/replay speed instability was again much like that of the *V220* in terms of wow. However, more critical spectral analysis of the demodulated test signal revealed more flutter in the *KD-X2* transport, but a similar amount of capstan wow. Performance figures were quite adequate all the same; the *'X2* was as speed-stable as most good budget machines. Nakamichi standards can't be expected at this price!

Ironically, bias adjustment of the *KD-X2* was better balanced than that of the *V220*, giving around +3dB more treble headroom with ferric and chrome tapes. Sensitivity was more accurately set for commercial tapes too, and all frequency responses were slightly flatter, as the graphs show. Inevitably this is subject to some variability on budget decks, and it appears that

the *V220* is no more accurately set at the factory than the *KD-X2*. Other manufacturers get better results from their products in this area than do JVC.

Sound quality

Metal tape (TDK *MA* and JVC *ME*) gave a slightly glassy hard sound with a degree of spitching with sibilance. Wow slightly corrupted the sound of harmonica and organ.

Treble 'feathered' with TDK *SA* and there was again a glassy quality. Wow was noticed as a 'watery' quality, but we felt the overall result was fair.

Ferric tape gave very even tonal balance, but slight loss of treble detail. Cymbals were a bit swishy. In general though, we felt the result was good.

Over-large, plummy bass was obvious with musicassettes and low level fine detail was weak. Being evenly balanced across the midrange though, we felt the character wasn't unpleasant and there was surprisingly convincing stereo. Generally, a nice sound.

Summary

A fairly basic budget deck with Dolby B and C noise reduction, the *KD-X2* uses LEDs rather than fluorescent displays, for record level metering, and has mechanical transport controls. Although these transport buttons are mechanically interlinked, they do not in our view justify the term 'logic control'. They would not allow, for example, 'punch-in' recording or going direct from record into fast rewind, operations which are possible on the electronically-controlled transport of the JVC *KD-V220*.

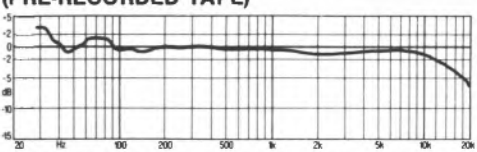
Performance of the *KD-X2* was marginally inferior to the *V220* in many areas, but not that of tape matching. Because this is so important with regard to sound quality of recordings, it actually made better balanced recordings than the *V220*. Musicassette replay quality was similar and judged good because of its clarity, but replay speed was too fast. Despite some weaknesses, then, the *KD-X2* must be a Best Buy at the price.

BEST BUY

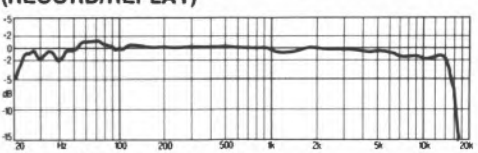
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	35Hz-12.0kHz	good
Speed accuracy	+2.0%	very poor
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	22Hz-14.0kHz	good
Frequency response, chrome	22Hz-15.0kHz	very good
Frequency response, metal	22Hz-15.0kHz	very good
Stereo separation	−49dB	average
Distortion	0.6%	good
Noise	−53dB	good
Speed variation	0.12%	average
Modulation noise	−39dB	average
Flutter energy (band level)	−29dB	good
MOL, ferric, 315Hz/10kHz	+4.0dB/−6.5dB	good
MOL, chrome, 315Hz/10kHz	+0.0dB/−6.5dB	average
MOL, metal, 315Hz/10kHz	+3.0dB/+0.0dB	average
Input/output performance		
Line in sensitivity/overload	75mV/>3V	
Mic input sensitivity/overload	0.34mV/22mV	
Output	300mV	
Typical price inc VAT	£100	

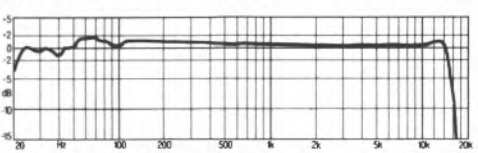
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



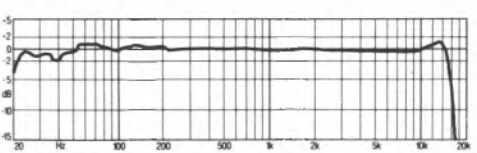
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

JVC KD-V220

JVC (UK) Ltd, JVC House, 12 Priestley Way, Eldonwall Trading Estate, Staples Corner, London NW2 7AF
Tel 01-450 3280

JVC's budget cassette decks have invariably been good value. The *KD-V220* is yet another new model in the company's large and regularly updated range, being a low-cost basic design fitted with Dolby B and C noise reduction systems.

The satin black front panel looks quite busy, since it carries a number of white legends, a few warning lights, a considerable web of white styling lines, plus the usual array of controls and buttons. Tape type selection is manual, using a rather small lever switch, a similar switch being used for Dolby selection.

JVC manage to include comprehensive logic control at the price, with punch-in recording and rewind direct from record. The press-plates were a bit stiff, causing the deck to slide backward on shiny surfaces, I found. I held it down during the test. A 'shift' key modifies their role; if it is pressed down simultaneously search facilities like 'Index-scan' and 'Blank-skip' are activated.

The bright blue fluorescent displays of the record meters were easy to see and followed musical peaks well. The visual clutter of the fascia made switch finding a trifle awkward and automatic tape type selection would have been more worthwhile than some of the gadgets, I feel, but the logic was good at the price.

Lab report

Bias had been set high, favouring midband distortion and overload performance on recordings, at the expense of treble overload (saturation), which was poor.

This trade-off produces messy treble.

Bias ratios for the three tape types were inappropriate for European (IEC) tapes. With IEC IV metal just about 'flat' (see graph), IEC I ferric has falling treble. Accentuated by Dolby action, the result will be a dull sound with ferric tapes, except those with very high treble sensitivity, like Maxel *XL-IS*. Sensitivity was +2dB too high as well. Most pseudo-chromes, like TDK *SA* and Maxell *XL-II*, will match well.

Metal tape matching was problema'.ic. The treble peak visible in the graph with IEC IV tape becomes a pronounced treble rise with tapes like TDK *MA* and Sony *ES*. Dolby action magnified this considerably on the review machine, since Dolby tracking was poor due to incorrect sens.tivity setting again (+2dB error with *MA*), giving excesssive treble under test.

Maxell *MX* was the best match, but wideband noise testing of spectral balance whilst level-tracking showed some treble emphasis even with this tape.

Record and replay amps produced very little noise. Hiss on recordings, using Dolby C, measured −74dB, but there was slight hum that measured −60dB on the more audible 100Hz component, as well as at 50Hz.

I rarely mention cassette decks' mic amps, even though they were tested. JVC's gets a mention here because it overloaded at 10mV (7% distortion) instead of around 30mV, like most. Sensitivity was low too, so a high output mic, though more likely to cause overload, is needed.

The transport was reasonably flutter free but exhibited rapid capstan warble (wow) at a rate of 7Hz.

Replay frequency response was quite well maintained to high frequencies and Dolby B replay tracking accurate as a result. Musicassettes should not sound dull.

Sound quality

With TDK *MA* a bright sound was obvious, but an absence of grittiness and 'blasting' probably due to the low flutter of this machine, made it acceptable, at least in the short term. Maxell *MX* had a more even tonal balance and provided a good all-round performance, we felt. Slight hum was just noticeable at high volume, plus wow on critical programme.

TDK *SA* (pseudo-chrome) gave a slightly dull and warm tonal balance with treble loss due to saturation. Transients, as with strummed steel-string guitar, were blurred, as were hi-hat cymbal sounds.

There was general loss of definition. Wow added to the blurring and became obvious with critical programme such as piano.

Ferric (TDK *AD*) had a warm tonal balance and lacked both detail and definition. Wow again smeared the performance and was noticed with organ and piano in particular.

Musicassettes had fine tonal balance and well-defined treble, noticeable with harpsichord, guitar and hi-hat in particular.

There was plenty of treble at low levels too. Again, wow was noticed and by this time we felt that piano and organ lovers might object very strongly to it.

Summary

Despite a fairly congested front panel, the *KD-V220*'s logic-controlled transport made operation easy enough, especially since the logic was comprehensive. Scan and search facilities are included, amounting to quite a lot for the price. Dolby B and C are fitted.

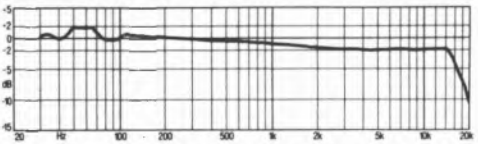
Measured performance was found a bit awry in various areas that affect recording quality, and wow proved disconcerting at times. Reasonable results were obtained with chrome tapes. Ferrics sounded dull and lifeless and metals somewhat bright, Maxell *MX* being a best match. Musicassettes were handled successfully — a good point.

TEST RESULTS

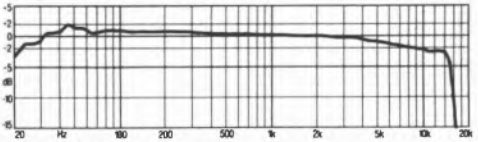
Replay of pre-recorded musicassettes		
Frequency response	25Hz-15.0kHz	very good
Speed accuracy	+1.0%	average
Noise	−62dB	very good
Record/replay using blank tape		
Frequency response, ferric	20Hz-14.0kHz	good
Frequency response, chrome	20Hz-16.0kHz	very good
Frequency response, metal	23Hz-16.0kHz	very good
Stereo separation	−49dB	average
Distortion	1.1%	average
Noise	−55dB	very good
Speed variation	0.15%	average
Modulation noise	−35dB	very poor
Flutter energy (band level)	−29dB	good
MOL, ferric, 315Hz/10kHz	+4.5dB/−9.0dB	average
MOL, chrome, 315Hz/10kHz	+1.0dB/−10.0dB	average
MOL, metal, 315Hz/10kHz	+4.0dB/−2.0dB	very poor

Input/output performance	
Line in sensitivity/overload	75mV/>3V
Mic input sensitivity/overload	0.4mV/10mV
Output	300mV
Typical price inc VAT	£140

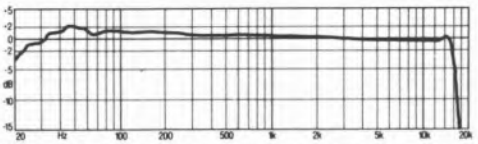
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



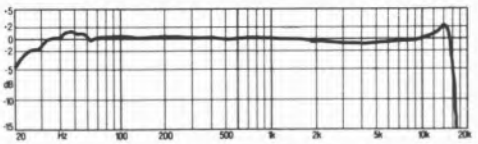
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

JVC KD-VR320

JVC (UK) Ltd, JVC House, 12 Priestley Way, Eldonwall Trading Estate, Staples Corner, London NW2 7AF
Tel 01-450 3280

Although only the next model up from the '*V220*, JVC's auto-reverse '*VR320* felt better built and looked better finished too. In this sense it was altogether a nicer product, but like the '*V220*, it lies in a very competitive market sector where a lot of alternatives are available.

This is a low-cost auto-reverse deck, with reverse recording — achieved by use of a rotating head platform. The *VR320* does not have optical leader-tape sensing for fast reverse, so unattended recordings of an entire cassette will have a gap of around ten seconds of missing programme at the end of the first side, as the leader tape runs through before and after reversing. The '*VR320* shares this minor drawback with many other decks that don't use optical sensing.

The transport buttons were small, square panels that proved easy to tap with a finger and they needed only very light pressure for easy operation.

JVC have built in a very comprehensive logic that accepts some of the most awkward commands, like punch-in recording and fast reverse direct out of record mode.

In contrast, the two interdependent buttons for tape selection are small, have very small legends and so are difficult to use. Most other manufacturers have abandoned this cost-cutting arrangement as impractical.

Attractive bright orange fluorescent record level meters are fitted and these did a good job of indicating music peaks clearly.

Dolby B and C noise reduction systems are included here, plus auto-start from an external timer.

Lab report

Replay frequency response, which affects musicassette reproduction, was much the same on this deck as other recent JVC machines, like the '*V220* and '*X2*. It was flat (ignoring the minor −1dB shelving) to 10kHz, after which output fell away slowly (see graph). Freedom from reverse azimuth error gave an identical characteristic in reverse and there was no change or instability in output after repeated reversals. The machine was in good adjustment.

Spectral analysis of replay noise from 10kHz to 30kHz revealed use of an mpx filter in the replay path — a strange ruse, adopted, I suspect, to obtain improved noise figures. Lacking supersonic components above 16kHz, replay noise (CCIR weighted) was very low at −63dB (−72dB Dolby B). Recording noise was lowered by a dB or so too. A notably low level of hum suggests that JVC engineers have tried hard to achieve a low all-round noise performance.

The transport ran fast by 1%, forward and reverse, which is just acceptable. Speed stability was relatively good, wow being distributed, rather than concentrated into one objectionable component. Flutter was well suppressed too. Performance in reverse was similar to that going forward and replay-only showed similar characteristics.

Peak record level has been kept down to −2dB below Dolby flux, which helped toward the low

OVU average distortion figure of 0.5% — high bias also played a part here. Treble overload (saturation) figures were poor and the head had trouble coping with the high bias required for metal tape, giving poor overload results (MOL and saturation).

Again, as on the '*V220*, the microphone amplifier overloaded prematurely at just 10mV (for 7% distortion). Most manage 30mV or so.

Recording frequency responses were gratifyingly flat with all tape types — as the graphs show. Dolby tracking was poor however, upsetting these results at low levels.

Sound quality

TDK *MA* metal gave a rich and ponderous sound. It wasn't unpleasant, but lacked bite and attack. Speed stability was disappointing on critical piano and organ programme. This tonal balance, we found, tends to disguise flutter and distortion problems, but it also generates a somewhat bland and unexciting sound.

Tonal balance with TDK *SA* was fairly neutral, but slow wow was noticed. Transients were mildly blurred. However, quality was felt to be satisfactory.

TDK *AD* ferric tape gave a pleasantly euphonious result, with neutral tonal balance tinged by softening due to saturation.

The deck again gave neutral tonal balance with musicassettes, while good Dolby tracking brought out low level fine detail well. The sound had bite and was enjoyable. Wow and flutter seemed innocuous, except when listening to organ and piano when, after a while, its 'dirtying' effects became a bit wearing.

Summary

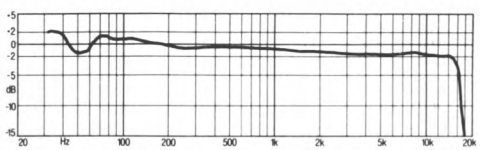
The *KD-VR320* is a well built and finished auto-reverse deck, but lacks quick auto-reverse. Its transport has full logic control and light, easy-to-use press-plates. Less fussy styling than the '*V220* gave it a neat appearance, bright orange fluorescent record meters being an eye-catching feature on this deck.

Uncommonly awkward tape selector buttons were annoying to use. Dolby B and C noise reduction are fitted. Measured performance was good, except for early overload in the mic amps, poor utilisation of metal tape performance and limited treble with ferric and chrome tapes. Recording quality with all tape types was felt to be good in the sense that it was inoffensive, but not exceptional. Musicassettes were handled very well compared with so many other decks.

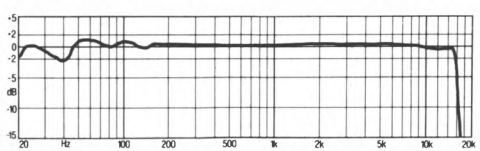
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	30Hz-16.0kHz	very good
Speed accuracy	+1.2%	average
Noise	−63dB	very good
Record/replay using blank tape		
Frequency response, ferric	20Hz-15.0kHz	very good
Frequency response, chrome	20Hz-16.0kHz	very good
Frequency response, metal	20Hz-16.0kHz	very good
Stereo separation	−49dB	average
Distortion	0.5%	very good
Noise	−55dB	very good
Speed variation	0.10%	good
Modulation noise	−39dB	average
Flutter energy (band level)	−28dB	good
MOL, ferric, 315Hz/10kHz	+4.0dB/−9.0dB	average
MOL, chrome, 315Hz/10kHz	+0.0dB/−8.0dB	average
MOL, metal, 315Hz/10kHz	+3.0dB/−2.5dB	very poor
Input/output performance		
Line in sensitivity/overload	85mV/>3V	
Mic input sensitivity/overload	0.35mV/10mV	
Output	300mV	
Typical price inc VAT	£190	

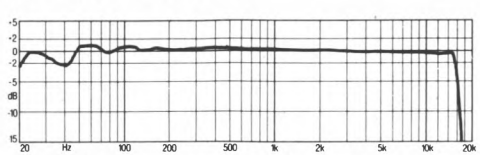
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



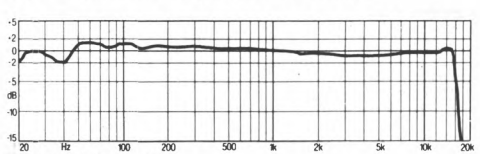
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Marantz SD-152

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

Marantz have adopted more discrete styling lately, seen in the satin black finish and gold lettering of the *SD-152*. The machine looks fairly smart and proved more pleasant to operate than the preceeding budget model. My only reservation this time regards the legends, which were confusing. Dolby B and C noise reduction systems are selected by a large, square button at the end of the row set out for tape-type selection, and I found myself pressing this by mistake when trying to select ferric tape. But doubtless owners will quickly overcome this.

Although the transport buttons are mechanical in their linkage to the transport, they had a fairly easy action and didn't clank too furiously as budgets decks go. With clear legends above them. I found these buttons quite easy to use. A simple three-digit, unlit mechanical tape counter is fitted, without zero-stop. There are twin microphone inputs and a headphone output too.

The LED record level meters had limited range, reaching down to −10dB only. Their marked maximum of +6 proved to be actually just +3dB above Dolby level, so it was impossible to know what musical peaks were doing when trying to utilise the full capabilities of metal tape. In the event though, it proved wise to keep metal record level down in any case.

Lab report

A respectably flat replay frequency was measured on both channels, output falling away slowly above about 10kHz.

Dolby B replay tracking was excellent, largely because of the flat response, so this deck will give plenty of treble with musicassettes and not suffer the dullness and vagueness that afflicts so many.

The replay amplifiers were quiet, having adequately low hiss and hum. Track alignment was accurate too. Coupled with acceptable speed error, at 1% fast, and extremely good replay speed stability, the *SD-152* exhibited good all-round replay performance.

Record gain (sensitivity) adjustment for blank tapes was a bit awry, especially with IEC I (ferric) where gain was +2dB too high. This would suit insensitive budget tapes only.

Recording frequency responses were very well adjusted for quality chrome and metal tapes and the machine obviously has quite a good head; the graphs show there were few ripples or funnies. Marantz have obviously opted to adjust the deck for cheap ferric tapes though, since treble rises with IEC I, which represents little better than 'cooking' ferric these days. Dolby tracking was very accurate with matching tapes.

Budget decks from Japan progressively improve and the *SD-152* is no exception here. Its transport was surprisingly speed stable, basic drift being negligible. As a result, wow was low and fairly random in nature.

Analysis showed no dominant capstan component. There were no flutter 'shoulders' around a fundamental tone, as evidenced by the low flutter band-level of −30dB.

Both separation and distortion figures were

good enough to pass without comment. Ferric headroom figures were excellent, chrome average and metal somewhat poor. In fact bias was a bit low for metal, giving excellent treble overload at +0.5dB but unusually low mid-band overload at +1.5dB.

Sound quality

Possibly due to early overload (low MOL), metal tape often distorted on vocal peaks, causing spitching. Tonal balance was thought amenable, though with recessed detail. Keeping level down made hiss more obvious, since metal is noisy. Hum was not a problem though.

Chrome (TDK *SA*) had, like metal, a recessed and distant quality, but was again considered amenable to listen to. There was some loss of clarity and featheriness in the treble, but on the whole, reproduction of the *SD-152* reached a good standard.

TDK *AD* had obviously rising treble on this deck, and sounded unpleasant. Memorex *MRX1* gave a more even tonal balance and although a bit treble-soft proved compatible all the same, we felt.

A forward midband in the replay response made musicassettes sound slightly dull and 'cuppy', which was not too pleasant a quality. However, there was good imaging and adequate treble under all conditions, which alone was quite good for a budget machine so, on balance, the *SD-152* managed fairly well compared with usual in this area.

Summary

The *SD-152* is a basic cassette recorder bereft of facilities, but still incorporating Dolby C in addition to Dolby B. It caters for metal tape too, so meets the minimum requirement for hi-fi recordings these days.

Whilst some low-cost recorders sound and feel somewhat crude, the *SD-152* managed to avoid this.

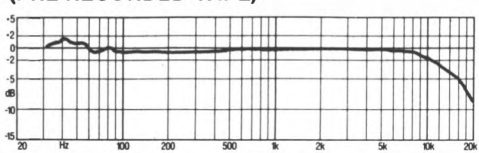
Although its 'budget' market position is obvious on inspection, all the controls worked positively and, confusing legends apart, it proved fairly easy to use.

Measured performance was up to scratch for the price; no glaring weaknesses exist. Sound quality with musicassettes had plenty of treble: we judged it acceptable. Recordings on good ferric tape were bright, but on chrome results were relatively good. Metal tape was a trifle disappointing because it would not accept high recording levels, making hiss more obvious.

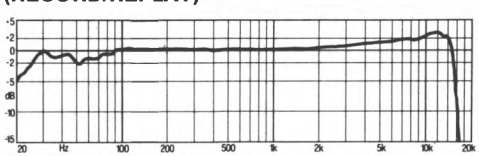
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	24Hz-12.0kHz	good
Speed accuracy	+1.0%	average
Noise	−59dB	average
Record/replay using blank tape		
Frequency response, ferric	23Hz-10.0kHz	good
Frequency response, chrome	23Hz-15.0kHz	very good
Frequency response, metal	23Hz-15.0kHz	very good
Stereo separation	−49dB	average
Distortion	1.1%	average
Noise	−53dB	good
Speed variation	0.08%	good
Modulation noise	−40dB	good
Flutter energy (band level)	−30dB	very good
MOL, ferric, 315Hz/10kHz	+3.5dB/−4.5dB	good
MOL, chrome, 315Hz/10kHz	−0.5dB/−7.0dB	poor
MOL, metal, 315Hz/10kHz	+1.5dB/+0.5dB	very poor
Input/output performance		
Line in sensitivity/overload	80mV/>3V	
Mic input sensitivity/overload	0.6mV/26mV	
Output	500mV	
Typical price inc VAT	£105	

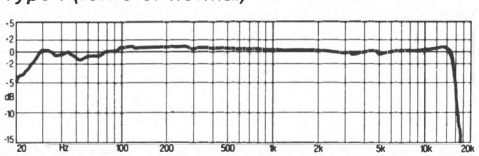
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



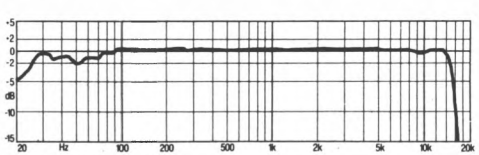
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Marantz SD-451

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

With this auto-reverse model Marantz have adopted the now-common rotating head platform arrangement, which allows reverse recording as well (unlike the fixed-head *SD-340* reviewed in the last issue). However, Marantz have not adopted optical leader sensing for fast reverse, so when recording or playing there will be a gap of many seconds in a programme before reverse is actuated at the end of a tape.

The transport looked very solidly built and the deck in fact did feel well made. Helping this impression were the transport control buttons, set out in a neat row and linked in with logic. They had a short, light action and could be lightly tapped with a finger to give the transport a command.

Marantz have fitted a number of music finding options, most being related to the ability to detect quiet passages between tracks. It can scan a tape, giving 10 seconds play from each music track, it can find a numerically specified track or it will return to a particular point on a tape that has been previously specified by pressing a 'memory' button. Repeat play of a track or whole tape is possible too.

Automatic tape-type selection is fitted, which is not only convenient, but also prevents ruined recordings through mis-selection of tape type. Marantz provide a bright blue illuminated tape counter and both Dolby B and C noise reduction systems.

The *SD-451* is neatly styled and has a clearly legible front panel, free of visual clutter and ambiguities. It proved simple enough to use.

Lab report

Correctly adjusted for IEC Primary Reference tapes in terms of frequency response — as the flat graphs show — this deck will give even tonal balance with most quality blank tapes, including chromes. As with the *SD-152* model, record-gain (sensitivity) for ferrics was set a bit high, apparently favouring budget types like TDK *D* for good dolby tracking. However, these will sound a trifle dull, so some juggling with tapes will be needed to find the best one.

Metal tape matched well for frequency response and sensitivity, but maximum midband output at +3dB was lower than that of good ferrics, suggesting head limitations with the high bias required for metal. Results will be respectable all the same, since treble performance with a tape like TDK *MA* will be superior to that of other types. *MA* will also beneficially lift treble a bit, cancelling the droop of the IEC IV test tape seen in the graph.

Chrome tape matching will be very good with brands like TDK *SA* and Maxell *XL-II*, with accurate Dolby tracking maintained at low levels.

Peak record level has been set at Dolby reference level flux (200nWb/m) as is now common, but the OVU LED is red, so music peaks should be taken 'into the red' when recording, otherwise hiss will become noticeable. Both the record and replay amps were, in themselves, hiss and hum free though, so hiss levels are tape and not

machine dependent, around −72dB being possible with Dolby C.

Marantz use a good transport that was fairly speed accurate and speed-stable in both directions although cyclic wow (6Hz) was heard under test — especially in reverse. Flutter was well suppressed.

Treble output on replay only fell steadily above 2kHz, being +2dB down at 10kHz on both channels, forward and reverse. This was poor and inevitably Dolby B made the error worse, since it always magnifies response deviations.

Sound quality

With Sony *ES* metal the *SD-451* had a prominent upper midrange delivery, weak lower bass and somewhat coarse, treble, this latter quality being attributed to flutter. Treble lift continually drew attention to this problem, and much of the 'shimmering' was lost with Maxel *MX*, which sounded altogether more amenable. Wow was just detectable as a fast, regular modulation of sustained organ notes and the like; this was a minor blemish.

TDK *SA* (pseudo-chrome) gave even tonal balance, healthy treble and some slight smear. It was rated as more pleasant over a period than metal, if less explicit at high frequencies.

Ferric (TDK *AD*) displayed solid bass and even tonal balance, with good apparent treble extension. There was the usual HF messiness and grainy quality of ferric tape, but overall, the result was good.

Musicassettes sounded 'enclosed', lacking low-level detail and vocals were thick and congested. Imaging exhibited stability and was liked. There was a strong bass slam too. Upper treble was missing completely.

Summary

The *SD-451* is an auto-reverse deck capable of reverse recording, but does lack a fast reverse system to cut out silent gaps at the end of a tape. Marantz have fitted a whole variety of music search and scan functions.

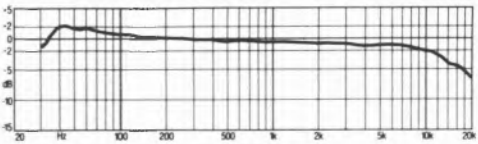
The machine is well built and cleanly styled. Inclusion of automatic tape-type sensing and large transport buttons with a short, light action made it effortless to use and commands were not met with clanking noises from the mechanics, except when auto-reversing.

Sound quality with musicassettes was found mediocre, being dull and lacked clarity or detail. Recording quality reached a good standard with chrome and ferric tape types though, and was beyond serious criticism at the price.

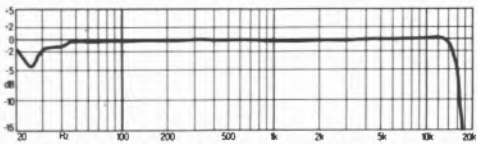
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	28Hz-10.0kHz	good
Speed accuracy	+1.1%	average
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	28Hz-15.0kHz	very good
Frequency response, chrome	28Hz-16.0kHz	very good
Frequency response, metal	28Hz-15.0kHz	very good
Stereo separation	−49dB	average
Distortion	1.4%	average
Noise	−54dB	very good
Speed variation	0.12%	average
Modulation noise	−49dB	very good
Flutter energy (band level)	−29dB	good
MOL, ferric, 315Hz/10kHz	+4.5dB/−8.5dB	average
MOL, chrome, 315Hz/10kHz	+1.0dB/−8.0dB	good
MOL, metal, 315Hz/10kHz	+3.0dB/−0.5dB	poor
Input/output performance		
Line in sensitivity/overload		90mV/>3V
Mic input sensitivity/overload		0.6mV/26mV
Output		400mV
Typical price inc VAT		£160

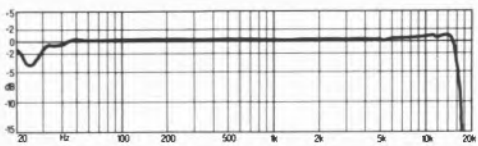
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



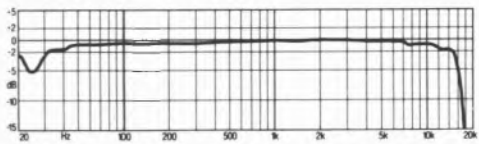
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Marantz SD-74

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

This is an expensive, three-head auto-reverse machine, fitted with dbx in addition to Dolby B and C noise reduction systems. Marantz told me the word 'digital' on the fascia referred to their view that dbx made the *SD-74* 'digital ready' by giving it as much dynamic range as digital systems (such as Compact Disc). But the view that dbx gives cassette the performance of digital systems like Compact Disc, is one that I (and many others) cannot share. In practice dbx introduces noise modulation — the noise level, though low of course, goes up and down with the signal level — and the effect of this is to produce a 'whooshing' around solo piano notes, for example. This degradation in my view outweighs the slightly lower overall hiss level, compared with Dolby C. However, the *SD-74* has Dolby C for those who prefer it.

Fitting independent record and replay heads in the rotating head platform introduces problems. Twin independent, stationary erase heads must be used for reverse-recording, making this a four-head deck. (Marantz's marketing department missed this one!). Fast auto-reverse with optical leader tape sensing is used, an unusual feature being that this will not function until 15 seconds playing time has elapsed.

A selection of music search systems are fitted which, as on all machines, are based on an ability to detect gaps between pieces of music. Bright blue fluorescent displays are used for the record level meters and the tape counter. The transport is logic controlled and worked nicely, although it is noisy when direction changing and a small stop button was difficult to find. The *SD-74* did not really seem to offer much of value in the way of facilities, considering its price.

Lab report

The head end stops were out of adjustment in the reverse direction, introducing azimuth error and falling treble (−4dB at 12kHz) in the replay frequency response, this being amplified as always by Dolby B. However, in the forward direction, the replay response demonstrated that Marantz do attempt to follow IEC 94.

Hiss in the replay amps was low, but at −59dB hum was not — though it only became noticeable with low level recordings played at high volume. Low hiss in the record amps and −18.5dB of noise reduction with Dolby C kept hiss to a low level of −72.5dB with chrome tape. Peak record level (OVU) has been set to Dolby level.

The transport ran slow forwards (−0.3%) and fast backwards (+0.7%), giving a speed difference of 1% which, with fast reverse, will be just noticeable.

Speed stability characteristics varied, both over time and between forward and reverse. In reverse, jerky speed variations produced 0.3% flutter peaks and, over a period of many minutes, wow would occasionally rise to 0.2%. Although not by any means intolerable, this was still not overly impressive considering the price. Marantz's own budget decks managed better.

Distortion was very high at low frequencies,

where it measured 4.5%, hence degrading the overall average figure to that quoted in the results table. The head gave good overload figures with ferric tape but was no better with metal. I suspect that it was saturated by the high bias needed for metal.

Frequency response with ferric and chrome tapes was flat, as the graphs show, but metal had some bass emphasis. Dolby and dbx emphasised this at low levels. Sony *ES* metal tape gave good results, due to its increased treble sensitivity, which was useful here.

Sound quality

Initial recordings on TDK *MA* were bass heavy, but this cleared after a few auto-reverses, settling down to a slightly warm tonal balance, displaying acceptable treble attack. Wow was apparent even with non-critical rock music with vocals, piano and the like. It 'blurred' recordings and was generally heard as smearing, rather than discrete warbling. dbx gave 'sing-along' hiss, as usual, Dolby C being preferable.

Chrome (TDK *SA*) gave a good, even tonal balance but the speed stability problems remained, introducing blurring. Distortion was heard on vocals, doubtless due to the very low MOL of the deck. It added messiness to the sound.

Ferric (TDK *AD*) gave the same warm sound as metal, but with fluffier treble, as is usual. Both wow and flutter were heard to contaminate the vocals.

Musicassettes gave well differentiated treble detail in the forward direction, but a woolly sound with muffled transients in reverse. Speed instability was apparent as obvious irregular warbling of sustained notes. Gritty flutter components were heard too.

Summary

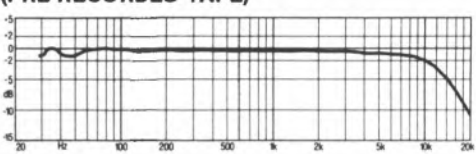
The *SD-74* is expensive with the ability, unusual in an auto-reverse deck, to provide off-tape monitoring, via the independent record and replay heads which are siamesed together on a rotating head platform. In spite of the high price, some useful facilities are omitted. Music search systems have been included, but not automatic tape-type selection or user adjustable bias for tape tuning. The transport uses single-capstan drive too.

The deck was found easy to use, except for its small stop button. Sound quality was mediocre-to-poor in most respects. Overall, we thought that this up-market Marantz model represented poor value for money.

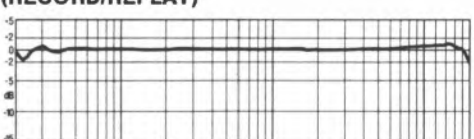
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	28Hz-10.0kHz	good
Speed accuracy	+0.7%	good
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-20.0kHz	very good
Frequency response, chrome	20Hz-20.0kHz	very good
Frequency response, metal	20Hz-20.0kHz	very good
Stereo separation	−48dB	average
Distortion	3.1%	very poor
Noise	−54dB	very good
Speed variation	0.14%	average
Modulation noise	−35dB	very poor
Flutter energy (band level)	−24dB	average
MOL, ferric, 315Hz/10kHz	+3.5dB/−5.0B	good
MOL, chrome, 315Hz/10kHz	−1.0dB/−5.5dB	poor
MOL, metal, 315Hz/10kHz	+3.0dB/+0.0dB	average
Input/output performance		
Line in sensitivity/overload	85mV/>3V	
Mic input sensitivity/overload	—mV/—mV	
Output	500mV	
Typical price inc VAT	£315	

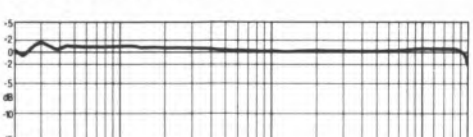
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)

Type IV (metal)

NAD 6155

Hi-Fi Markets Ltd, Cousteau House, Greycaine Road, Watford WD2 4SB
Tel (0923) 27737

Styled to look chunky, the *6155* comes in NAD's usual rather sombre dark grey finish; confusing styling artifices such as unnecessary legends and lines are absent. Partly as a result of this, the deck was easy to understand and use.

Transport buttons actuate the cassette mechanism mechanically, so they lack logic and clank a bit. However, not much pressure is needed to operate the buttons, so the deck stood firm in use.

Innovation comes in the form of 'play trim' — a control that trims treble level to achieve flat replay frequency response, prior to Dolby deprocessing. This avoids the approximate doubling of replay errors that Dolby B introduces at low levels and is meant to combat the dull, lacklustre sound so frequently mentioned in this book with musicassette reproduction.

Variable bias is also included, operating on all three tape types, including metal. It provides tape tuning, allowing a wide variety of blank tapes to be used. There is a switchable 19kHz pilot tone (MPX) filter. LED record level indicators cover a good range and have OVU set to Dolby flux, as usual. They are placed after the treble boost of record-equalisation so show actual treble levels reaching tape. Finally, but importantly, Dolby HX Pro provides overload 'headroom extension'.

Lab report

Azimuth was a bit out on my early test sample and treble output proved initially unpredictable, due to shaky head/cassette location. After use and azimuth re-alignment (it's not generally my policy to do this), the deck settled down, providing a reliably flat replay frequency response to 10kHz with zero play trim, according to the official IEC (BASF) test tape. Above 10kHz, output fell slowly to −3dB at 18kHz, as the graph shows.

'Play trim' worked well, giving around 3dB lift and cut at 10kHz, not shown in the replay graph. This is meant to trim record-equalisation errors in musicassettes, which occur quite commonly, due to a lot of misunderstanding over standards. The other common problem of incorrect recorded azimuth is also combatted. Though not aimed at compensating for the deck's head azimuth error, it does a fair (if not perfect) job of this too.

'Play trim' should be zeroed for recordings made on the machine, since they don't suffer azimuth or record-equalisation errors (with matching tape). The record/replay graphs clearly show reasonable matching to IEC Primary Reference tapes at centre-bias, and (filter out) a broad, flat frequency response characteristic.

Output at very high frequencies was stable, contributing to a low modulation noise figure of −42dB. This is in spite of the use of a single capstan transport. Analysis showed that this mechanism suffers little flutter, reflected in the low modulation noise and flutter energy level in test results.

Distributed wow, though, was higher than usual, as one might expect from a solidly built transport with a heavy flywheel and thick capstan, but this balance is acceptable. Subjectively, flutter can be as annoying as wow, but in a different way.

Hiss and hum levels were low, although high hum harmonics were present. Dolby B and C tracked well. NAD, unlike Denon, have chosen to use Dolby HX Pro simply to improve treble overload margins. The *6155* shows some distinct traits here, ferric tape having high midrange but average treble overload ceilings, whilst chrome is the reverse. Metal tape did well in both areas.

Bias adjustment was sufficient to accommodate all awkward high performance tapes like Maxell *XL-IS* ferric, BASF *CR-MII* super-chrome, TDK *MA* and Maxell *MX*, giving the *6155* excellent flexibility and the potential for very accurate tape matching. Low input sensitivity calls for a high record level setting, especially with metal tape.

Sound quality

At centre bias TDK *MA* sounded edgy and had occasional peak distortion. Loss of clarity and 'imprecision' (slow wow) were noted too. Treble improved at '+4' bias. Maxell *MX* tape and use of conservative record level (+3dB above OVU) successfully provided a smoother, more confident sound with improved clarity, quality being judged very good, but piano remained 'watery' in pitch.

BASF *CR-MII* super-chrome (max bias) gave a very stable, even and natural sound, with fine clarity. It proved enjoyable and impressive. Slight drone (hum harmonics) was audible at high volume.

There was less muddle than usual with BASF *LH-MI* ferric tape (centre bias), but high level treble was thin and indistinct, due to saturation. Overall, quality was very good for ferric tape.

With musicassettes, piano again had a watery, imprecise quality to it — not offensive, but a degradation all the same. Generally though, sound quality reached a high standard, with well defined transients, a fine sense of clarity and solid bass. Imaging was good too. Play trim proved a valuable asset, limited boost often being needed to add zest and a sense of openness.

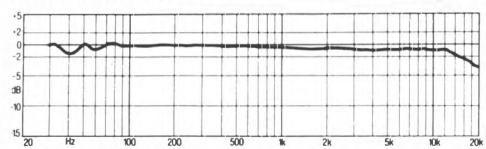
Summary

Solidly built, but fairly simple, the *6155* lacks many minor facilities but includes some valuable ones. Dolby HX Pro gives improved tape overload performance, user adjustable bias allows good and versatile tape matching while 'play trim', can minimise the dullness often heard with musicassettes. Easy enough to use, the deck 'feels' less sophisticated than most at the price. Balancing this was a good measured performance and excellent sound quality from musicassettes and recordings, 'advanced' tape being usable. Slight wow compromised critical programme.

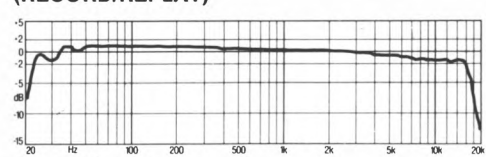
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	22Hz-16.0kHz	very good
Speed accuracy	+1.5%	poor
Noise	−58dB	average
Record/replay using blank tape		
Frequency response, ferric	22Hz-16.0kHz	very good
Frequency response, chrome	22Hz-17.0kHz	very good
Frequency response, metal	22Hz-18.0kHz	very good
Stereo separation	−52dB	good
Distortion	1.3%	average
Noise	−53dB	good
Speed variation	0.13%	average
Modulation noise	−42dB	good
Flutter energy (band level)	−34dB	very good
MOL, ferric, 315Hz/10kHz	+4.5dB/−8.0dB	good
MOL, chrome, 315Hz/10kHz	+0.5dB/−4.0dB	average
MOL, metal, 315Hz/10kHz	+4.0dB/+2.5dB	good
Input/output performance		
Line in sensitivity/overload	130mV/>3V	
Mic input sensitivity/overload	—mV/—mV	
Output	650mV	
Typical price inc VAT	£200	

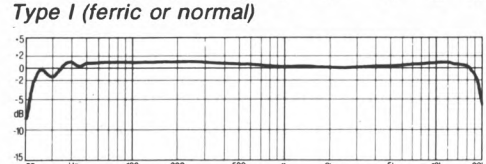
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



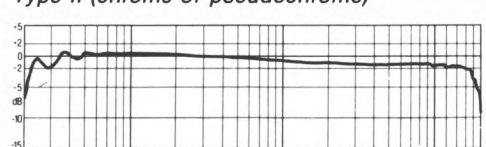
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Nakamichi

Pop into your nearest Nakamichi stockist. You'll be convinced.

LISTEN HERE AND YOU'LL SEE

AVON
BATH Paul Green Hi-Fi (0225) 316197
BRISTOL Absolute Sound & Video (0272) 24975
Radford Hi-Fi (0272) 40878
WESTON-SUPER-MARE Paul Roberts Hi-Fi (0934) 414423

BEDFORDSHIRE
KEMPSTON Bedford Audio (0234) 854133
LUTON Technosound (0582) 30919

BERKSHIRE
BRACKNELL B&B Hi-Fi (0344) 424556
NEWBURY B&B Hi-Fi (0635) 32474
READING B&B Hi-Fi (0734) 583730
WINDSOR Radford Hi-Fi (0753) 556931

BUCKINGHAMSHIRE
AYLESBURY Chiltern Hi-Fi (0296) 31020
CHESHAM Chesham Sound & Vision (0494) 786494
HIGH WYCOMBE B&B Hi-Fi (0494) 35910
MILTON KEYNES Technosound (0908) 604949

CAMBRIDGESHIRE
CAMBRIDGE University Audio (0223) 354237
Audio Services (0223) 68305
PETERBOROUGH Hi-Fi People (0733) 41755

CHESHIRE
WARRINGTON Doug Brady (0925) 828009
WILMSLOW Hi-Fi Centre (0625) 524766

CORNWALL
CAMBORNE Camborne Audio (0209) 714286

CUMBRIA
CARLISLE Mison Radio (0228) 22620
WHITEHAVEN H. L. Elliott (0946) 3671

DERBYSHIRE
CHESTERFIELD Audio Centre (0246) 34923
Audio Scene (0246) 204005
DERBY Active Audio (0332) 380385

DEVON
EXETER Gulliford Hi-Fi (0392) 218895

DORSET
BOURNEMOUTH Suttons Hi-Fi (0202) 25512

ESSEX
BRAINTREE Beechwood Audio (0376) 29060
BRENTWOOD Brentwood Music Centre (0277) 221210
COLCHESTER Audio File (0206) 577519
EPPING Chew & Osborne (0378) 74242
RAYLEIGH Rayleigh Hi-Fi (0268) 779762
SAFFRON WALDEN Chew & Osborne (0799) 23728

GLOUCESTERSHIRE
CHELTENHAM Absolute Sound & Video (0242) 583960

HAMPSHIRE
CHANDLER'S FORD Hampshire Audio (042 15) 65232
PORTSMOUTH Hopkins Hi-Fi (0705) 822155
WINCHESTER Whitwams (0962) 65253

HERTFORDSHIRE
BISHOP'S STORTFORD The Audio File (0279) 506576
WATFORD Acoustic Arts (0923) 33011
RADLETT Radlett Audio Consultants (092 76) 6497

HUMBERSIDE
GRIMSBY G. E. Manders (0472) 51391

KENT
CANTERBURY Canterbury Hi-Fi (0227) 65315
CHATHAM Sevenoaks Hi-Fi (0634) 46859
SEVENOAKS Sevenoaks Hi-Fi (0732) 459555
TONBRIDGE Tonbridge Hi-Fi (0732) 361 767
TUNBRIDGE WELLS Coulden & Curry (0892) 30151
Sevenoaks Hi-Fi (0892) 31543

LANCASHIRE
BLACKBURN Practical Hi-Fi (0254) 698185
BLACKPOOL Practical Hi-Fi (0253) 27703

LEICESTERSHIRE
LEICESTER Design Stereo (0533) 541338
LOUGHBOROUGH Sound Advice (0509) 218254

LINCOLNSHIRE
BOSTON Yates & Greenhough (0205) 55755

GREATER LONDON
BECKENHAM Sevenoaks Hi-Fi 01-658 3450
BROMLEY Halcyon Electronics 01-464 2260
CROYDON Spalding Electrical 01-654 1231
E17 Myers 01-520 7277
HARROW Harrow Audio 01-863 0938
HOUNSLOW Musical Images 01-570 7512
ILFORD A.T. Labs 01-5180915
N1 Grahams 01-837 4412
N7 Bartletts Hi-Fi 01-607 2296
N22 Goodwins 01-888 0077
NW1 Subjective Audio 01-387 8281
NW6 Audio T 01-794 7849
Studio99 01-624 8855
NEW MALDEN Unilet 01-942 9567
SE13 Billy Vee 01-318 5755
SE18 Sevenoaks Hi-Fi 01-855 8016
SW3 Martins of Chelsea 01-730 3328
UXBRIDGE Uxbridge Audio (0895) 33474
W1 Hi-Fi Experience 01-580 3535
K. J. Leisuresound 01-486 8263
Spatial Audio 01-637 8702
Telesonic 01-636 8177
Welbeck Audio 01-580 1326
W2 H. L. Smith 01-723 5891
W5 Ealing TV 01-567 8703
WC2 Covent Garden Records 01-379 7427

GREATER MANCHESTER
BOLTON Cleartone (0204) 31423
MANCHESTER Cleartone 061-835 1156
OLDHAM Audio Counsel 061-633 2602
ROCHDALE Cleartone (0706) 524652

MERSEYSIDE
LIVERPOOL W. A. Brady 051-733 6859

NORFOLK
NORWICH Basically Sound (0508) 70829

NORTHAMPTONSHIRE
NORTHAMPTON Listen Inn (0604) 37871

NOTTINGHAMSHIRE
ATTENBOROUGH John Kirk Hi-Fi (0602) 252986
NOTTINGHAM Forum Hi-Fi (0602) 622657
Nick Dakin (0602) 783862

OXFORDSHIRE
OXFORD Absolute Sound & Video (0865) 60844
Horns of Oxford (0865) 511241

SALOP (SHROPSHIRE)
SHREWSBURY Avon Hi-Fi (0743) 55166

STAFFORDSHIRE
HANLEY Hi-Fi Systems (0782) 265010

SURREY
ADDLESTONE Cosmic Radio (0932) 54522

SUSSEX (EAST)
BRIGHTON Brighton Cassette & Hi-Fi (0273) 695776
Sevenoaks Hi-Fi (0273) 733338
HASTINGS Hastings Hi-Fi (0424) 442975

SUSSEX (WEST)
BOGNOR REGIS Jaysound Audio (0243) 826355
CHICHESTER Chichester Hi-Fi (0243) 776402
WORTHING Bowers & Wilkins (0903) 64141

TYNE & WEAR
NEWCASTLE J. G. Windows (0632) 321356
SUNDERLAND Saxons (0783) 657578

WARWICKSHIRE
WARWICK JCV (0926) 493796

WEST MIDLANDS
BIRMINGHAM Five Ways Hi-Fi 021-455 0667
Griffin Radio 021-692 1359

WILTSHIRE
SALISBURY Rutters (0722) 22169
SWINDON Absolute Sound & Video (0793) 38222

WORCESTERSHIRE
WORCESTER West Midlands Hi-Fi (0905) 58046

YORKSHIRE
BARNSLEY Hi-Fi Centre (0226) 205549
BRADFORD Ernicks of Bradford (0274) 309266
HUDDERSFIELD Huddersfield Hi-Fi (0484) 44668
LEEDS Audio Projects (0532) 789115
Image Hi-Fi (0532) 789374
SHEFFIELD Audio Centre (0742) 737893
Micron Audio (0742) 360295
YORK Vickers (0904) 29659

IRELAND
BELFAST Audio Times (0232) 249117
Lyric Hi-Fi (0232) 681296
Walton & Gordon (0232) 792221
DUBLIN Cloney Audio (0001) 889449
DUNGANNON Zeus Audio (086 87) 48576

SCOTLAND
ABERDEEN Holburn Hi-Fi (0224) 585713
DUNFERMLINE Andrew Thomson (0383) 724541
EDINBURGH Audio Aids 031-226 3979
Hi-Fi Corner 031-225 9535
Hi-Fi Corner 031-556 7901
FALKIRK Hi-Fi Corner (0324) 29011
GLASGOW Hi-Fi Corner 041-248 2840
Maeto Musik 041-638 8252
Music Room 041-221 2527
Stereo Showcase 041-332 5012
STIRLING Hi-Fi Corner (0786) 75053

WALES
CARDIFF Audio Excellence (0222) 28565
SWANSEA Audio Excellence (0792) 474608

Nakamichi B&W

Nakamichi B&W UK Ltd Marlborough Road Lancing West Sussex BN15 8TR Tel. (0903) 750750

Nakamichi BX100E and BX125E

Nakamichi B&W (UK) Ltd, Marlborough Road, Churchill Industrial Estate, Lancing, West Sussex
Tel (0903) 750750

For this 'budget' machine (!) Nakamichi do not fit Dolby C — the *BX-100E* has Dolby B only, which provides −10dB of hiss reduction, compared with Dolby C's −20dB. However, as tapes improve and get quieter this matters less. It is possible to make almost hiss-free recordings with Dolby B providing appropriately quiet tapes are used, together with high record levels. Dolby B is necessary for musicassettes as well.

Although Nakamichi's 'baby', the *BX-100E* is still equipped with the same logic-linked, light-action transport control panels seen on their more expensive models. These require only a light tap with a finger to elicit an immediate response from the transport and the *BX-100E* works with the same uncanny silence and silky precision as all Nakamichi's machines. The logic allows all commands except punch-in recording.

Selection of bias and equalisation are kept apart, allowing for example 120μS chrome tapes to be made. The bias buttons are, as always, confusingly identified only by Nakamichi's own designations: EX (ferric), SX (chrome) and ZX (metal). Memory stop, timer and auto-repeat functions are fitted, but not microphone inputs.

Internally, independent bias and record-gain adjusters are fitted on left and right channels for each tape type, so the machine can be tweaked to suit any tape.

Lab report

On test, the *BX-100E* had a replay response flat from 30Hz right up to 16kHz, after which output actually rises. The practical benefit is full treble output from pre-recorded musicassettes, coupled with proper Dolby B tracking, resulting in excellent clarity, detail and imaging.

Head alignment was correct and replay hiss adequately low. Spectral analysis revealed 50Hz and 150Hz hum components at −62dB, and subsequent listening tests showed these to be just audible when playing low level recordings at high volume. In my view hum should have been lower. Replay speed was slightly fast at +0.8%, which is a just-detectable error. Replay speed stability was excellent at 0.05% wow and flutter (DIN weighted).

Spectral analysis of a recording showed that the transport suffered various wow components from 3Hz to 8Hz in rate, but flutter was fairly low by single capstan standards. The transport was adequately speed stable.

Bias was well set to give a balanced low/high frequency tape overload performance and record-gain (sensitivity) was accurate enough with the IEC Primary Reference tapes to give correct Dolby tracking with recordings — confirmed by real-time spectral analysis of weighted pseudo-random noise decreasing steadily from 0dB down to −30dB.

Frequency response (IEC Primary References) can be seen in the graphs; ferric and chrome are perfectly flat, metal has slight plateau emphasis of treble. This means metals with extra treble sensitivity, like TDK *MA*, will sound a bit bright.

Distortion and separation figures were good; OVU was set low (−3dB, ref Dolby level), making recordings a bit hissy if adhered to.

Sound quality

Transients were delivered with real definition and bite from musicassettes, treble detailing was richer than one would generally imagine possible and imaging also proved better than usual. The presence of solid, deep bass added more 'body' than is common. A relatively clear, 'wideband' sound with musicassettes was both involving and entertaining.

We found recordings with TDK *MA* and Sony *ES* had a glassy-hard treble quality about them, due to the plateau lift of treble noted in tests, but freedom from flutter rubbish kept the treble clean. Hiss was barely audible with Sony *ES* recorded to a high level. Other IEC-like metal tapes, like Scotch *XSM-IV* and That's *MG* gave a more neutral sound. There was some sense of pitch-diffusion and occasional pitch 'falter' was detected with critical organ programme, but these phenomena were slight.

Chrome tape (TDK *SA*) gave a tonally smoother, less forward and more natural sound, but it also had less well differentiated treble. BASF *CR-EII* had similar properties, but was marginally more lucid and 'solid' (pitch-stable) in its sound. The low OVU level, when adhered to, made *SA* a bit hissy. Not bad, but not great, we felt.

RECOMMENDED

Ferric recordings (TDK *AD*), like chrome, displayed even tonal balance but messier treble and more obvious hiss. Generally, though, their standard was judged to be good.

Summary: BX100E

A high-performance and relatively expensive cassette deck, the *BX100E* lacks all but the most important facilities — even Dolby C is ommitted. However, this deck is not a disappointment relative to its price, for those who rate sound quality highly and have enough knowledge to get the best from the machine, keeping in mind the comprehensive internal adjustment possible.

Additionally, Nakamichi's quality of build and finish, together with their slick and silent logic controlled transport system made the *BX-100E* satisfying to use, but independent bias and equal switching does require diligence to avoid error. Despite the lack of Dolby C, hiss wasn't a nuisance providing high quality 'quiet' blank tapes were used — such as Sony *ES* metal and BASF *CR-EII* — plus healthy recording levels.

Summary: BX125E

The *'125* is basically a *BX-100* fitted with Dolby C. This makes it similar to the *BX-150*, which was previously the least expensive Nakamichi to have Dolby C in addition to B. Visually, the *'125* lacks the *'150*s illuminated red LED tape counter, and the output control is rotary instead of being a slider. Otherwise facilities are identical.

Under test the *'125* proved very similar to the *'100* and *'150* in all respects; all test results printed are for the *'100*. It has good speed stability, characterised by very low flutter for a single capstan transport, but a small amount of wow (0.08%) at 2Hz and 5Hz.

I was disappointed to see rising treble with the IEC IV Primary Reference (metal) tape. Predictably, TDK *MA* measured +4dB up at 20kHz since it has more treble than the IEC tape. It will sound very bright as a result.

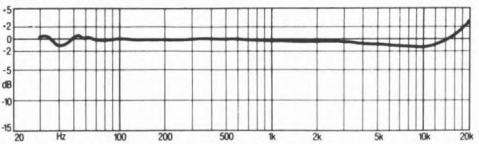
With BASF *CR-EII* chrome the *'125* gave a silky-smooth and clear sound, but was restrained, or 'laid back'. There was more detail with *SA*, but it lacked *CR-EII*s confident treble and sense of natural clarity.

TDK *AD* ferric had a slightly warm tonal balance but good clarity for ferric and was liked. The sense of solidity achieved with musicassettes played on Nakamichi's dual capstan drives was not present with the *'125*, but it did have much of their clarity and insight, plus fine imaging. Another impressive performer, the BX125 is a 'Best Buy' while the *'100E* is still recommended.

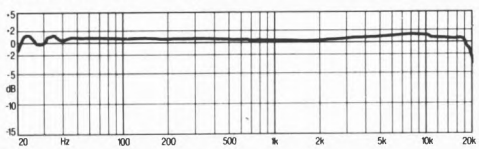
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	23Hz-18.0kHz	very good
Speed accuracy	+0.8%	good
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-20.0kHz	very good
Frequency response, chrome	20Hz-19.0kHz	very good
Frequency response, metal	20Hz-20.0kHz	very good
Stereo separation	−57dB	very good
Distortion	1.2%	average
Noise	−54dB	very good
Speed variation	0.06%	good
Modulation noise	−42dB	good
Flutter energy (band level)	−36dB	very good
MOL, ferric, 315Hz/10kHz	+3.0dB/−6.0dB	good
MOL, chrome, 315Hz/10kHz	+1.0dB/−8.0dB	good
MOL, metal, 315Hz/10kHz	+4.0dB/−1.0dB	poor
Input/output performance		
Line in sensitivity/overload		52mV/>3V
Mic input sensitivity/overload		—mV/—mV
Output		450mV
Typical price inc VAT		£250, £300

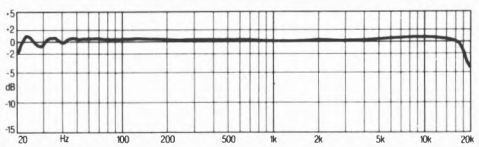
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



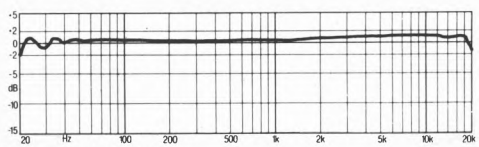
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Nakamichi BX150

Nakamichi B&W (UK) Ltd, Marlborough Road, Churchill Industrial Estate, Lancing, West Sussex
Tel (0903) 750750

Aside from the BX125, this is the most basic Nakamichi to use Dolby B and C noise reduction systems — there is a lower priced BX-100 with only Dolby B. Like all Nakamichis, it is all satin-black, well built and incredibly smooth and silent in operation.

The deck has simple basic facilities, like memory stop at zero on the counter, auto-repeat play and timer play/record. Basic items like the tape counter and record level controls are all well thought out though. The counter uses a bright, four-digit, red LED display that can be easily seen from a distance and in poor lighting. The only problem with these things is that they lose their count if the machine is switched off.

The record level indicators use red LEDs to show peak level and there are twin input level faders and a single output level fader, all three having a long, smooth action. An annoying but possibly necessary feature of all Nakamichis is their use of independent bias and equalisation switches. This increases the number of buttons to be pressed and increases the possibility of error. If, however, you wish to record chrome with ferric eq (like all pre-recorded chrome cassettes), so increasing treble headroom at the expense of hiss, it can be done on a Nakamichi, but virtually no other deck. Professionals might want this facility.

Lab report

Replay response followed what is, doubtless, Nakamichi's own version of IEC replay response. There was a −1dB suckout above 4kHz which does not help Dolby B replay tracking accuracy, being magnified to at least −2dB by Dolby action. Treble rose above 12kHz though, reaching +1.8dB at 18kHz. By normal standards, the BX-150 is accurate and it seems that all current Nakamichis are adjusted to possess this replay curve. It's not in perfect agreement with the official IEC tape, but it is close enough. Speed accuracy was perfect.

Speed stability tests showed that there were no discrete flutter components, but a high overall level — an unusual result. Swapping tapes revealed a complex situation with this deck. Using TDK tapes as Nakamichi recommend, 'jerks' in the cassettes caused wideband flutter. The same thing happened with many other brands, with one exception. BASF Chrom IIS, with its Special Mechanics, gave virtually no flutter, band level falling from −21dB to −28dB. This showed the BX-150 to have an excellent flutter performance, which is usually compromised by cassette mechanics in practice. Wow existed at 1Hz and 5Hz. Modulation noise was low-ish at −39dB.

The machine was slightly under-biased by current standards — something I believe to be useful for rock recordings with high treble energy. It provides a higher treble overload ceiling, at the expense of the mid-range ceiling — but this is well above indicated peak record level on most machines in any case. Nakamichi

put OVU at −3dB below Dolby level on this deck, which is low considering it uses peak reading meters. Metal tape gave an almost-flat tape overload (MOL) ceiling, with +3.6dB at 315Hz and +2.2dB at 10kHz, ref. IEC level. This is +7dB to +8dB above OVU on the BX-150.

Nakamichi still haven't sorted out record/replay frequency response with IEC II-type chromes. The BX-150 gives rising treble, being set up for Japanese pseudo-chromes. With 'Europeanised' TDK SA, it gave +2dB of treble lift above 3kHz — much like IEC II, shown in the graph. Frequency response was very flat and wide with IEC-type metal and ferric tapes, so compatibility here is very good.

Sound quality

The BX-150 gave very good insight and detail into a recorded performance with TDK MA metal tape. Even tonal balance and good extension at frequency extremes were immediately apparent in listening tests. The sound was firm and open and had plenty of definition and attack. After a while a thin treble quality was noticed and treble 'splash'. Treble at times sounded out of control and distorted. Flutter affected cymbals badly too, giving them an unpleasant coarse quality.

Chrome tape had less of a treble problem but was still a bit out of control at the top end. Imaging was again good, but grittiness affected violin (flutter) and low rate speed variations gave organ a swimming sound.

Ferric provided very amenable sound quality. There was treble smearing due to hf saturation, as usual, but insight into the music was still judged good and the sound less bright and thin than with metal and chrome. Sound quality with this tape type then, was very good.

Replay quality was bright and clear, but had the 'diffuse' quality noticed on all other decks, except Nakamichi's own ZX-9. Still very good though, with plenty of attack, little vagueness and reasonably solid imaging.

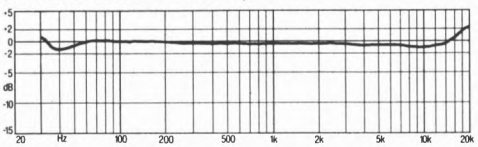
Conclusion

We were a bit disappointed by the BX-150. It was very good, but possibly could have been better. Flutter added its curious 'dirtiness', degrading pitch purity, and there was edgy treble with metal and chrome tape too. We used recommended TDK tapes. Maxell metal and TDK HX 'chrome' would both have given better sound quality on this machine, because both have less treble sensitivity.

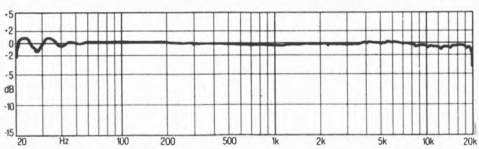
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	30Hz-19kHz	very good
Speed accuracy	0.05%	very good
Record/replay using blank tape		
Frequency response, ferric	20Hz-20kHz	very good
Frequency response, chrome	20Hz-16kHz	very good
Frequency response, metal	20Hz-20kHz	very good
Stereo separation	−49dB	good
Distortion	1.4%	average
Tape hiss, ferric	−68dB	good
Tape hiss, chrome	−69dB	good
Tape hiss, metal	−67dB	average
Speed variations (wow and flutter)	0.13%	poor
Modulation noise	−39dB	average
Flutter energy (band level)	−24dB	average
MOL, ferric, 315Hz/10kHz	+2.6dB/−5.8dB	good
MOL, chrome, 315Hz/10kHz	−0.5dB/−6dB	poor
MOL, metal, 315Hz/10kHz	+3.6/+2.2dB	good
Input/output performance		
Line in sensitivity/overload	55mV/—V	
Mic input sensitivity/overload	NONE	
Output level	500mV	
Typical price inc VAT	£340	

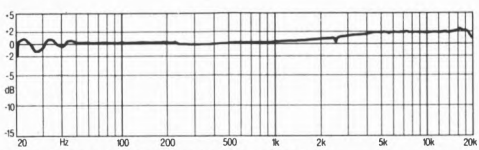
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



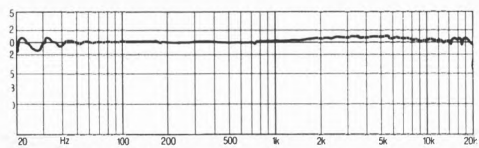
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Nakamichi BX300

Nakamichi B&W (UK) Ltd, Marlborough Road, Churchill Industrial Estate, Lancing, West Sussex
Tel (0903) 750750

Listening tests and lab tests consistently showed speed stability to be a very broad ranging problem on cassette decks, responsible for distortion, pitch slurring, diffuseness and many other obscure subjective phenomena. Closed-loop, dual capstan decks eliminate virtually all these degradations in one go and also isolate cassette tape from cassette mechanics, which themselves produce severe flutter.

It is not surprising that Nakamichi should use this form of drive on all their better decks and we were especially interested in their cheapest (if cheap is the word!) model to have this drive system — the BX-300.

Three heads have also been fitted, to allow off-tape monitoring, and user-adjustable bias for tape tuning. This is another facility we found to be very important for optimising sound quality. It might not be theoretically the perfect way of going about things, because MOL's change when bias is adjusted, but it does have a lot of impact upon perceived sound quality. Because cassette tapes are now so alike too, very little bias change is actually required to get tonal balance just right. Nakamichi fit a single control for all types, so settings will have to be memorised when changing between tape types. Calibrations should have been added to the scale for this purpose.

Another unusual feature was a pitch control. It varies replay speed and therefore pitch.

All other features of the BX-300 — logic control, tape selectors, Dolby B and C — are identical to those of the BX-150.

Lab report

As expected speed stability was unusually good with this deck. Flutter measured 0.07% and wow 0.04%. There was virtually no drift. Flutter sideband analysis showed there were none! Some wow was measurable, but it was minor. The deck gave an amazing performance in this area.

Bias adjustment finely trimmed metal frequency response by a few dB at 20kHz, but this is all that is needed, because metal cassette tapes are all much alike.

Chrome adjustment range was much larger, chrome and ferric tapes being more sensitive to bias change than metal. It was just sufficient, at maximum, to give perfect results with BASF Chrom IIS (superchrome) and therefore TDK SA-X as well. The deck can therefore be matched to the best 'chrome' tapes available.

Similarly, it can be matched to all ferric

BEST BUY

tapes, because nominal centre-range bias gave an almost flat response with IECI, as the graph shows.

At centre-bias on the control, ferric and chrome tape overload ceilings (MOL's) were very good and conventionally balanced between low and high frequencies. Curiously though, metal tape was substantially over-biased, which rather compromised its potential.

As usual with current Nakamichi decks, replay frequency response had a −1dB or so dip at 2kHz, but treble rose steadily above this frequency to +2.2dB at 18kHz. By normal standards though, replay response was very flat and extended — something that is plainly audible we find. Replay speed accuracy was perfect at the pitch control's central setting. Adjustment range was a large 7%.

Sound quality

Metal tape (TDK MA) gave very neutral tonal balance, tinged by a slight extreme-treble lift. Increasing bias brought this under control and sound quality was considered excellent. There was solid imaging, good, clean treble and delightful clarity. Reducing bias resulted in treble splash and was nasty. Some low rate speed instability was still just detectable, but we were being extremely critical here and expecting Compact Disc stability from our recordings — something the BX-300 nearly achieved.

Chrome tape (TDK SA) needed some bias increase to keep treble under control, but with this it was difficult to be certain which was source and which was tape at times. These were astonishing results.

With ferric tape we found that there was a compromise to be had between best treble control (increased bias) and best treble level (decreased bias), using TDK AD. In the end, some softness was accepted in return for good control. Other tapes would alter these observations though.

The BX-300 replay quality with pre-recorded cassettes sounded less bright than our ZX-9 reference, but had much of the image stability and cleanliness that allows close listening. It was of a very high standard.

Conclusion

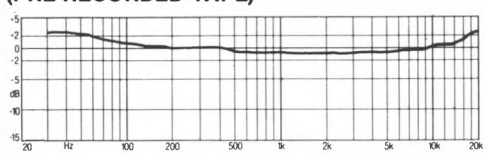
The BX-300 was a pleasure to listen too, both with recordings made on the machine and with pre-recorded musicassettes. Reassessed this time, it remained one of the few really excellent machines we tested.

TEST RESULTS

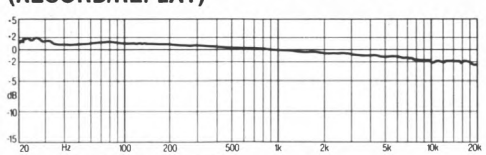
Replay of pre-recorded musicassettes		
Frequency response	50Hz-17kHz	good
Speed accuracy	+0.1%	very good
Record/replay using blank tape		
Frequency response, ferric	25Hz-20kHz	very good
Frequency response, chrome	20Hz-20kHz	very good
Frequency response, metal	20Hz-20kHz	very good
Stereo separation	−53dB	good
Distortion	0.5%	good
Tape hiss, ferric	−66dB	average
Tape hiss, chrome	−69dB	good
Tape hiss, metal	−67dB	good
Speed variations (wow and flutter)	0.04%	very good
Modulation noise	−41dB	good
Flutter energy (band level)	−36dB	very good
MOL, ferric, 315Hz/10kHz	+4.9dB/−7dB	good
MOL, chrome, 315Hz/10kHz	+3.0dB/−8.2dB	good
MOL, metal, 315Hz/10kHz	+6.6/−2.8dB	poor
Input/output performance		
Line in sensitivity/overload	65mV/—V	
Mic input sensitivity/overload	NONE	
Output level	930mV	

Typical price inc VAT £499

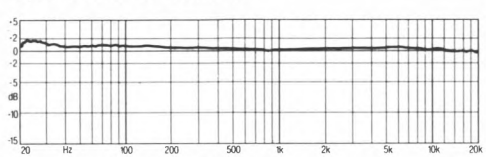
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



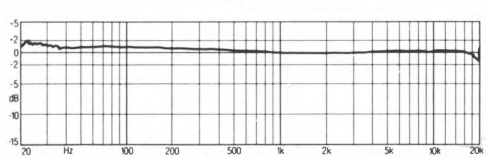
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Nakamichi RX505E

Nakamichi B&W (UK) Ltd, Marlborough Road, Churchill Industrial Estate, Lancing, West Sussex
Tel (0903) 750750

Nakamichi's auto-reverse decks, the *RX-202, '303* and *505*, achieved instant fame when released as the whackiest gadgets ever to hit the hi-fi market. Their mechanical cassette reversing system physically turns the cassette around, instead of making the transport go into reverse as do all others.

All the head components remain securely located and are not subject to the wear that will, ultimately, affect the rotating head platforms of normal auto-reverse decks, causing loss of treble due to incorrect azimuth. Tape-run azimuth error due to tape being pulled 'backward' in normal auto-reverse decks is avoided too.

The transport itself is a conventional dual-capstan design, instead of requiring the complexity seen in the *Dragon*. Reverse recording can be provided, unlike the Dragon that has only reverse play. The *RX-505E* does not have fast auto-reverse though; it records and plays through the leader, introducing a silence of around 12 seconds. Finally, independent record and replay heads are fitted (discrete, not siamesed).

Nakamichi fit far more facilities to this deck than others, even the *Dragon* and *ZX-9*. It has music search (gap sensing), auto skip over a silent end in a musicassette, timer, fader, memory stop/play, MPX and sub-sonic filters. Unusually for a Nakamichi, 'punch-in' recording is possible with the logic controlled transport. Bias fine tuning allows tapes to be matched in accurately, and works with metal tape, ferric and chrome.

Like all Nakamichi's the *RX-505E* operates with silky precision, but its independent bias and equalisation selectors without status indicators give wide latitude for selection error. There are no mic inputs either.

Lab report

As expected, frequency response of recordings can be adjusted to perfect flatness (using bias fine tune) from 20Hz to 20kHz. The sub-sonic filter attenuates a response rise below 20Hz caused by equalisation circuits.

The record-eq settings were a bit curious, giving falling treble with IEC I and II Primary References (ferric and chrome) at centre-bias. Ordinary hi-fi tapes will give a dull sound at this setting. The deck matches high performance tapes like BASF *LH-MI*, Maxell *XL-IS* and TDK *AD-X* (ferrics), and BASF *CR-MII*, TDK *SA*, Sony *UC-XS* (chromes) well though.

Frequency response was flat with the IEC IV Primary Reference (metal), which means the deck suits most metals when using centre-bias. I was surprised to find though, that there was insufficient bias increase range to obtain flat response from TDK *MA*. It has +1dB shelf lift of treble, which will add slight brightness. Bias reduction accommodated Maxell *MX* perfectly.

Nakamichi's discrete heads have excellent performance, providing extremely high overload ceilings in the mid-band and at high frequencies — without the use of Dolby HX Pro! In conjunction with low hiss, they give wide dynamic range. Hum was better suppressed than that of

other models. Replay frequency response was close to flat from 20Hz right up to 20kHz.

When delivered, the deck had some wow (0.08%), but little flutter. I was suspicious about this and requested a second sample. It had an identical spectral pattern and slightly worse performance figures. In essence, the *RX505E* suffers slight wow and a bit more flutter (worse than a *BX100E*) than I have come to expect from Nakamichis.

Sound quality

Expecting perfection, Sony *ES* metal was a bit disappointing on the *RX-505*. The sound was either a bit bright with jittery treble, or dull, when adjusting bias. Maxell *MX* — surprisingly with bias increase — did sound near-perfect, with clean stable treble, a fine sense of clarity and yet a nice, relaxed delivery. Piano sounded watery instead of solid in pitch terms.

Matters were never quite right again with BASF *CR-MII*, but TDK *SA* proved a perfect match, giving a clarity and stable treble which was unusual.

Exceeding all expectations, ferric tape (TDK *AD*) gave most impressive results, relatively speaking, improving clarity and treble performance. Musicassette reproduction had fine transients and stable imaging, too. Enhanced depth and some dimensionality were noted, resulting in a generally more plausible and lifelike quality to musicassette than is common, but some of the pitch solidity expected from a dual capstan transport did not materialise.

Summary

The *RX-505E* is an auto-reverse deck with a unique and highly entertaining mechanical reverse system that physically spins the cassette around. The System also allows a complex dual capstan transport to be used, plus independent, discrete record and replay heads that give the machine superb frequency response and overload headroom. Nakamichi's auto-reverse cannot be described as fast, but many other facilities, such as music search, blank skip and fine bias tuning are provided.

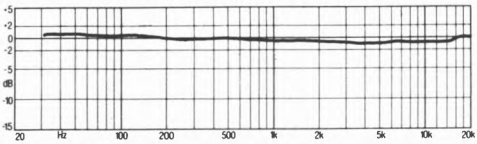
The transport operates with silky precision but does not have an excellent measured performance. There is broad tape matching, thanks to variable bias. The separate bias and eq buttons require care to avoid mistakes. Status indicators would help here.

Recording sound quality reached a high standard with suitable tapes as did musicassette replay quality. Watery pitch was a notable weakness.

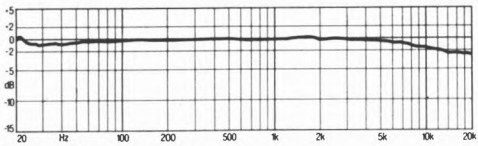
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-20kHz	very good
Speed accuracy	+0.7%	good
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-18kHz	very good
Frequency response, chrome	20Hz-18kHz	very good
Frequency response, metal	20Hz-20kHz	very good
Stereo separation	−49dB	average
Distortion	0.3%	very good
Noise	−54dB	good
Speed variation	0.1%	average
Modulation noise	−44dB	very good
Flutter energy (band level)	−32dB	very good
MOL, ferric, 315Hz/10kHz	+5dB/−3dB	very good
MOL, chrome, 315Hz/10kHz	+2.5dB/−7dB	good
MOL, metal, 315Hz/10kHz	+7dB/−0.5dB	poor
Input/output performance		
Line in sensitivity/overload		50mV/>3V
Mic input sensitivity/overload		—mV/—mV
Output		1000mV
Typical price inc VAT		£800

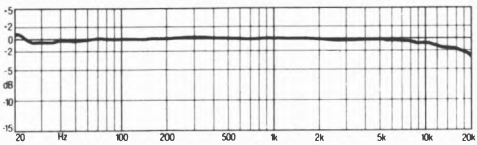
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



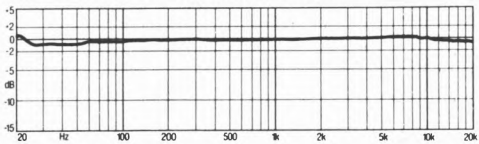
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Nakamichi ZX-9

Nakamichi B&W (UK) Ltd, Marlborough Road, Churchill Industrial Estate, Lancing, West Sussex
Tel (0903) 750750

Never failing to attract attention, the ZX-9 is a massive black machine covered in strange looking controls and legends. It is Nakamichi's top 'conventional' model, not having auto-reverse or auto-azimuth correction, as in the Nakamichi Dragon. It is perhaps really intended for professional or semi-professional use.

The ZX-9 uses closed loop, dual-capstan drive to eliminate cassette shell flutter problems. It has a direct drive motor on the main capstan, but the back-tension capstan is belt driven from the main capstan motor. Dolby B and C are fitted, but not Dolby HX-Pro.

Bias is user adjustable, from front panel presets. However, it is adjustable to achieve flat frequency response, which is not the right way of doing things on a serious machine. Nakamichi under-bias, so with normal ferric, chrome and metal tapes, adjusting bias for a flat response under-biases by conventional standards. For normal use, I don't object to under-biasing — it makes a lot of sense. However, I do feel a professional machine should have easily-accessed record equalisation adjustment. There are, I am told by Nakamichi B&W, two internal inductors (L101 and L201) which can be tweaked to change record equalisation. A 23kHz test signal is advised though and details need to be obtained from Nakamichi before adjustment is attempted.

The Nakamichi bias controls should be calibrated and have a detent position too. They were awkward to use, but have vast adjustment range, especially with metal tape. Sensitivity is adjustable on the front panel too.

Tape type bias and replay equalisation are independently switch selectable. Three heads are fitted, the record head being independent from the replay head. A hassle with this is that azimuth must be adjusted to suit every cassette inserted, for perfect results.

Needless to say, this deck was delightful to use. It has wonderfully light and responsive touch controls, perfect logic and a fast, silent transport. It was easy to make mistakes with control settings though, because of the multiplicity available. I would like to have seen auto-tape selection with manual over-ride.

Lab report

Replay response rises in treble output above 10kHz and replay speed was perfect, as was head height.

Frequency response can be made almost perfectly flat from 30Hz up to 20kHz with any tape type, as the graphs clearly show. A +0.5dB rise exists around 6kHz though. Even strange tapes, like high-bias chrome BASF Chrom II are easily accommodated. Dolby tracking was perfect and all distortion figures very low.

Speed stability figures depend upon the tape used too. BASF Chrom II was essential — even in this dual capstan machine — to get best results. Modulation noise was low at −44dB,

plus a low total flutter sideband energy figure of −37.5dB. TDK SA gave figures 2dB worse than this and MA-R wasn't in the race, being about 4dB worse.

Nakamichi imply in a pamphlet on the ZX-9 that it has virtually no identifiable flutter. Our ZX-9 clearly did have flutter, even though it was at a very low level. Spectral analysis identified regular wow at 1.3Hz, 6Hz and 8Hz, plus regular flutter components at 18Hz, 25Hz and 36Hz. Wow measured 0.04% and flutter 0.07%.

The treble overload ceilings (saturation) achieved were astonishing, with IEC Primary Reference Tapes. IEC I ferric almost matched metal tape at −3dB and IEC II chrome was a hair's breadth behind at −4.5dB. Metal was no better than usual at −1dB, but its 315Hz MOL was very high at +5.8dB.

Sound quality

Using TDK MA, recordings sounded just slightly brighter and harder than source. It was difficult to tell a recording from Compact Disc though, except by tape hiss.

Pitch purity and stereo imagery reached an astonishingly high standard too. Piano had perfect solidity; it didn't have 'cracked' tone or any warble. Metallic percussion instruments like cymbals and triangles were not as diffuse as usual.

We noticed loss of treble control due to saturation when trying to capture high level transient information.

Chrome tape (TDK SA) was a bit bright, but suffered little overload. It had even better pitch stability than MA and cleaner sibilants and treble.

Ferric, in the form of TDK AD, gave slightly smeared treble, but it still sounded better than usual and was suitably impressive.

Replay quality of the ZX-9 defied full analysis, we feel. It was its ability to take the typical papery, hazy sound of a prerecorded cassette and give it solidity that constantly impressed us during comparative listening tests. Lack of flutter had much to do with this, as did treble output stability.

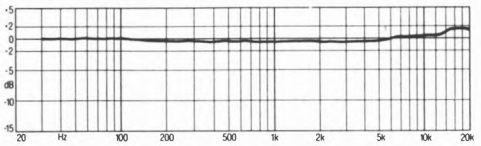
Conclusion

As a working professional recorder, the ZX-9 could be better. However, in as-delivered form, its sound quality was excellent, especially when replaying prerecorded cassettes. The quality of its recordings was extraordinary too. This really is an astonishing cassette recorder which really worked properly in all respects.

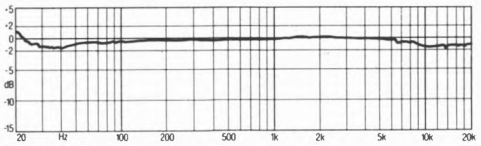
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	31Hz-18kHz	very good
Speed accuracy	+0.7%	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-20kHz	very good
Frequency response, chrome	20Hz-20kHz	very good
Frequency response, metal	20Hz-20kHz	very good
Stereo separation	−52dB	good
Distortion	0.5%	good
Tape hiss, ferric	−67dB	average
Tape hiss, chrome	−70dB	very good
Tape hiss, metal	−69dB	good
Speed variations (wow and flutter)	0.04%	very good
Modulation noise	−42dB	very good
Flutter energy (band level)	−35dB	very good
MOL, ferric, 315Hz/10kHz	+3.0dB/−3.0dB	good
MOL, chrome, 315Hz/10kHz	0dB/−4.5dB	very good
MOL, metal, 315Hz/10kHz	+5.8/−1.0dB	average
Input/output performance		
Line in sensitivity/overload	40mV/—V	
Mic input sensitivity/overload	NONE	
Output level	900mV	
Typical price inc VAT	£999	

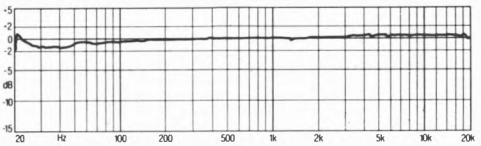
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



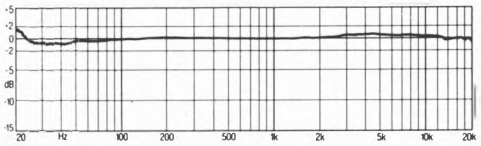
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Nakamichi Dragon

Nakamichi B&W (UK) Ltd, Marlborough Road, Churchill Industrial Estate, Lancing, West Sussex
Tel (0903) 750750

This awesome looking machine is totally fascinating in the way it seeks to overcome problems in cassette replay. The point to note with the *Dragon* is that its complexity is directed towards playing commercial musicassettes, or for that matter blank tapes recorded on other decks, with negligible transcription error. It also makes fine recordings — almost as a by-product!

Nakamichi's major innovation is the elimination of replay azimuth error, using an azimuth-sensing head which tilts automatically to give the optimum head-to-tape alignment for playback of any given recording. Sensing is achieved by splitting a single head pole into two stacked portions, comparing the phase of their output and then motor driving an azimuth correction platform until phase error is zero. Since a stereo cassette track is just 0.6mm wide, this means each part of the pole stack is just 0.3mm high!

As if auto-azimuth was not enough, the *Dragon* uses a dual-capstan, auto-reverse transport too. To accomplish this trick both capstans must change speed as well as direction, in order to apply back tension, so independent capstan motors are necessary. Nakamichi use direct-drive to each capstan, which allows electronic speed trimming so the supply capstan always runs 0.2% slower. A quartz speed reference is used.

Out of interest, Akai used the same drive technique in their *GX-R99* auto-reverse deck, though they use a rotating head platform to give reverse recording. Such things tend to increase the likelihood of azimuth error, especially when wear sets in. As the *Dragon* design seeks to minimise azimuth problems, it uses a four pole fixed-stack record head and cannot reverse record — only reverse play.

Manually variable bias and record gain are provided for each channel and tape type — seen as little adjusters on the fascia. Frequency response is set by bias adjustment, not by record equalisation. Bias selection and replay equalisation (120/70μS) are independently selectable, as usual on Nakamichis. The transport logic allows punch-in recording, whereas most Nakamichis do not!

Lab report

I made a special short test tape to check auto reverse and auto-azimuth on the *Dragon*. Along the tape, azimuth increased in steps up to extreme error. Contrary to what the flashing indicators suggest, the deck applies continuous correction along the length of a tape — not just at the start — and it is achieved within about one second (the owner's manual and *Dragon* pamphlets do explain this). When the adjustment limit is reached, a fast clicking sound is heard, probably from a drive clutch. One commercial tape I played caused this noise, which was disconcerting, though the handbook makes no mention of it.

The test tape used wideband pseudo-random noise. Real-time spectral analysis showed the *Dragon* got replay response absolutely correct within fractions of a second when azimuth changed! The system has astonishing resolution

RECOMMENDED

and accuracy, considering deviational errors are in terms of minutes of arc.

Replay frequency response followed Nakamichi's usual theoretical interpretation of the IEC standard, having a −1dB dip around 4kHz and treble lift above 12kHz (+3dB at 18kHz). Listening tests show this has no bad effect. The characteristic was identical in both directions of play. Replay speed was stable and had a negligible error of +0.4% fast, again in both directions of play. Replay speed stability was excellent at 0.03% total wow and flutter.

Cumulative record-plus-replay speed stability was much the same. I carefully checked the transport when playing a forward recording in reverse and found, as Nakamichi claim, that the transport gives nearly identical results to forward play.

Both wow and flutter were minimal. Spectral analysis showed that capstan wow really has been suppressed to a very low level on the *Dragon* — it was better than a *ZX-9*, dual direct-drive possibly being the reason (the *ZX-9* has a belt driven slave capstan). It was lower than that of the Revox *B215*, which also uses dual direct drive. Analysis showed extremely low band-flutter and modulation noise too — amongst the lowest of any machine tested. Nakamichi really have engineered an astonishingly good transport here.

Replay hum wasn't low at −58dB, but since this was the 50Hz component only, more audible upper harmonics (100Hz and 150Hz) being around −65dB, it wasn't noticed in listening tests. Replay hiss was well suppressed.

Record/bias noise levels were low enough to get full benefit from quiet tapes, but OVU has been set low, so if used to set recording levels results in about −71dB hiss with chrome and Dolby C.

Tape distortion hardly existed. Below about 1kHz, switching from source to tape brought no change in the real-time display of spectral content and the read-out, even with an input signal of 40Hz at OVU. At 3kHz though, total harmonic distortion had risen to 0.7% — and there's a reason behind this.

Record equalisation has been set with bias high, to provide flat frequency response. High bias gives low bass/midrange distortion, but degrades treble distortion and overload (saturation). Treble overload (saturation) with metal tape (IEC IV) was relatively poor at −3dB, although it was respectable with ferric and chrome.

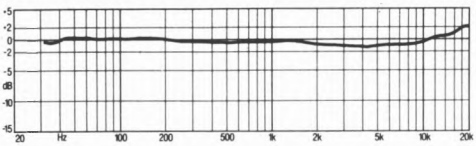
Bias adjustment range was enormous, even with metal tapes. All tapes can be accommo-

continued overleaf

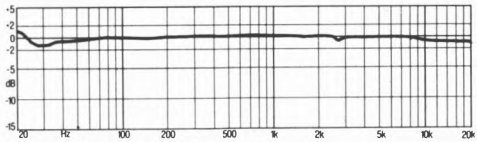
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-18.0kHz	very good
Speed accuracy	+0.4%	very good
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-20.0kHz	very good
Frequency response, chrome	20Hz-20.0kHz	very good
Frequency response, metal	20Hz-20.0kHz	very good
Stereo separation	−49dB	average
Distortion	0.4%	very good
Noise	−54dB	very good
Speed variation	0.03%	very good
Modulation noise	−45dB	very good
Flutter energy (band level)	−37dB	very good
MOL, ferric, 315Hz/10kHz	+4.0dB/−5.0dB	very good
MOL, chrome, 315Hz/10kHz	+1.2dB/−8.0dB	good
MOL, metal, 315Hz/10kHz	+6.2dB/−3.0dB	very poor
Input/output performance		
Line in sensitivity/overload	50mV/>3V	
Mic input sensitivity/overload	—mV/—mV	
Output	450mV	
Typical price inc VAT	£1250	

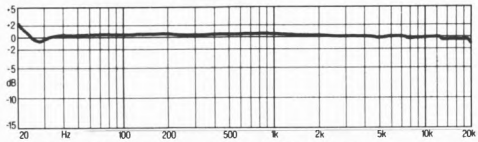
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



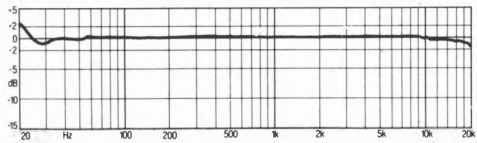
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Nakamichi Dragon

continued

dated, but some (dual layer?) types, like Maxell *XL-IIS* and BASF *CR-MII*, never quite adjust out for the sort of ruler flat response shown in the graphs.

Finally, seeing the slight lift up at 20Hz on the record-response graphs and noting the presence of a sub-sonic filter (on a cassette deck?), response to 1Hz was analysed.

Low frequency boost, to get flat bass response, results in a sub-sonic peak. This is tamed with a 10Hz notch filter (!) in the amplifiers. As a result of all this, there is residual +2dB boost at 15Hz. Selecting the sub-sonic filter reduces it and output lower down. This shows how far Nakamichi go with their cassette decks.

Sound quality

When decks get as good as the Dragon, sound quality of recordings is as much or more affected by 'external' factors, such as Dolby circuits, the tape used and accuracy of bias adjustment, as anything else. The latter we took great care with in order to get a perfect source/tape tonal balance match, after using the machine's adjustment system.

Perhaps over-ambitiously, we expected TDK *MA* to give an absolutely identical copy of various digital recordings, but couldn't in the end satisfy ourselves that there wasn't just the slightest hint of tizziness at high frequencies. We attributed the effect to flutter but, on reflection, I suspect that high frequency non-linearity due to over-bias may well be responsible. However, we were prepared to be ruthlessly critical with the *Dragon* and this really was a minor — almost subliminal — blemish. I do believe the machine is over-biased for metal, but most listeners would be more than satisfied with metal recordings.

Various pseudo-chromes, like TDK *SA*, were tried but their slightly 'creamy' sounding opaqueness, although pleasant, was too limiting we felt. BASF *CR-MII* is the best choice and by careful setting of record level (+3dB maximum) it gave fine clarity, sharp transients and little hiss, without Dolby, whilst not suffering compression on musical crescendos or the tizziness noted with metal. The best compromise was Dolby B, which 'slowed' transients slightly but allowed lower record level before hiss became evident. Dolby C gave too much of an enclosed sound. With Dolby B it is best to use 120μS equalisation with chrome, since the raised treble overload headroom this provides gives cleaner transients.

It was ironic that we really were most impressed by simple TDK *AD* ferric tape. Expecting less, we were surprised at how, with Dolby B, the *Dragon* reproduced fine treble detail, well defined attack on transients and a smoothness that is uncommon with ferric. There was slight feathering on piano and some pollution of steady organ notes, possibly due to the cassette mechanics. Nevertheless, the end result was remarkable.

It was in the reproduction of musicassettes that this deck really did excel. Rather than just 'more of the same, but better', the *Dragon* gave a complete step up in this area by producing unusually sharp stereo images. It had all the usual attributes of image depth, pitch steadiness and the ability to separate music from background hiss, which we have noticed with other very expensive decks. The *Dragon*'s imaging properties were unique though, a good musicassette being easily on a par with LP, in respect of image location and far better on the solidity and strength of left/right images — an area where LP is really very weak, due to simple mechanical problems. For those who want or have to hear (for professional reasons) what is on a musicassette, the *Dragon* has no rivals.

Summary

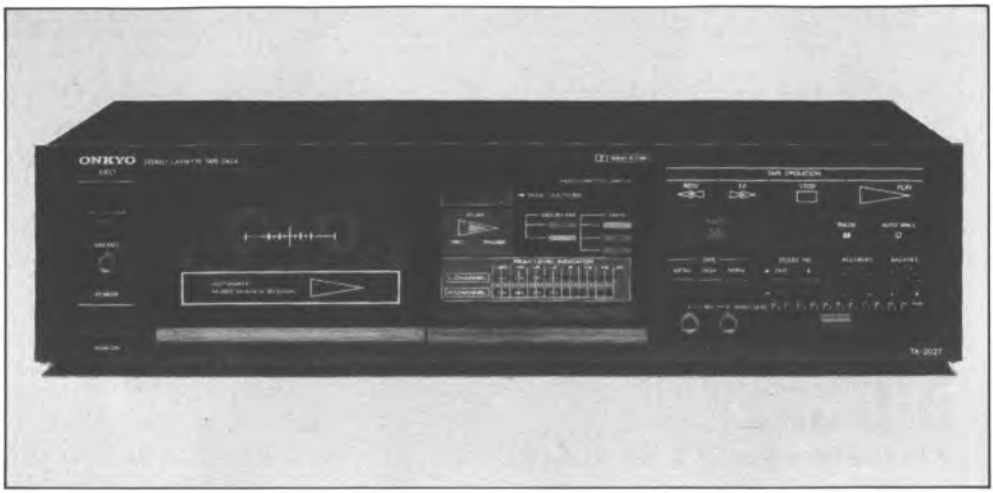
The main thrust of the *Dragon*'s design rationale has been toward obtaining perfect fidelity from pre-recorded cassettes, and to achieve this it has automatic head azimuth adjustment of astonishing complexity and resolution. The *Dragon* has auto-reverse play (though not fast reverse with optical leader sensing) but does not offer reverse record, which is impossible with auto-azimuth.

With the most speed stable (dual-capstan dual-direct drive) transport of any deck in the world and Nakamichi's nit-pickingly close adherence to the IEC replay standard, this deck provides definitive sound quality from all musicassettes. The sense of clarity and sharp, stable imaging this machine provides with them (well, good ones) re-defines what the medium is capable of.

Recordings reached a very high standard too, depending as much upon the tape selected and accuracy of set-up as inherent machine performance. The deck is over-biased for metal though, but sensibly biased for ferric, making ferric recordings unusually impressive. Those on BASF *CR-MII* (super-chrome) were a trifle better in terms of speed stability and freedom from high frequency 'feathering' (Dolby B, 120μS) and — most obviously — lack of hiss, which is where chrome scores. To say the least an extremely impressive machine.

Onkyo TA-2027

Goodmans Loudspeakers Ltd, 2 Marples Way, Kings Cross Centre, Havant, Hants
Tel (0705) 486344



A straightforward unidirectional deck, the *TA-2027* features a logic controlled transport and — very usefully — variable bias for tape matching. We thought the styling fussy, but the deck looks much like so many others, except for a clear acrylic panel whose lines light up blue.

Tape selection is manual, with illuminated legends clearly showing what type has been chosen — a simple but useful feature. Similar and equally useful indicators provide quick confirmation of Dolby B and Dolby C selection.

Logic control would accept all commands except 'punch-in' recording. The machine is built into a metal case, which, although strong, did induce a slightly hollow, clanky sound when the machine was mode changing. A simple mechanical tape counter, without memory, has been fitted.

Onkyo fit a music scanning system based on gap sensing, plus a DIN 'current fed' output on the rear panel, in addition to normal line outputs. This year, virtually no other deck tested had this somewhat archaic input/output standard.

Record level is shown by twin LED indicators that run from −20dB up to +6dB. Peak record level (OVU) has been set to Dolby flux, which is a common and sensible choice.

Lab report

At central detent position on the bias adjuster, record equalisation was set to give an excellent set of flat frequency responses when recording on ferric, chrome and metal tapes — as the graphs show. One could hardly complain about ruler-flat traces like this and it is a characteristic I have noted before with Onkyo decks.

The flat IEC II (chrome) trace in particular suggests that the company is well in touch with European tape standards. The compromise chrome sensitivity value of −1.2dB suggests the deck has been adjusted to suit both pseudo-chromes like TDK *SA* and true chromes like BASF *CR-EII*. Ferric and metal sensitivities were perfectly set for correct Dolby tracking and tests confirmed that Dolby introduced little response error at low levels.

It was a pity that bias was not adjustable for metal tape, but a large range of variation with ferric and chrome allowed it to accommodate awkward formulations like Maxell *XL-IS* (super-ferric) and BASF *CR-MII* (super-chrome), giving owners greater flexibility in tape choice.

The single capstan transport exhibited little flutter but had capstan wow, which was heard as a slowish warble. The effect was not serious, allowing a speed stability figure when recording of 0.09% (total DIN weighted wow and flutter). Speed accuracy was poor, the transport running +1.4% fast.

Distortion (TDK *MA*) was not especially low, yet the head had plenty of overload headroom when using metal tape, unlike so many others. It managed unusually well with ferric and chrome too, being a marginal improvement upon Nakamichi's *BX-100E* head, I note. Onkyo have used a very sensible bias level to retain good

treble overload headroom (saturation) without compromising that at lower frequencies.

Hum was negligible — another plus mark. Hiss was adequately low for chrome musicassettes. There was error in the replay frequency response, due to inadequate high frequency gain. Rapid roll-off of high frequencies suggested a small degree of azimuth error too. These effects combined to produce falling treble, as the replay graph shows. This will result in a dulled sound with musicassettes, made worse by Dolby mistracking which amplifies the problem.

Sound quality

Metal tape (TDK *MA*) gave a particularly smooth and natural sound, with no tonal emphases. There was a good sense of clarity and little sign of the edginess that is common with metal tape. Slight wow was barely detectable and cymbals exhibited little flutter shimmer. This was an impressive performance.

Using BASF *CR-MII* and Dolby B (bias set to +3) the *TA-2027* delivered an unusually smooth, clear, open sound quite beyond what is normally expected in this price bracket. There was little sign of treble saturation and no hiss. The performance was marginally better than that achieved with metal tape, due to an improved sense of ease and clarity.

Using Dolby B and no bias adjustment (bias set in the detent position) with TDK *AD* ferric tape, hiss was just audible, but again there was a fine sense of natural balance and clarity. Treble sounded just slightly softened out on peaks and diffuse.

Musicassettes exhibited slight softening on transients and lack of extreme treble was apparent. Good imaging and pitch stability were noted. Excessive speed was noticed as slightly frantic tempo! Generally, quality was good.

Summary

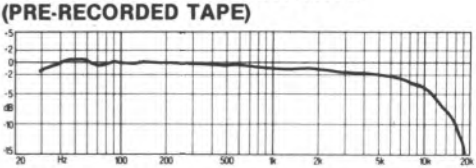
Well built, the *TA-2027* features logic controlled transport and user adjustable bias. This allows fine tuning of the machine to any tape, getting rid of frequency response errors even with the most awkward advanced formulations, so this deck is especially flexible in terms of tape matching.

Sound quality of recordings was excellent. Freedom from serious speed problems, perfect tonal balance and good headroom ensured fine results with all tape types — especially superchromes. This deck really excelled in recording quality; musicassettes replay was good, although not exceptional.

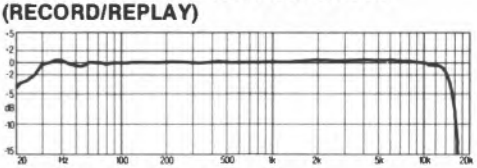
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	27Hz-7.0kHz	poor
Speed accuracy	+1.4%	poor
Noise	−58dB	average
Record/replay using blank tape		
Frequency response, ferric	26Hz-15.0kHz	very good
Frequency response, chrome	22Hz-15.0kHz	very good
Frequency response, metal	26Hz-15.0kHz	very good
Stereo separation	−53dB	good
Distortion	1.5%	average
Noise	−55dB	very good
Speed variation	0.09%	good
Modulation noise	−39dB	average
Flutter energy (band level)	−31dB	very good
MOL, ferric, 315Hz/10kHz	+5.0dB/−7.0dB	good
MOL, chrome, 315Hz/10kHz	+0.5dB/−7.0dB	average
MOL, metal, 315Hz/10kHz	+4.0dB/+0.5dB	average
Input/output performance		
Line in sensitivity/overload		60mV/>3V
Mic input sensitivity/overload		0.7mV/25mV
Output		500mV
Typical price inc VAT		£160

REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)

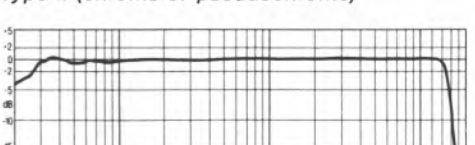


OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)

Type II (chrome or pseudochrome)



Type IV (metal)

Pioneer CT-1160R

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

This is a fast auto-reverse deck, using optical leader tape sensing to avoid intervals of silence when changing direction at the end of a tape. The mechanism uses the now popular rotating head platform to allow reverse recordings as well. These features apart, the *1160R* is a fairly standard auto-reverse design.

Pioneer's styling seems unimaginative, with a jumble of sombre panels and border lines, while the switches are not particularly well marked. I must say that I was surprised at the small interdependent tape selector buttons, which are difficult to see and use. They encourage selection error, which can ruin a recording.

The transport buttons had a short, light action and worked through very comprehensive logic that allowed all commands, including punch-in record, fast-reverse from record and reverse whilst recording. Dolby B and C are fitted, plus a small mechanical tape counter. It was virtually impossible to see a tape in the compartment, which was a trifle frustrating.

Lab report

Record equalisation was fairly well set to give flat frequency response with commonly-available good-quality blank tapes. The ferric graph shows slight upper treble droop, but this is small enough to be balanced out by using a tape with its own treble rise, like Maxell *XL-IS,* to get a brighter sound. Dolby tracking proved very good, but the deck was record-gain adjusted very much for sensitive Japanese pseudo-chromes, not BASF chrome, which will as a result show Dolby tracking error.

Bias had been adjusted high for good midband overload and distortion figures, at the expense of treble overload, which proved poor with ferric and chrome tapes. The deck needs high-saturation tapes, like TDK *SA-X* (pseudo-chrome) and Maxell *XL-IS* (ferric). Pioneer should really use less bias, since it is tape saturation at high frequencies that gives cassettes confused and dulled treble. Metal tape worked quite well in all respects though, due to good matching.

The transport gave an unusual performance. Rapid flutter was audible as an almost 'buzzing' or pitch-vibrating quality under test. Spectral analysis revealed −19dB flutter peaks 40Hz either side of the test tone. This put flutter band-energy level at −19dB — a very high value. Wow was very low however, so the usual form of capstan warble was absent.

In reverse, the transport became speed-erratic, drifting in jerks by up to 0.4% of nominal speed (4.75 cm/sec). This introduced transient wow, and slight capstan wow was evident too (a different capstan is used in reverse). Flutter and speed inconsistency rather condemned this transport.

Replay frequency response was acceptably flat to 8kHz, but fell away above this frequency. There was quite a lot of wavering of treble output too, but no reverse azimuth error. Track alignment was poor in the forward direction, introducing crosstalk.

Replay noise and hum values were low, but

replay speed stability suffered the flutter problem described earlier. In other words, the flutter will affect musicassettes much as it will the recordings made on the machine.

Sound quality

TDK *MA* gave a bright, edgy sound, with sibilance. Maxell *MX* was a better match, producing even tonal balance. However, the flutter problem proved subjectively appalling. Piano notes rasped and buzzed, giving notes a 'dirty' quality. Wow was apparent as indeterminate pitch. Notes wouldn't 'stay still'.

Chrome tape (TDK *SA*) displayed an even tonal balance but the flutter and wow problems rather overwhelmed appreciative listening. The right channel developed erratic output, due to an intermittent fault.

Ferric had a pleasant, 'soft' tonal balance, but with adequate treble. Again we found that flutter and wow introduced a perturbing 'sawing' quality.

Musicassettes had a forward 'shouty' sound, due to lack of high treble and weak bass. Flutter dirtied sustained notes in particular, although it wasn't quite so pervasive on replay only. The overall effect was judged to be unenjoyable.

Summary

Featuring both fast auto-reverse and reverse recording, it has good control logic and transport operating buttons that were pleasant to use. However, Pioneer's use of small, illegible markings for two small, interdependent tape-type selector buttons made tape selection rather difficult.

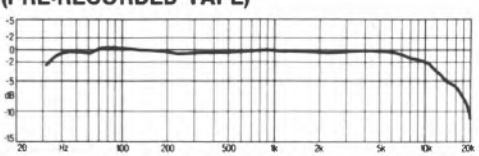
Dolby B and C noise reduction systems are fitted, plus auto-start from an external timer, so long, unattended and uninterrupted (no end of tape gap) recordings are possible with this machine.

Sound quality with all tapes was overshadowed by severe flutter, which gave everything a dirty, buzzing, rasping quality that proved very unpleasant to listen to. Musicassettes suffered less from this, but were blighted by a 'shouty' sound, exhibiting weak bass and little high treble. We felt that this deck had poor performance in all respects.

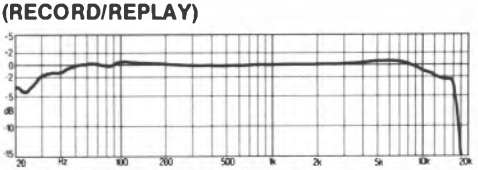
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	32Hz-11.0kHz	good
Speed accuracy	+0.6%	good
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	28Hz-16.0kHz	very good
Frequency response, chrome	28Hz-16.0kHz	very good
Frequency response, metal	28Hz-17.0kHz	very good
Stereo separation	−45dB	average
Distortion	0.7%	good
Noise	−53dB	good
Speed variation	0.10%	good
Modulation noise	−40dB	good
Flutter energy (band level)	−19dB	poor
MOL, ferric, 315Hz/10kHz	+4.0dB/−11.0dB	poor
MOL, chrome, 315Hz/10kHz	+0.5dB/−10.0dB	average
MOL, metal, 315Hz/10kHz	+4.0dB/−1.5dB	very poor
Input/output performance		
Line in sensitivity/overload	65mV/>3V	
Mic input sensitivity/overload	0.5mV/30mV	
Output	370mV	
Typical price inc VAT	£150	

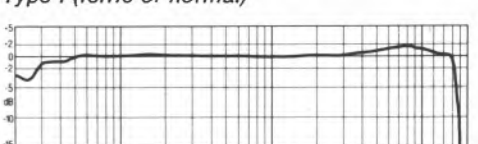
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



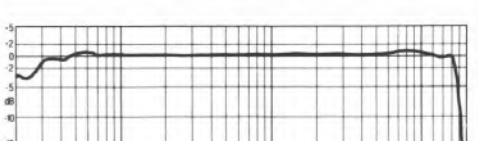
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Pioneer CT-A7X

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

This model has been designed as a straightforward, no-compromise high-quality deck. Consequently it lacks all gizmos like auto-reverse — and even computer tape tuning. Pioneer have stuck to the usual arrangement of independent (siamesed) record and replay heads, providing off-tape monitoring whilst recording. A dual-capstan transport is used too, this drive method being effective at suppressing flutter in particular.

Instead of offering numerous gadgets, the *CT-A7X* is beautifully built and finished. It has a well thought out control layout and the transport (inevitably, at this quality level) works via very comprehensive logic. It allowed recording to be started direct from fast reverse and from playing ('punch-in' recording). The 'return' button could be used to interrupt any mode and cause the transport to wind to zero on the counter.

Pioneer use bright blue fluorescent record-level meters, covering a range from −20dB to +10dB, relative to a OVU level set −2dB below Dolby flux — a somewhat low setting. Dolby B and C are included, plus a music scan system based on gap searching and a timer switch that allows automatic start from an external timer.

The cassette door slides open quietly and, knowing when a cassette has been inserted, shuts itself!

Lab report

There was more treble wavering than expected at high frequencies, when making replay tests with the IEC international standard test tape. Loaded into a digital store and analysed out of real time, to avoid test equipment time constants, variation turned out to be 1.5dB maximum from this tape, and 1dB from a 10kHz recording on chrome. Not bad, but not so good either.

Replay frequency response was correct to 10kHz, but fell away at higher frequencies. The wavering and indeterminacy of high frequencies was much like that of a budget deck and certainly no match for Nakamichis, against which the *CT-A7* is squarely pitched. Nor was the accuracy of its replay response, which I consider mediocre.

Replay hiss and hum levels were low — especially hum at −74dB. Replay speed was set a bit fast at +1%, but replay speed stability from the dual-capstan transport was excellent at around 0.03% total (DIN weighted) wow and flutter. Much the same performance was achieved when recording, additive effects increasing the wow slightly to 0.05%. Like all good dual-capstan transports though, this design pushed modulation noise down to around −5dB lower than usual (−43dB in a 1kHz-3kHz band) and generated almost no flutter. But whereas mediocre dual capstan transports may often wow slightly, due to capstan eccentricity and the like, Pioneer's exhibited little wow and what did exist was distributed, being difficult to pin down subjectively.

Measurement surprisingly showed the head to dislike strong bass signals, producing 3% distortion at peak record level (i.e. OVU). At the indicated metal tape recording level (+5), 10%

third harmonic distortion was measured.

All tape overload (MOL) levels were low too, although bias had obviously been set low to keep the treble overload ceiling up. Pioneer do appear to have a problem here though. A midband overload (MOL, 315Hz) value for chrome tape of −2.5dB was worse than that of most budget decks and metal wasn't very impressive at +2.5dB either.

A final disappointment on the *CT-A7X* was extremely poor record-equalisation accuracy for chrome tape. All chromes available in the UK will sound far too bright on this machine. Metals like TDK *MA* and Sony *ES* will also sound over-bright, but Maxell *MX* matches properly.

Sound quality

With TDK *MA* metal tape, the *A7* sounded 'busy' in the treble and had weak lower bass. There was no sign of coarseness or unpleasantness to the treble though. Maxell *MX* metal gave a natural tonal balance and sweet treble. Sound quality was excellent if record levels were not pushed up unduly, except that deep bass was again weak.

With TDK *SA* chrome, vocals were pushed forward in their upper registers, due to a plateau of high frequency emphasis. The sound soon became muddled, due to distortion, at high levels. It was a choice between this or some hiss.

Ferric (TDK *AD*) sounded smooth and relaxed. Treble was free of graininess or coarseness, but did 'splash' a bit. Results were considered excellent for ferric tape.

Musicassettes had a thin, gutless sound, due to lack of deep bass again. There was little depth dimensioning and poor insight into the music. Imaging was mediocre for an expensive deck and transients lacked crispness. The *'A7X* was peculiarly unimpressive with musicassettes.

Summary

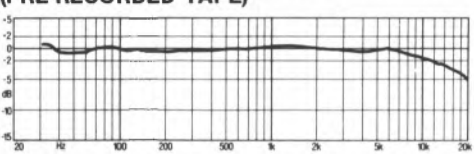
Ergonomic design of the *CT-A7X* was first class, and automatic tape-type sensing proved an asset. Under test, though, the CT-A7X showed some surprising weaknesses. Replay response should have been more accurate and HF stability better. Adjustment for blank tapes — especially chrome — was poor. No user-adjustable bias is provided. Overload ceilings were also poor.

Sound quality with chrome tape was found tonally unbalanced but clean, due to the excellent dual-capstan transport. Results with Maxell *MX* metal were fine if record levels were kept down, but then hiss became a bit more apparent. Ferric gave excellent results. Musicassette reproduction should have been better at this price level.

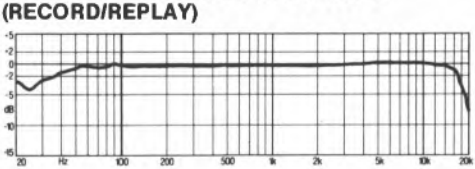
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-14.0kHz	good
Speed accuracy	+1.0%	average
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	30Hz-17.0kHz	very good
Frequency response, chrome	30Hz-5.0kHz	very poor
Frequency response, metal	28Hz-20.0kHz	very good
Stereo separation	−52dB	good
Distortion	1.4%	average
Noise	−53dB	good
Speed variation	0.05%	very good
Modulation noise	−43dB	very good
Flutter energy (band level)	−36dB	very good
MOL, ferric, 315Hz/10kHz	+3.0dB/−4.0dB	good
MOL, chrome, 315Hz/10kHz	−2.5dB/−5.0dB	very poor
MOL, metal, 315Hz/10kHz	+2.5dB/+1.0dB	poor
Input/output performance		
Line in sensitivity/overload	60mV/>3V	
Mic input sensitivity/overload	—mV/—mV	
Output	700mV	
Typical price inc VAT	£440	

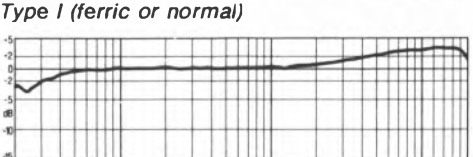
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



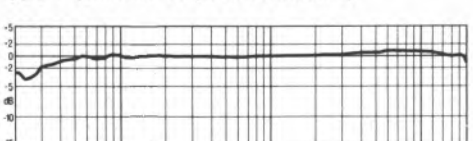
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Pioneer CT-A9X

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

Now in fashionable black finish and given an 'X' suffix, this deck was originally tested as the CT-A9. Pioneer have largely resisted the temptation to load the deck with gadgets, instead going for performance features.

To this end the deck has three heads for off-tape monitoring whilst recording. It has a tape tuning system with standard, under- and over-bias conditions available. The system also adjusts sensitivity and record equalisation. Closed loop, dual capstan drive is employed — a blessing because it can eliminate wow, modulation noise and flutter.

Tape type selection is automatic, which prevents selection error and ruined recordings. Old metal tapes without sensing holes cannot be accommodated.

The record level displays are very bright green and peak read accurately, but OVU has been set – 2dB below Dolby flux, which is a bit low. In their handbook, though, Pioneer do say that peaks can run up to Dolby level.

The cassette window is back lit and the tape counter also shows time remaining.

Logic control allowed punch-in recording and immediate fast rewind out of record mode. A 'tape return' button would stop play or recording and start rewind back to zero on the counter. This was simple and useful.

Lab report

Factory-set bias, obtained by not using the auto tape tuning facility, gave very high treble saturation levels, but slightly reduced mid-band overload. Consistency of performance between tape types suggested Pioneer have adjusted this deck carefully and deliberately to obtain better treble performance, at the expense of mid-band headroom — a sensible approach. Standard auto-bias ('peak') set bias even lower, giving ferric tape almost metal performance in treble saturation headroom. All mid-band overload levels (MOL's) were above OVU by + 3dB to + 7dB with ferric, chrome and metal, so adequate headroom is maintained if advised maximum record levels are used.

Record/replay frequency responses proved flat with all three tape types — as the graphs show. Especially notable was lack of rising treble with metal tape; this ensures that nasties like 'spitching' and hardness don't prevail. Pioneer's tape tuning system was more accurate than many in this respect, but Dolby action increased treble loss at low levels.

We had to be impressed by the transport mechanism. There were virtually no flutter side-bands, resulting in an extremely low equivalent band level value of – 38dB flutter distortion. This is the same as 1.2% distortion, compared with around 10% from most decks and up to 30% from the worst. It's a substantial improvement. Equally, modulation noise was exceptionally low at – 43dB, compared with a typical level of – 38dB. Wow had virtually been eliminated too. Spectrum analysis of the demodulated wow signal showed only 6Hz and

12Hz components and these were at an extremely low level. Wow measured 0.02%, flutter 0.06% and drift 0.03% — amazing results! Note that this deck is more speed stable than any turntable can ever hope to be and almost as stable as a CD player!

Replay frequency response was almost ruler flat from 30Hz up to 18kHz, divergence being 0.5dB or less. The test tape isn't guaranteed to be more accurate than this. Replay speed was correct, but head height a bit out of adjustment. There was 1dB-2dB more Dolby B treble loss at low levels than expected.

Sound quality

TDK MA tape ('peak' auto-bias) gave an exceptionally smooth, stable sound — even on difficult orchestral peaks. It was totally relaxing. Some detail and insight was missing from violin, in comparison with the CD original. The natural sibilance in vocals and speech was slightly muted too. Piano reproduced with astonishing freedom and naturalness, apparently unrelated to background tape hiss. This was especially impressive and due, in no small part, to lack of modulation noise. Pitch stability was perfect, although some wiriness was just discernible with organ.

Chrome tape (TDK SA) gave similar results, but was a bit blander, woollier and soft. Fine treble detail was confused or lost, partly from falling treble due to Dolby action. BASF Super Chrom IIS, under-biased, gave results as good as metal.

Ferric tape (TDK AD) gave astonishing results. Less soft and woolly than chrome (in fact, TDK SA), the ferric tape's treble detail was maintained as if saturation was not occuring at all. Hiss was not a problem.

Replay quality was extremely good, but fell well short of the musical insight and image solidity of our reference Nakamichi ZX-9, which was a surprise. Tonal balance was correct, but there was a vagueness to the sound that made it uninvolving.

Conclusion

The CT-A9X may not look beautiful, but it produces startling recordings with ferric and metal tape in particular.

It was easy to use. Fidelity with pre-recorded cassettes was excellent, even though not reaching the highest standards. A fine machine.

TEST RESULTS

Replay of pre-recorded musicassettes

Frequency response	25Hz-20kHz	very good
Speed accuracy	+0.3%	very good

Record/replay using blank tape

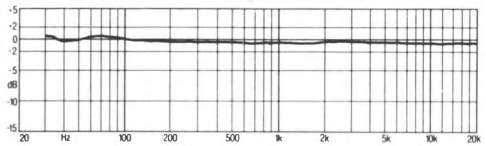
Frequency response, ferric	30Hz-20kHz	very good
Frequency response, chrome	25Hz-16kHz	very good
Frequency response, metal	25Hz-20kHz	very good
Stereo separation	–52dB	average
Distortion	1.4%	average
Tape hiss, ferric	–66dB	average
Tape hiss, chrome	–68dB	average
Tape hiss, metal	–67dB	average
Speed variations (wow and flutter)	0.02%	very good
Modulation noise	–43dB	very good
Flutter energy (band level)	–38dB	average
MOL, ferric, 315Hz/10kHz	+1.2dB/–4.4dB	poor
MOL, chrome, 315Hz/10kHz	–0.2dB/–6.4dB	average
MOL, metal, 315Hz/10kHz	+1.8/–0.6dB	poor

Input/output performance

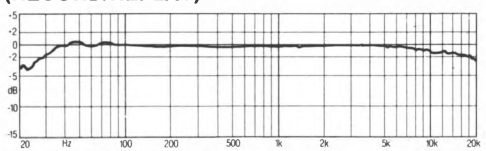
Line in sensitivity/overload	50mV/—V
Mic input sensitivity/overload	NONE
Output level	580mV

Typical price inc VAT £690

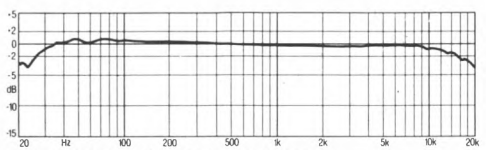
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



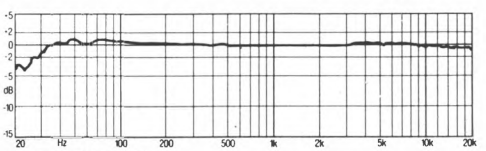
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Revox B215

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

Like its predecessor, the *B710 MkII*, this machine has been designed as much for studio as for home use. It is a no-compromise machine at a no-compromise price, solidly built and incorporating some uniquely useful features.

Revox haven't missed a trick with this one: the automatic tape tuning properly adjusts bias, record equalisation and record-gain, holding the values in non-volatile memories for instant recall when changing between tapes. Tests showed that all tapes, including awkward ones like BASF *CR-MII* (super-chrome), are tolerated. Automatic tape sensing is used too, but with manual override so, for example, chrome tape can be recorded with 120μS equalisation.

A sophisticated tape 'counter' in fact measures reel speeds and computes elapsed tape time, allowing time points to be found, with reasonable accuracy, on any cassette, without the need to reel back to the start. Allied to this system is the ability to memorise two time location positions (called LOC1 and LOC2) which can be returned to. Or the machine can be asked to find a specified time point.

Full logic control of the transport is provided, allowing 'punch-in' record. Revox use their own twin capstan mechanism which has no fewer than four motors — there are independent speed-controlled direct-drive motors for each capstan and separate motors for each reel. Siamesed independent record and playback heads give off-tape monitoring. Dolby HX Pro is used to improve on the limited treble overload (saturation) performance of the *B710 MkII* which we noted in the last issue. Dolby B and C noise reduction systems are provided.

Infra-red remote control is available, and there is a serial link for wire-transmitted commands. No mic sockets are provided though, dedicated external units being necessary.

After careful manual reading and some acclimatisation, the *B215* proved easy to use, but its operating sequences are not necessarily self-evident, because of strong internal logic. It was a case of 'easy — once you know how'. The transport mechanism, which is an engineering masterpiece, moves with the speed and quiet precision of the best.

Lab report

Revox take the same view of IEC replay response as Nakamichi, ignoring the tape as a standard and using a theoretical curve instead. This results in rising treble above 14kHz, seen in the replay response graph. Subjectively, the effect is slight but beneficial as pre-recorded musicassettes aquire good transient definition and sharp imaging — all other things being equal.

Speed accuracy proved adequate at +0.5% fast and replay speed stability extremely good at 0.03% wow and flutter (DIN weighted). At −58dB the replay amps had a bit more hiss than some, but tape hiss will exceed this figure so it is acceptable. There was hum, measuring −64dB at 100Hz and −66dB at 150Hz. This could be heard under very critical conditions. Since some budget

machines manage better, Revox should cure this. Dolby B replay tracking was excellent.

The LCD record level meters have OVU at Dolby level. Recordings to this level were unaffected by hiss from either the record amps or replay amps, Dolby C giving −19dB of noise reduction, reducing hiss to −72dB with BASF chrome, for example. Hum performance was mediocre, being identical to the replay-only results.

Record overload levels (MOL and saturation) are now very good, being a hair's breadth below Nakamichi levels. Distortion was higher than the rock-bottom results from a Nakamichi though, due to the latter's use of non-siamesed heads.

The computer tuning system gave a high degree of repeatability in its settings and we couldn't fault it. As a consequence, tapes always gave the same performance, even after repeated tuning; some systems are erratic.

Dolby tracking was near-perfect and frequency response with all tapes ruler flat — as the graphs of IEC tapes show. This was a fine and consistently repeated performance.

Spectral analysis showed negligible flutter with BASF's latest chrome tapes, but revealed slight capstan wow at 5Hz and 10Hz.

Sound quality

Much like the previous *B710 MkII*, the *B215* provides recordings of fine clarity on metal tape. There was again the sense of listening only to electronic circuits, but with a bit of hiss added, only noticeable at high volume. Stereo imaging was needle sharp and perfectly steady too. We noticed very slight wow on critical organ music, which was a pity.

BASF super-chrome tape (BASF *CR-MII*) again gave a perfectly even, steady sound, but with some slight softening and diffusion of treble on sustained high levels. It was only this feature that gave chrome away on difficult programme. Otherwise chrome had much the same lucid quality as metal tape on the *B215*.

Transients were best maintained without noise reduction (see *Technical Introduction*) and this was a perfectly valid option on the *B215*, because of its ability to accept BASF super-chrome, which has very wide dynamic range.

Ferric recordings were slightly vague in treble quality, possessing splashy transients, and some graininess, but this is usually the case. The *B215* still did a good job with most quality ferric tapes, especially Maxell *XL-IS*.

Musicassettes had a sense of depth about

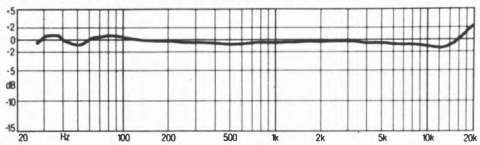
continued overleaf

RECOMMENDED

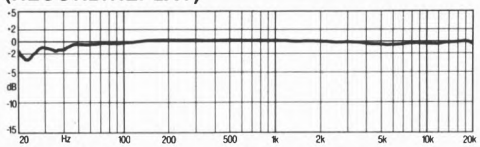
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	22Hz-20.0kHz	very good
Speed accuracy	+0.5%	good
Noise	−58dB	average
Record/replay using blank tape		
Frequency response, ferric	26Hz-20.0kHz	very good
Frequency response, chrome	26Hz-20.0kHz	very good
Frequency response, metal	26Hz-20.0kHz	very good
Stereo separation	−47dB	average
Distortion	1.0%	good
Noise	−53dB	good
Speed variation	0.03%	very good
Modulation noise	−44dB	very good
Flutter energy (band level)	−39dB	very good
MOL, ferric, 315Hz/10kHz	+2.5dB/−1.8dB	average
MOL, chrome, 315Hz/10kHz	+0.5dB/−5.0dB	average
MOL, metal, 315Hz/10kHz	+4.0dB/+1.2dB	good
Input/output performance		
Line in sensitivity/overload	50mV/>3V	
Mic input sensitivity/overload	—mV/—mV	
Output	750mV	
Typical price inc VAT	£1090	

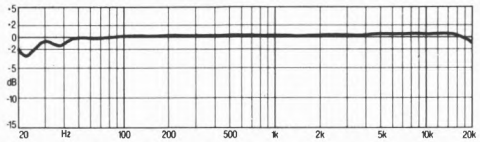
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



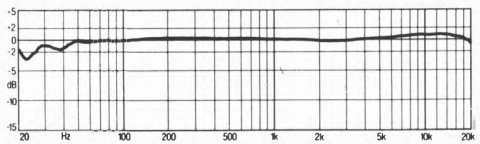
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

continued

them; we felt this deck had the ability to delve into a performance even on relatively poor tapes — a feature noticed only on a few other top quality machines. Poor tapes became entertaining, instead of being beyond use. The quality of good musicassettes was properly revealed in relatively stable imaging, cleaner treble delivery and a sense of solidity that added realism.

Summary

A complex machine, the Revox has a twin-capstan transport, with each capstan directly driven. The hubs have their own speed controlled dc motors, all four motors being mounted on a solid, die-cast chassis — as is the solenoid controlled head platform.

Computer tape tuning optimally sets bias, record gain and record equalisation for any tape. Automatic tape type sensing is employed with manual over-ride. There are non-volatile memories for tape tune state and for remembering time points on a tape, time positions being computed automatically from hub speeds. Infra-red remote control is fitted, and so is a hardwire serial link.

The *B215* had a fine measured performance, ignoring the slight blemishes of low level hum and capstan wow, which would rarely be heard. It gave impeccable sound quality both with recordings and with musicassettes. It is undoubtedly one of the best cassette machines available.

Interior of B215, showing modular electronics

THE ONLY CORNERS WE CUT ARE ON OUR TAGS

You have probably seen them. In dealers windows, attached to display models at exhibitions or featured in advertisements in the hi-fi press. Manufacturers are inordinately proud of them. As well they might be. We dish them out pretty sparingly.

So just why does a *HI-FI CHOICE* recommendation carry so much weight?

Because we commit thousands of pounds and many hundreds of man hours testing equipment for every issue of *HI-FI CHOICE*. And when we say 'testing', we really mean it.

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

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

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

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

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

If you prefer not to cut up your magazine use a photocopy of this form.

RUSH ME THE ISSUES OF Hi-Fi CHOICE TICKED BELOW:

- ☐ Loudspeakers (36)
- ☐ Cassette Decks & Tapes (37)
- ☐ Cartridges & Accessories (38)
- ☐ Amplifiers & Tuners (39)
- ☐ Hi-Fi Choice Best Buy Guide 1985
- ☐ Hi-Fi Choice CD Players and Turntables (40)
- ☐ Hi-Fi Choice Binders
- ☐ Hi-Fi Choice Loudspeakers (41)

PRICES (inc P&P): UK £3.50, Rest of World £4.25 (Air Service), Binders: UK £3.50, Air Service £4.50.

☐ Please debit my Access/Visa/Diners/American Express/Mastercharge* card
☐ I enclose cheque/postal order/international money order* for £_____

Card_____ Signed_____

Name _____

Address _____

Make cheques payable to:
Sportscene Publishers Ltd.
Send coupon with remittance to:
Hi-Fi Choice Offer, PO Box 320, London N21 2NB.1
*Delete where not applicable

HI-FI CHOICE

Sansui D55CM

Sansui (UK) Ltd, Unit 10A, Lyon Industrial Estate, Rockware Avenue, Greenford, Middlesex
Tel 01-575 1133

This is a simple but smart looking budget deck, neatly styled using a satin black fascia carrying coloured legends and buttons. An absence of bright trims avoids the common tinselly appearance of so much hi-fi.

Sansui like to use the word 'computer', proclaiming in legends the presence of 'computer logic control', 'compu selector' and 'compu edit'. A look inside revealed no sign of a microprocessor chip, so I presume the presence of simple electronic logic is seen as 'computer' technology. Both the compu edit and selector functions work only in conjunction with Sansui record decks and amplifiers, the first referring to synchronised cueing of the deck when recording LPs (though this breaches copyright of course) and the second refers to synchronised input selection on the amplifier.

Sansui's well thought-out control button arrangement has electronic logic allowing all commands except punch-in recording. The transport was relatively smooth and quiet in operation. No zero-stop has been included with the mechanical tape counter (unilluminated), but rewinding direct from play automatically engages gap-search (called 'AMPS'), stopping rewind at the first 4 second gap detected. With classical music cassettes, 'stop' must be pressed first to avoid spurious operation.

A welcome feature of the *D-55CM* is automatic tape type selection. Both Dolby B and C are included too, but not a headphone output. A single mic. input (mono speech or vocals) has mixing with the line input.

Lab report

Like the *D-59M* I tested last year, the *D-55* has a particularly poor head prone to overload and distortion — especially with the high bias required by metal tape. The test results paint a gloomy picture here, worse than that of any other deck in the book. Midband overload with ferric tape barely reached the IEC 0dB reference flux level (250nWb/m), whilst that for chrome and metal tape was unusually poor at −3dB or more below the reference flux.

Bias had been set lowish, giving good treble overload performance though.

Another direct result of the poor head was very high OVU distortion with metal tape. At low frequencies it reached 14%, falling to around 6% further up the audio band. The published figure of 8.3% is an overall average of three readings (40Hz, 300Hz & 3kHz) and clearly shows how poorly the Sansui deck compares with budget rivals.

What this means is that recording levels must be kept down (no more than OVU on peaks) to avoid overload and distortion. Tape hiss and hum on this deck will therefore be more obvious as a result.

Ironically, the deck also produces more hiss than usual in its replay amps, and more hum (−55dB). This further limits the dynamic range of the *D-55CM*.

For a budget deck, the transport displayed fair

— if not exceptional — speed stability. Fairly strong 5Hz-rate capstan wow exists, but not a surfeit of flutter. The wow affected musicassette performance almost as much as recordings.

Replay frequency response displayed steadily falling treble, measuring −3.5dB at 10kHz. This induces Dolby B mistracking with musicassettes, which heightens the problem, resulting in noticeably dull sound.

Frequency response of recordings made on the deck was fair with all tape types — as the graphs show. Quality ferrics should be avoided though, since they will tend to give a very bright sound.

Sound quality

At well below OVU, Sony *ES* metal tape gave a forward sound with good transients but papery upper treble. There was a jelly like quality to pitch from wow and on occasions it produced 'quivering', which was upsetting. Good clarity and even tonal balance existed. Hum was just audible at high volume.

At Sansui's recommended peak record level of +6dB for metal, distortion made the sound mucky, with nasty, grating distortion and compressed peaks. The problem was unpleasant and obvious.

With chrome tape (BASF *CR-EII*) there was good tonal balance but we found that high distortion destroyed clarity and made the sound messy.

TDK *AD* ferric gave reasonable clarity, but a thin sound due to treble emphasis. Treble quality was shimmery (fast shake). BASF LH-EI had less obvious treble and gave best results of all tapes.

Musicassettes had a fulsome and warm quality, with piano occasionally sounding shaky, due to wow. The sound was bland.

Summary

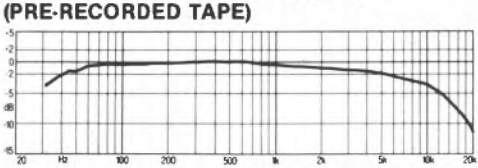
Use of logic transport control, automatic tape type sensing and a fascia reasonably uncluttered by visual gimmicks made the *D-55CM* an easy deck to understand and operate. It has few facilities, but Dolby B and C are included, as usual these days. Synchronisation with other Sansui products is also possible, making the system operation on the *D55-CM* a lot easier.

Measured performance of this deck was poor, with distortion, wow, hum and falling treble in the replay response all being worse than usual. This was reflected in poor sound quality with recordings on metal and chrome tape in particular, as well as musicassettes.

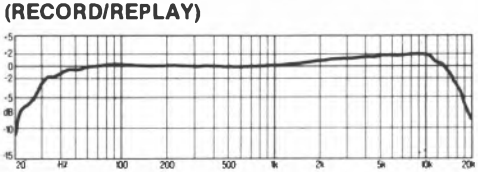
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	40Hz-6kHz	poor
Speed accuracy	+1.1%	average
Noise	−55dB	very poor
Record/replay using blank tape		
Frequency response, ferric	30Hz-16.0kHz	very good
Frequency response, chrome	30Hz-16.0kHz	very good
Frequency response, metal	30Hz-15.0kHz	good
Stereo separation	−36dB	very poor
Distortion	8%	very poor
Noise	−52dB	poor
Speed variation	0.15%	average
Modulation noise	−40dB	average
Flutter energy (band level)	−29dB	good
MOL, ferric, 315Hz/10kHz	+0.5dB/−5.0dB	very poor
MOL, chrome, 315Hz/10kHz	+4.5dB/−6.0dB	very poor
MOL, metal, 315Hz/10kHz	+3.0dB/−0.5dB	very poor
Input/output performance		
Line in sensitivity/overload		90mV/>3V
Mic input sensitivity/overload		1mV/20mV
Output		350mV
Typical price inc VAT		£140

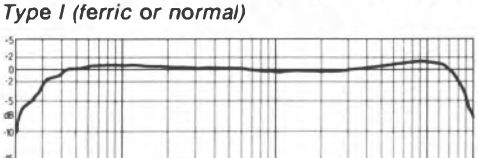
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)

Type IV (metal)

Sony TC-FX320

Sony (UK) Ltd, Sony House, South Street, Middlesex TW18 4PF
Tel Staines 61688

Although one of Sony's most basic Dolby C equipped hi-fi decks, the *TC-FX320* offers style and build quality similar to that of the more expensive *'420R* auto-reverse model. This is in marked contrast to the more common policy of heavily cost-cutting such basic models.

For example, the *'320* retains the very flexible logic controlled transport of the *'420*, and so is somewhat better equipped than most of its competitors. In use, the large touch-plates fell easily to hand on the well laid-out front panel; they are identified by simple symbols. Little pressure was needed to actuate them and the transport responded to unusual commands such as going direct to rewind from record, record from rewind and 'punch-in' record.

Sony provide a muting button, which seems a bit superfluous and, I would guess, is probably a hang-over from a deck fitted with music-search. Pressing the play and rewind buttons simultaneously instigates rewind to the start of a tape, followed automatically by play — a useful little feature. 'Cue and review' allows programme to be heard whilst fast winding. The machine will not start from an external timer though.

Tape type and Dolby selection are made through push buttons. Although they were a lot more clearly identified than many, automatic selection would have made this deck one of the easiest budget designs to use.

Lab report

A performance much like that of the *'420* in certain key areas suggests that Sony achieve good consistency of adjustment and use the same standards across the range of budget models. The latter proved a mixed blessing.

The review sample *'FX320* was very accurately set up for Sony *HF* (ferric), *UCX* (chrome) and *ES* (metal) tapes, just like the *'420*. This was impressive for a budget deck and gives the machine a head start over all competitors by endowing it with relatively flat frequency response.

Because Sony *ES* and *UCX* both vary somewhat from the IEC tape standard, the graphs of IEC response printed with this report do not apply when using the Sony tapes. *ES* metal did not display slightly falling treble and *UCX* did not have the rising treble seen with IEC II standard tape. Most other pseudo-chrome tapes are more IEC-like than *UCX* tape so the *'FX320* will, as the graph suggests, sound bright with other formulations, such as TDK *SA* for example.

Again, it is frustrating to note that Sony haven't yet discovered that no less than four years ago (1981) the international cassette replay standard changed. They still appear to be adjusting to the old standard, judging from the consistent inaccuracy of their replay frequency response. On this deck it was −3dB down at 10kHz. This sort of error would be more tolerable if it wasn't approximately doubled, at low levels, by the action of Dolby B, resulting in a very dull sound.

The transport exhibited good speed stability, considering the budget status of this deck. Neither wow nor flutter were a problem. Wow was

distributed in nature, so there was no persistent warbling or the like, for the ear to latch on to. Replay speed was a bit fast, the error being tolerable.

Sony-set OVU high on this deck and wring a full −20dB hiss reduction from Dolby C so, like the *FX420*, the machine can get around −76dB hiss with quality low-noise tape. Sony's own *ES* metal being an example. Use of a high OVU peak record level increased distortion slightly to an overall average value of 1.8%. Bias was well set to give reasonable treble overload ceilings.

Sound quality

Sony ES metal tape gave excellent high frequency presence and attack, but with an even tonal balance and no smudging of cymbals or hi-hat. Mild flutter was heard as light fizziness and there was a certain warmth to the sound. A degree of fast pitch warble was heard on organ, but this was tolerable.

Sony *UCX* produced the feathery treble typical of pseudo-chrome, but tonal balance was again neutral. Flutter and wow were more of a problem — heard as gritty and 'shattered' treble. There was pitch 'dilution' by wow components too, not heard directly as wow except on the most critical piano programme.

There was some dulling of transients with Sony *HFS* ferric tape, and other strong treble signals. Spitching was heard too, plus hiss — even with Dolby C. We thought performance only fair with ferric.

Musicassettes had a dull and enclosed sound, lacking low level high frequency detail. There was little ambient information too. Strings, especially, sounded boxy.

Summary

Solidly built and cleanly styled budget deck, the *TC-FX320* fully reflects — in appearance at least — Sony's reputation for making hi-fi that important bit better in quality than usual.

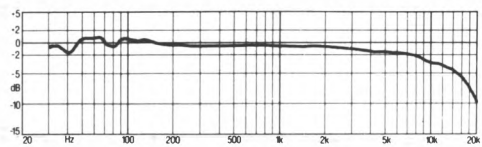
In use, the *TC-FX320*'s comprehensive logic controlled transport and a scattering of useful facilities made operation very easy, the only proviso being that the small and visually identical buttons used for Dolby and tape-type demanded some scrutiny.

A major benefit displayed by this deck was the accuracy with which it had been set up for Sony's own high quality tapes — especially Sony *ES* metal. This ensured excellent recording quality, except with ferric. A major drawback was inaccurate replay frequency response, which made musicassettes sound dull and lifeless.

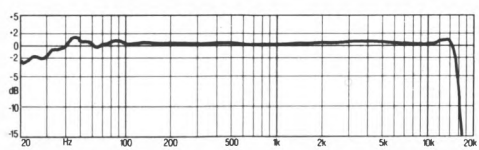
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-9.0kHz	average
Speed accuracy	+1.0%	average
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-15.0kHz	very good
Frequency response, chrome	20Hz-12.0kHz	good
Frequency response, metal	20Hz-15.0kHz	very good
Stereo separation	−50dB	good
Distortion	1.8%	poor
Noise	−54dB	very good
Speed variation	0.13%	average
Modulation noise	−39dB	average
Flutter energy (band level)	−32dB	very good
MOL, ferric, 315Hz/10kHz	+4.0dB/−8.0dB	good
MOL, chrome, 315Hz/10kHz	−0.5dB/−6.5dB	poor
MOL, metal, 315Hz/10kHz	+3.0dB/+0.0dB	average
Input/output performance		
Line in sensitivity/overload		100mV/>3V
Mic input sensitivity/overload		0.4mV/32mV
Output		700mV
Typical price inc VAT		£120

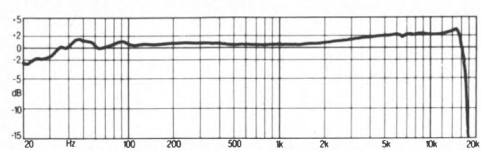
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



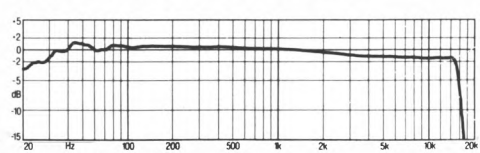
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Sony TC-FX420R

Sony (UK) Ltd, Sony House, South Street, Middlesex TW18 4PF
Tel Staines 61688

With this model Sony offer the fairly solid build quality and good standard of styling and finish for which they are known, and the *FX420R* does look a bit neater than many competitors. It is an auto-reverse deck fitted with the now-common rotating head platform, to provide reverse recording.

Although the transport has carriers for optical leader-tape sensors, they are not fitted, so the machine reverses at the very end of a tape — not when it 'sees' clear leader tape. Consequently, this is not a fast-reverse machine, and unattended recordings will have something like a ten second gap at the end of the tape where it traverses leader tape, before reversing.

Tape type selection is manual, which was a disappointment. Sony fit a logic controlled transport and it proved capable of accepting even the most awkward commands, like reverse-record direct from forward-record, 'punch-in' record and going straight into fast wind from record. There was some metallic clanking from the internals in response to these commands, but all were acted upon efficiently.

Dolby B and C noise reduction systems are fitted, and twin LED record level meters. The latter have peak record level (OVU) set very high, which minimises noise, but unfortunately at the expense of distortion.

Lab report

Dolby C gave a full −20dB hiss reduction on this machine, compared with a commonly achieved result of 18-19dB. This fact, put together with the high OVU point, meant the deck gives a noise floor of around −76dB in use, which is very low. Distortion at OVU measured 1.3% overall average, which is a fair result considering that some decks did no better despite their lower OVU levels.

The head proved capable of respectable mid-band overload figures, metal tape being a curious exception, since it was effectively under-biased. However, Sony's trump card here is their own, high quality cassette tape, which not unexpectedly provided the best results.

Sony *ES* metal tape has inherently high overload, plus low noise (for metal). On the *FX420* it gave impressive overload ceilings of +4dB/+2.5dB (315Hz MOL/10kHz saturation), plus a flat frequency response, since the deck has obviously been adjusted to match it perfectly. Dolby tracking was excellent too, so the picture didn't change at low levels.

Sony *UCX* pseudo-chrome and *HF* ferric tape both matched the deck equally well, as one would expect. *UCX* gave less treble lift than the IEC II reference tape, whose response is shown in the graph. Sony *ES* metal tape has an extreme treble peak compared with IEC IV, so extending treble further than that seen in the frequency response graph of IEC IV.

Since tape matching remains a problem with many cassette decks, Sony have a distinct advantage in this area. But sad to say, replay-only response was extremely inaccurate — something we have noted before with Sony models. Treble was

–4dB down at 10kHz in both directions of play, an effect that Dolby B emphasises, producing a dull sound with musicassettes. Replay hiss and hum were both found to be commendably low, and replay speed tolerably accurate in both directions of play.

The transport had little capstan wow, giving a good DIN weighted total wow and flutter figure of 0.08%. However, there was significant flutter, especially in reverse.

Sound quality

Rough-sounding treble with Sony's *ES* metal tape was attributed both to flutter and distortion. Tonal balance was thin and fast wow was heard on sustained notes. Hiss was very low. In reverse, treble quality was slightly worse and wow more obvious. Curious left and right channel dropouts occurred in reverse too, this being an intermittent fault we suspect.

Sony *UCX* (pseudo-chrome) provided neutral tonal balance tinged by presence boost. High level transients were softened and treble became a bit fluffy, but the 'fizz' of metal was lessened. Flutter became less obvious with this less bright tonal balance, making *UCX* listenable, we felt.

Sony *HF* had a thin tonal balance, plus loss of transient attack and bite. Flutter and wow were again evident, and felt to be subjectively wearing after a time. Hiss with this model was very low for ferric.

Replay of musicassettes revealed a lifeless and flat sound, without sparkle or ambient information. Speed stability was adequate, though an occasional pitch wobble was heard. However, we felt that musicassette quality was rather disappointing.

Summary

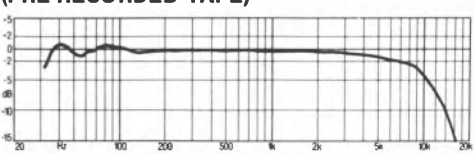
The *TC-FX420R* is a well made and neatly styled auto-reverse deck, but without 'fast reverse'. It will reverse record and its logic controlled transport systems accepted even the most difficult commands successfully. This blend of qualities made it somewhat easier and more pleasant to use than many decks which is important in so competitive a field.

Being set up to match Sony tapes, as one might expect, tape matching was accurate and recording quality benefited from this. However, disturbing factors were flutter and distortion, which rather compromised reproduction. Noise was very low. If slightly 'dull' tapes are used (Maxell *MX*, Sony *UCX* and TDK *D*), these problems become less apparent. Musicassette quality was flat and lifeless.

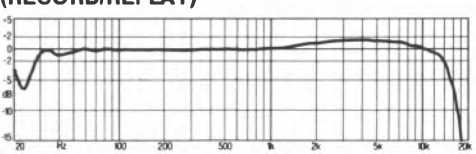
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	33Hz-8.0kHz	average
Speed accuracy	+0.9%	average
Noise	–61dB	good
Record/replay using blank tape		
Frequency response, ferric	28Hz-14.0kHz	good
Frequency response, chrome	28Hz-16.0kHz	very good
Frequency response, metal	28Hz-15.0kHz	very good
Stereo separation	–52dB	good
Distortion	1.3%	average
Noise	–54dB	very good
Speed variation	0.08%	good
Modulation noise	–40dB	good
Flutter energy (band level)	–25dB	good
MOL, ferric, 315Hz/10kHz	+4.0dB/–7.5dB	good
MOL, chrome, 315Hz/10kHz	+0.5dB/–8.5dB	average
MOL, metal, 315Hz/10kHz	+2.5dB/+1.5dB	poor
Input/output performance		
Line in sensitivity/overload		90mV/>3V
Mic input sensitivity/overload		0.4mV/32mV
Output		650mV
Typical price inc VAT		£150

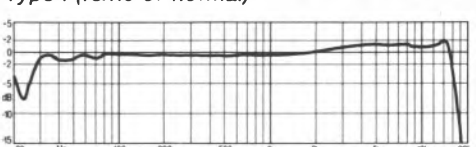
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



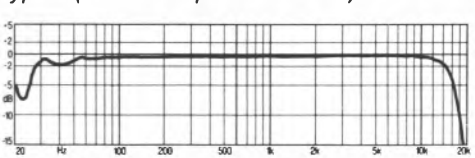
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Sony TCFX705B

Sony (UK) Ltd, Sony House, South Street, Middlesex TW18 4PF
Tel Staines 61688

Apparently aimed at the 'facilities and lights' brigade, the TC-FX705 appears to offer a multitude of facilities. But really, it offers no more in the way of obvious performance improvement over the 320, in that it doesn't have three heads, auto-reverse or adjustable bias — the sort of things we would consider useful or important. Instead, the 705 has such things as an automatic record level attenuator, digital display of peak levels, music search, auto-play from the beginning of a tape and memory stop. This deck was one of the few we came across that had an illuminated fluorescent electronic tape counter that did not lose its reading when power was switched off. In fact, there are many other features that we haven't the space to properly catalogue here, most of which appear to be based on the use of a microprocessor in the machine. In other words, they are functions where memory storage is the key, and have no impact upon fidelity.

In addition to its many memory functions, the 705 has Dolby B and C, automatic tape selection (which caters for ferrichromes) and logic controlled transport. The latter accepted all commands, including 'punch-in' recording, so it was more comprehensive than that of the budget models in this respect.

Like the other Sony models, though, the 705 was solidly built, nicely finished in satin black and worked with a slickness that is characteristic of Sony products. It was satisfying to use and — up to a point — easy too. All the memory functions were tedious to use though, as in our experience they usually are.

Lab report

Last year the 705 was one of two Sony decks with an unacceptable replay response; the other was a TC-K555 we returned as beyond adjustment. The 705 was duly azimuth-adjusted in the lab to bring treble up from −8dB to 0dB!

Replay frequency response was extremely flat after adjustment, but only Sony can guarantee that this is what the customer gets by improving their factory adjustment procedures. In its original state, this machine would have given a hopelessly dull and phasey sound with pre-recorded cassettes. In correct adjustment it should sound very good. Replay speed was fast yet again, measuring 0.8%.

Poor adjustment was suspected again with regard to the ferric record/replay frequency response. It suffered falling treble with Sony AHF tape and will give a dull sound. In contrast to this, treble rose with UCX-S pseudo-chrome, resulting in a bright sound. Sony Metallic and IEC IV tape gave a curious result, suffering sudden loss of extreme treble above 9kHz. It should sound reasonably even. This deck gave worse frequency responses than cheaper Sonys.

Speed stability was poor, we found in lab tests

that terrible flutter occurred at 38Hz, resulting in a band level of −16dB, equivalent to 16% flutter distortion. There was wow at 6Hz as well, which was heard as a warble during tests.

Distortion, tape hiss, tape overload ceilings, etc, all measured well.

Sound quality

Sound quality with metal tape was slightly coarse and hard-edged. Purity of tone — an obscure subjective phenomenon — was poor, due to flutter. Metallic percussion instruments sounded slightly 'dirtied' because of this. Organ sounded coarse and had a fast warble. Sustained piano notes sounded 'cracked' in pitch. The 6Hz wow was suspect here. All instruments had a slightly coarse, gritty quality. For uncritical use, this wouldn't be noticed, but serious classical music lovers might find certain aspect of this deck's performance offensive. There was loss of transient attack too, with Metallic tape.

The slight treble lift of UCX-S helped to brighten it up a bit and provided some subjective compensation for saturation. There was little differentiation at high frequencies, but good apparent 'bite'.

Ferric (Sony AHF) had big, wallowing bass and was a bit woolly and soft. However, it also sounded very amenable, except when severe distortion (flutter) tinged vocals. Piano again sounded cracked. By ferric standards though, the 705 did well.

Replay sound quality with pre-recorded cassette was astonishingly good. It was highly detailed, well defined and super-impressive. Startling in fact. But of course, the deck had been carefully azimuth-adjusted by us with the most accurate replay test tape in the world — the one that defines the international IEC replay response standard. Whether decks bought over the counter will manage this is, therefore, doubtful. What a pity that Sony's quality control has to be called into question here.

Conclusion

The TC-FX705 is a gadget freak's dream and it works well in providing competent, but not exceptional recording quality. If azimuth adjustment is usually as poor as our sample, replay quality will be hopelessly dull. On the basis of our tests, we wouldn't dare recommend this deck to critical listeners.

TEST RESULTS

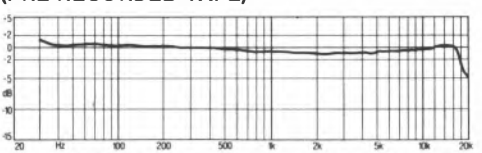
Replay of pre-recorded musicessettes		
Frequency response	25Hz-17kHz	very good
Speed accuracy	+ 0.8%	good
Record/replay using blank tape		
Frequency response, ferric	22Hz-12kHz	good
Frequency response, chrome	22Hz-10kHz	good
Frequency response, metal	22Hz-12kHz	good
Stereo separation	− 42dB	poor
Distortion	1.0%	good
Tape hiss, ferric	− 68dB	good
Tape hiss, chrome	− 69dB	good
Tape hiss, metal	− 69dB	good
Speed variations (wow and flutter)	0.07%	good
Modulation noise	− 39dB	average
Flutter energy (band level)	− 19dB	poor
MOL, ferric, 315Hz/10kHz	+ 4.5dB/ − 7dB	good
MOL, chrome, 315Hz/10kHz	+ 2dB/ − 7.5dB	good
MOL, metal, 315Hz/10kHz	+ 4/ + 0.5dB	average

Input/output performance

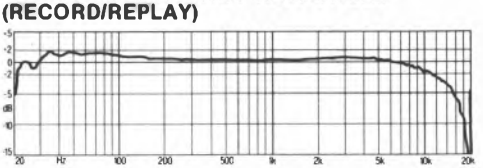
Line in sensitivity/overload	85mV/—V
Mic input sensitivity/overload	0.3mV/20mV
Output level	500mV

Typical price inc VAT £250

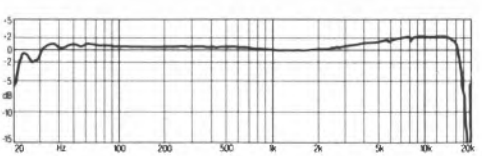
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



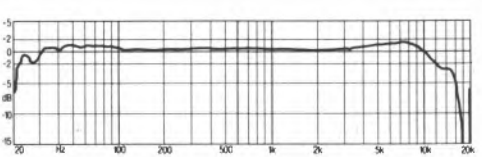
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

TEAC B380C

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

Finished in the usual satin black, the *V-380C* is a rather plain looking budget deck — as is now so common. Teac stylists make much use of white lines, scales and borders, set against both black and grey backgrounds, in order to jazz things up a bit.

Like so many budget decks, this one has twin inter-dependent tape selector buttons that are especially difficult to use, required settings being a not-so-obvious visual permutation, without associated status indicators.

Selection of Dolby B and C noise reduction is by interdependent switches, which admittedly makes some sense with Dolby and is in fact recommended by Dolby Labs. But there are no status indicators, unlike many budget decks. I still find independent switches far easier to understand and use though, and manufacturers are beginning to adopt them I note.

The record level indicators use five LEDs per channel and have a mask over them to give the appearance of ten. They cover a limited but adequate range of −10dB up to +6dB around an 0VU level usefully set to Dolby flux (200nWb/m), as is now common.

Teac fit a headphone socket and twin microphone inputs, plus a DIN input at rear that meets the archaic 'current fed' standard well. Few UK users will want it I suspect.

The transport is controlled by mechanically linked buttons, so there's no true logic as such. However, mechanical cross-links between the buttons provided most of the benefits. Little pressure was needed on them and I felt that they were perfectly adequate against those of competitors.

Lab report

Teac have set up this deck well for ferric and metal tapes, in terms of frequency response. Chrome has rising treble, as the graph shows, that Dolby will emphasise. Since most chrome-position tapes now available are either identical to or — like TDK *SA* — have more treble than the IEC II Primary Reference, treble will be prominent in practice.

Replay frequency response with musicassettes has falling treble due to incorrect (non-IEC) replay equalisation. Head azimuth was correct however and tape-to-head contact good at high frequencies, resulting in fairly stable output up to 18kHz.

Whilst replay hiss was low, there was some replay hum, a 150Hz component measuring −61dB.

The transport of this deck generated more broad-band flutter than is usual — an unusual characteristic that will detract from clarity. However, the effect was not severe by any means and, in its favour, the *V-380C* had no severe flutter peaks. Wow was distributed, no one component being so dominant as to capture attention. This is a plus point.

The high bias demanded by metal tape was obviously too much for the head, resulting in early magnetic overload and distortion. Bias was set

a bit low for metal too, limiting mid-band overload even further to just +0.5dB. This is a poor result. So is the 3% overall average distortion figure.

Premature overload, but this time electrical rather than magnetic, was also a problem in the mic amps. They accepted just 11mV before severe distortion set in, which is about 60% less than usual. This is not a low distortion machine, especially when recording with microphones on to metal tape.

Sound quality

With Maxell *MX* metal, the *'380* had a clouded sound with a murkiness that was disconcerting, if not overtly offensive. Clarity improved with Sony *ES*, except at high levels where the sound broke up to become compressed, sharp and splashy. The *'380* cannot be driven hard with metals. Piano displayed uncertain pitch.

TDK *SA* provided a fair sense of clarity at level well below 0VU, but wow was heard as intermittent shakiness. At high record levels, compression set in, but this time the result was one of softening and cloudiness, not hardening. No hum was heard with *SA*, but slight hum was noted with BASF *CR-EII* (poorer hum screening in the cassette itself). *CR-EII* provided improved clarity and treble smoothness compared to SA, as usual.

Ferric tape (TDK *AD*) proved most suited to the *V-380C*, with better clarity and a much easier, more relaxed delivery. Slight buzzing was heard on the right channel at this stage. Tonal balance leaned toward brightness.

Piano on musicassette had a soft, blurred quality; pitch indeterminacy was again a problem. 'Shaking' due to wow was occasionally heard. Generally vague delivery and poor 'timing' were noted.

Summary

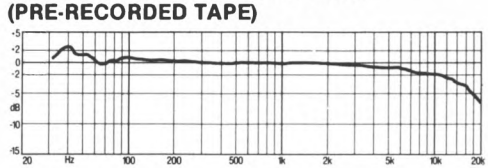
A budget deck of conventional layout, the *V-380C* has a fussy front panel encumbered by white lines, scales and legends in an attempt to make the machine look complex, although in fact, like its competitors, it is fairly simple. Dolby B and C noise reduction and tape type are selected by confusing interdependent push buttons; this is a common and irritating feature of budget decks generally.

Sound quality with metal tape was poor at high levels. Chrome was better but ferric proved best, being judged reasonable in absolute terms. Wow affected both recordings and musicassettes. Musicassette quality was generally poor.

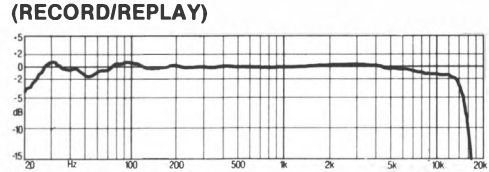
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	24Hz-10kHz	average
Speed accuracy	+0.7%	good
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	22Hz-14.0kHz	good
Frequency response, chrome	22Hz-15.0kHz	good
Frequency response, metal	22Hz-15.0kHz	good
Stereo separation	−49dB	average
Distortion	3.0%	very poor
Noise	−53dB	good
Speed variation	0.13%	average
Modulation noise	−39dB	average
Flutter energy (band level)	−28dB	good
MOL, ferric, 315Hz/10kHz	+3.0dB/−8.0dB	average
MOL, chrome, 315Hz/10kHz	−1.5dB/−7.0dB	very poor
MOL, metal, 315Hz/10kHz	+0.5dB/+1.5dB	very poor
Input/output performance		
Line in sensitivity/overload	80mV/>3V	
Mic input sensitivity/overload	0.4mV/11mV	
Output	650mV	
Typical price inc VAT	£110	

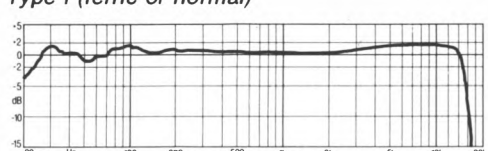
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



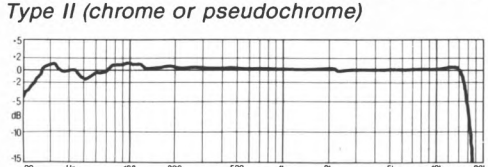
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Technics RS-B55

Panasonic (UK) Ltd, 300-318 Bath Road, Slough, Berks
Tel (0753) 34522

Along with Akai and TEAC, Technics are still convinced that the claims made for dbx noise reduction do justify its inclusion in their hi-fi cassette deck designs. A front panel sticker suggests that the *RS-B55* has 110dB dynamic range, a statement which my measurements proved to be blatantly misleading, as 90dB was the maximum it could really achieve. As I said when reviewing Akai's *GX-R66* which makes a similar claim (115dB!), this is just specmanship, used to entice purchasers. Such dynamic range would not be usable even if it were achieved, which it clearly isn't on this deck.

Actually, dbx suppresses both hum and hiss further than Dolby, and it prevents overload up to a point. But it can be heard working too, producing annoying swishing noises, especially with piano. For users who are likely to be offended by this, the *RS-B55* includes Dolby B and C as alternatives.

Technics have provided automatic tape type selection, which considerably eases operation. Selection status is usefully indicated by a blue fluorescent display. The same display also carries excellent, wide range, record level indicators and a tape counter, the latter having no memory, though.

Logic control is used for the transport, but we found that many of the buttons were awkwardly small.

A music search system operates when fast reeling is selected from play. 'Punch-in' recording however, was not possible, but going direct to fast reverse from record was.

Lab report

Technics have followed the IEC replay characteristic more closely this year, frequency response with musicassettes displaying a slower treble fall than before (see replay graph). With low replay hiss and hum, plus fair speed accuracy (1% fast) and stability (some flutter), this gives the *RS-B55* respectable overall measured performance with musicassettes.

The transport displayed a curious form of low rate random flutter in a band from 10Hz to 30Hz (repetition rate) on the demodulated speed spectrum analysis. Wow was found to be well suppressed though.

All the frequency response traces with IEC Primary Reference Tapes showed a downward trend, but I found that by selecting blank tapes with a compensatory rising response (see frequency responses in tape section), such as Sony *ES*, Sony *UCX-S* and Maxell *XL-IS*, flat overall response could be obtained. Under these conditions, Dolby tracking accuracy proved reasonable; dbx did not unduly affect low level response either. Technics have adjusted the deck well for market tapes.

The fluorescent record level indicator displayed a weakness not so common these days; they substantially under-read at low frequencies, being −6dB too low at 40Hz. Consequently, taking a bass signal up to OVU means recording at a very high tape flux level, the 40Hz distortion test on

metal tape returning no less than 8% distortion as a result. Bass-heavy music will suffer especially. The quoted distortion result is an average (40Hz, 300Hz, 3kHz at OVU) figure, and so partially reflects this problem.

Bias was set high, resulting in poor treble overload ceilings with ferric and chrome tape. This usually produces treble muddle and dullness through self-erasure. Midband overload levels were good though, also as a result of over-bias.

Sound quality

Sony *ES* metal tape provided even tonal balance and a fine sense of openness and clarity. There was little coarseness or edginess. Bass output was a trifle over-strong. Piano sounded pitch stable, 'solid' and realistic.

Keeping record level down to avoid saturation, BASF *CR-EII* chrome provided very easy, smooth reproduction with a good sense of clarity and no obvious speed stability problems. Sony *UCX-S* was brighter, but a bit less solid and believable.

There was a fine sense of clarity with BASF *LH-MI* ferric tape and well defined treble at low levels. At high levels though, treble 'splashed' and was compressed by self-erasure.

With musicassette, piano again showed good basic pitch stability, but not the solidity of clarity of the *ZX-9* reference.

Congested bass, plus muddle at high levels, were heard with a variety of musicassettes. Transients were well defined, but little high treble was obvious. Imaging proved mediocre. Comparatively speaking though, this performance was still fair.

Summary

This conventional (non auto-reverse) deck has Dolby B and C, plus dbx noise reduction; we do not favour dbx because although it suppresses noise further than Dolby it has the disadvantage of producing audible background swishing sounds with more critical programme.

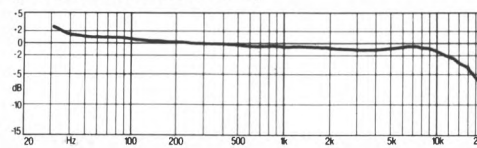
Technics offer the convenience of automatic tape type selection and logic control, but otherwise facilities are scarce on this machine. A blue fluorescent display panel contains record level indicators, tape counter and status legends.

Sound quality of recordings proved good. A fair sense of clarity, backed by good transient delivery and acceptable pitch stability, was heard, when using good tapes. Musicassette reproduction was competent, but not exceptional. High level muddle and a somewhat vague quality were weak areas here.

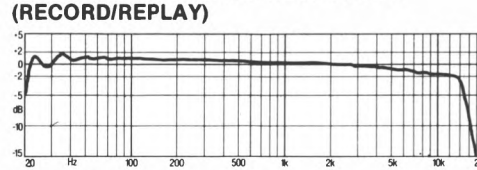
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	30Hz-12.0kHz	good
Speed accuracy	+1.0%	average
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	20Hz-14.0kHz	good
Frequency response, chrome	20Hz-15.0kHz	very good
Frequency response, metal	20Hz-16.0kHz	very good
Stereo separation	−50dB	good
Distortion	3.2%	very poor
Noise	−54dB	very good
Speed variation	0.10%	good
Modulation noise	−36dB	poor
Flutter energy (band level)	−26dB	good
MOL, ferric, 315Hz/10kHz	+4.5dB/−12.0dB	poor
MOL, chrome, 315Hz/10kHz	+1.0dB/−9.0dB	average
MOL, metal, 315Hz/10kHz	+4.0dB/−1.0dB	poor
Input/output performance		
Line in sensitivity/overload	90mV/>3V	
Mic input sensitivity/overload	0.36mV/28mV	
Output	450mV	
Typical price inc VAT	£200	

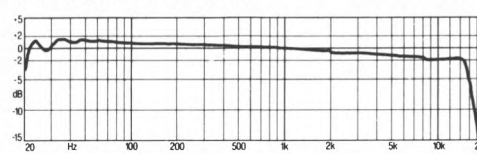
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



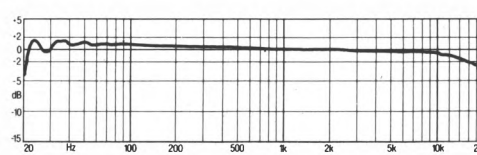
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Trio KX-54

Trio (UK) Ltd, 17 Bristol Road, The Metropolitan Centre, Greenford, Middlesex UB6 8UP
Tel 01-575 6030

Trio build this deck in a manner not now commonly seen with budget products. It has a metal chassis and front panel, which impart a good feeling of solidity, even though the transport controls tend to 'clang' as a result. But how Trio can describe these as 'soft touch', I don't know.

This budget design dispenses with all but the most basic facilities, though it does have Dolby B and C noise reduction systems, metal tape recording capability and a simple but useful music search system. Incidentally, I was amused to find no direct explanation of this in the owner's manual, where a description only explained the conditions under which it won't work — not how to work it! In fact, pressing a fast wind button whilst in 'play' mode causes the transport to find the next or previous recorded section by looking for a quiet gap. As usual with these systems, breaks of around 4 seconds silence can be detected, which is fine for pop music but of no use with classical music or speech recordings, where the programme includes quiet passages as well as definite 'gaps'.

Tape type selection is manual and there is a simple, unlit three-digit tape counter, without zero-stop. Two red LED displays indicate recording level and tests showed they captured musical peaks well enough, sensing high and low frequency information accuracy. Twin microphone inputs are fitted and the deck can be set to auto-start from an external timer for absent recording or play.

Lab report

There was substantial azimuth or replay equalisation error, resulting in a replay response characterised by falling treble. Output was −4dB down at 10kHz with Dolby B out, and since use of Dolby B with musicassettes only magnifies the error, the net result will be a very dull, vague sound on pre-recorded tapes.

Replay noise was very low, but this seems likely to be due in part to inadequate high frequency gain in the replay amps. Replay speed ran 1% fast and replay speed stability proved very poor at 0.25% total wow and flutter (DIN weighted). There was a lot of rapid speed drift, which resulted in substantial wow-ing. This will certainly be audible, even with musicassettes. Overall replay performance, which determines fidelity on musicassettes, was generally very poor by current budget-deck standards.

The speed drift problem of the transport was much the same in magnitude when recording, generating substantial levels of both wow and flutter. Flutter measured 0.3% and band-energy flutter level measured just −23dB — a very high figure. This will destroy all sense of clarity. Because the transport couldn't stick to one speed, drifting by an amount five times greater than usual (0.5%), it will make recordings pitch-indeterminate too.

Adjustment of frequency response for ferric and metal tapes was very good, although only metals with 'rising treble', such as TDK *MA* and Sony *ES* are perfectly compatible, to give a flat

response and perfect Dolby tracking. Chrome tapes will sound a bit bright, since the machine displayed +2dB treble lift, as the graph shows. Dolby will emphasise this.

The head gave good overload ceilings with ferric tape, but chrome tape was inexplicably poor in the midband and so was metal. Slightly low bias partly explains these figures, treble overload being better than usual, especially with metal tape. I suspect metal bias might also be pushing the head into non-linearity too though.

Sound quality

Subjectively, a 'jelly-like' wobbling of notes, due to wow, was obvious with all tape types. Piano notes were actually off-key, or 'cracked' with this deck. Tonal balance with TDK *MA* was good. Severe distortion due to overload occurred at high levels, though.

Chrome tape (TDK *SA*) sounded bright, but not overpoweringly so. Muddling was again the result of overload distortion and the pitch wobbling proved pervasive.

Ferric tapes gave an even tonal balance, a fairly soft presentation and less aggressive treble. Sound quality would have been good, except for the wow, which made piano notes meander severely.

Musicassettes sounded dull and leaden in tone. There was no apparent upper treble, causing cymbals and fine detail to be suppressed. Pitch was again shaky. Strong bass was evident.

Summary

The *KX-54* is a substantially built budget cassette deck, shorn of facilities to keep price down. Trio have included Dolby B and C noise reduction systems though, plus a simple but useful music search facility that will find the next or previous musical track on a tape whilst playing, using silent-gap sensing.

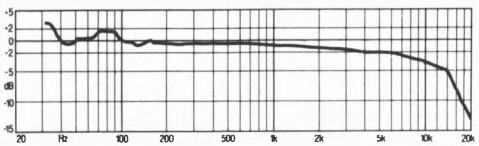
Tape type selection is manual, using large square press-buttons. The transport buttons are mechanically linked and need a fairly solid push to make them work, in spite of Trio's description of them as 'soft touch'! The transport clanked a bit in this process, which is only to be expected with budget designs.

Performance with musicassettes was poor — even as budget decks go. Their sound was dull and lifeless. Severe wow affected recordings, making everything vary erratically in pitch. This problem blighted the deck.

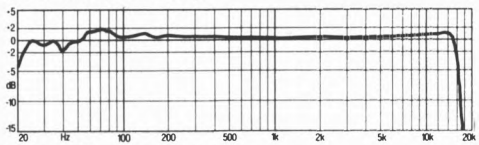
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	28Hz-7.0kHz	poor
Speed accuracy	+1.0%	average
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	22Hz-16.0kHz	very good
Frequency response, chrome	22Hz-16.0kHz	very good
Frequency response, metal	22Hz-16.0kHz	very good
Stereo separation	−47dB	average
Distortion	1.1%	average
Noise	−53dB	good
Speed variation	0.25%	very poor
Modulation noise	−35dB	very poor
Flutter energy (band level)	−23dB	average
MOL, ferric, 315Hz/10kHz	+3.5dB/−7.0dB	good
MOL, chrome, 315Hz/10kHz	−2.5dB/−7.0dB	very poor
MOL, metal, 315Hz/10kHz	+1.5dB/+0.5dB	very poor
Input/output performance		
Line in sensitivity/overload	70mV/>3V	
Mic input sensitivity/overload	1mV/90mV	
Output	300mV	
Typical price inc VAT	£100	

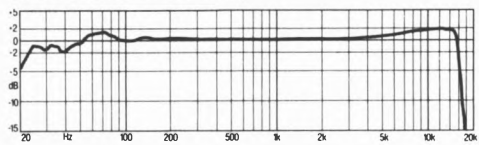
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



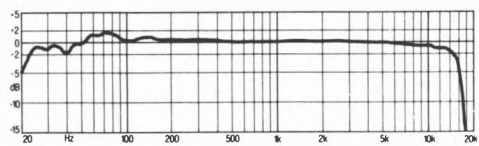
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Trio KX-74

Trio (UK) Ltd, 17 Bristol Road, The Metropolitan Centre, Greenford, Middlesex UB6 8UP
Tel 01-575 6030

This reasonably gadget-free auto-reverse deck is housed in a robust metal case, although internal inspection showed much the same sort of build as usual in fact. The front panel creates a favourable impression with well-located push buttons and switches which don't wobble furiously when pressed.

The transport is logic controlled and the control buttons were easy to identify and use, because the uncluttered front panel didn't distract the eye from their associated legends. 'Punch-in' recording was not possible, but most other commands, like going direct to fast rewind from recording, were.

Although reverse recording is provided, this is not a 'fast reverse' deck and so the leader tapes will cause a gap of about 10 seconds when making an unattended recording on both sides of a cassette, or when playing pre-recorded cassettes. Looking into the cassette compartment showed that fittings for the optical sensors existed, though the crucial parts were missing here.

Trio fit a simple but easily used music search system — this time the user's manual does explain how to use it, unlike the *KX-54*! Both Dolby B and C noise reduction systems are fitted, plus the considerable convenience of automatic tape-type selection.

Lab report

Measuring frequency response of recordings revealed a problem straight away. As the graphs show, ferric tape (IEC I) has falling treble above 5kHz, which will make it sound very dull. Even the tape with highest treble sensitivity, Maxell *XL-IS*, could not compensate for this response error. Dolby will emphasise the problem, resulting in extremely dull sound. Chrome was better, but still had falling upper treble.

Since ferric, chrome and metal midband overload figures (315Hz MOLs) were all high and treble overloads (10kHz saturations) low, over-bias was the problem. Looking inside the *KX-74* revealed the usual single pair (left and right) of bias-adjust potentiometers. This means that relative bias levels for the different tape types are linked, and allows the machine to be factory-set on tape alone, usually metal, to save time.

Because of this, predictably, metal tape gave a flat response , but the others did not. In fact, complicating the issue, metal record equalisation was found to be wrong, but I can't go into this here. Suffice it to say that the designers have apparently got relative bias levels and the bias/record equalisation balance wrong for this machine, meaning that if one tape gives correct results the others automatically won't.

Speed stability of the transport was respectable in both directions, when recording and when replaying. Some regular capstan wow was heard and measured (6Hz rate), plus a flutter peak at just −25dB 40Hz either side of a test tone. This sort of thing adds 'muck' and coarseness to programme, like distortion.

Replay frequency response was fairly flat up to

10kHz in both directions of play and Dolby B tracking good as a result. Higher frequencies fell away.

Replay hiss and hum were low, but replay speed a bit fast in both directions of play. Track alignment proved good.

Sound quality

Metal tape (Memorex *Metal IV*) displayed good clarity and even tonal balance, which we liked. There was slight grittiness from flutter, most noticeable on vocals.

Chrome tape (TDK *SA*) sounded smooth and distortion free; we felt that falling extreme treble helped keep toward this, but also conspired with saturation to dull and compress transients from cymbals and hi-hat in particular. Wow was present as a 'diluting' quality, or slurring.

Ferric tape (TDK *AD*) sounded muffled and woolly. Saturation muted transients.

Musicassettes sounded slightly dull but stereo imaging was acceptable. The speed error was noticeable against our Dragon reference, as was some flutter on critical programme.

Summary

A straightforward auto-reverse deck, the *KX-74* offers reverse recording, but not the ability to optically sense leader tape, for 'fast reverse'. It has the valuable convenience of automatic tape type selection and a simple front panel layout that made pressing the right button less than a hit and miss affair.

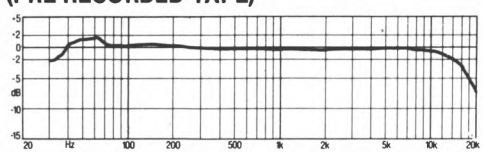
Trio have provided logic-linked transport control buttons that didn't need too much finger pressure. A disconcerting feature was the misleadingly labelled 'record arm' button, because it started recording immediately. The 'record pause' button must be pressed simultaneously to prevent this from happening.

Replay performance was quite good in both forward and reverse directions. Recordings on ferric tape were unacceptably dull, but chrome and metal gave reasonably good results. Overall, we felt that the *KX-74* could easily have been better, but performance was judged acceptable all the same.

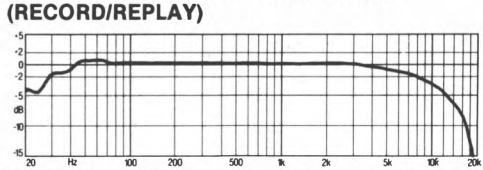
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	28Hz-14.0kHz	good
Speed accuracy	+1.3%	poor
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	28Hz-8.0kHz	average
Frequency response, chrome	28Hz-16.0kHz	very good
Frequency response, metal	28Hz-18.0kHz	very good
Stereo separation	−47dB	average
Distortion	0.5%	very good
Noise	−53dB	good
Speed variation	0.10%	good
Modulation noise	−32dB	very poor
Flutter energy (band level)	−28dB	good
MOL, ferric, 315Hz/10kHz	+3.5dB/−10.0B	average
MOL, chrome, 315Hz/10kHz	+0.5dB/−9.5dB	average
MOL, metal, 315Hz/10kHz	+4.0dB/−2.5dB	very poor
Input/output performance		
Line in sensitivity/overload	60mV/>3V	
Mic input sensitivity/overload	—mV/—mV	
Output	300mV	
Typical price inc VAT	£160	

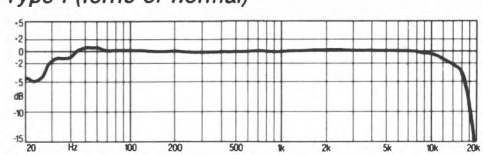
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



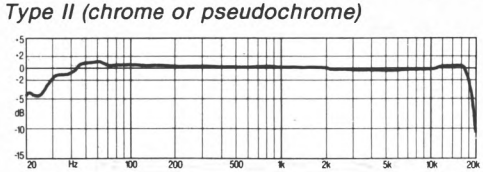
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Trio KX-780

Trio (UK) Ltd, 17 Bristol Road, The Metropolitan Centre, Greenford, Middlesex UB6 8UP
Tel 01-575 6030

Trio's *KX-780* has a single-capstan, unidirectional transport, fitted with independent (but siamesed) record and replay heads to provide off-tape monitoring.

'Music search', fitted to less expensive models, was not included on this one. Instead, the *KX-780* has a skipping arrangement which I found caused confusion in use. Pressing fast forward or rewind buttons during play resets the tape counter to indicate 100 and the machine then fast winds to 000. This, in effect, enables fixed lengths of tape to be skipped, because pressing twice makes the counter go to 200, so doubling the length of skip, and so on upward. Because this resets the counter, any previously set 000 position, which may for example be the start of a music track, is lost, nullifying the role of the counter.

The transport is logic controlled, but it is not wise to utilise its full capabilities, for fear of zeroing the counter. 'Punch-in' recording is not possible.

Variable bias allows fine tape tuning of ferric and chrome, but not metal; a fact the handbook fails to mention. Dolby B and C noise reduction systems are selected by a small slide switch, as is tape type. These were unsatisfactorily small and nasty.

Lab report

Like the *KX-74*, this deck gets frequency response with metal tape commendably flat, as the graph shows. Centre-position bias adjustment gives falling treble with IEC ferrics and chromes, but proved flat enough with TDK *AD* and *SA*, their slight extra treble sensitivity above IEC making them a fair match. However, this deck has a double-Dolby system where independent record and replay processors are fitted. Tracking between them was poor, resulting in substantially falling treble, which will introduce dullness into the sound at low levels.

Bias adjustment range was small, but just adequate to accommodate BASF *CR-MII* super-chrome and IEC I ferrics. Cheap ferric tapes will sound dull.

Checking treble overload (saturation) performance under variable bias confirmed the small adjustment range. On both ferric and chrome, bias adjustment could improve the ability to handle strong treble (10kHz saturation) by up to +3dB — though with bias set in the 'detent' values were relatively poor in the first place, at −10dB. This fact, coupled with fairly good mid band (315Hz) MOLs, demonstrated that bias was basically set too high.

Replay equalisation proved fundamentally accurate, but I was a bit concerned by the fact that every time the machine was stopped and started, treble output from the left channel measured differently! At worst, level was −2.5dB at 10kHz, at best −1dB. The right channel was stable though and reached 18kHz without loss — a good performance. In spite of zero high frequency error, Dolby B tracking was poor, due to misadjustment. Musicassette quality will be degraded slightly due to these problems.

There was some hum in the replay amplifier, the 50Hz component measuring −58dB; this was present when playing back the deck's own recordings too, as expected. Critical, high level listening will reveal it.

The transport ran +2% fast, but had a tendency to alter its speed by up to 0.5%. It was not very speed constant over a long period. In the short term, wow was fairly low, but spectral analysis revealed substantial flutter peaks, resulting in a poor flutter band-energy level figure of −24dB. This sort of thing adds coarseness to the sound and reduces clarity.

Sound quality

With metal tape (TDK *MA*), where no compensatory bias adjustment was available, the dullness introduced by Dolby tracking error significantly affected sound quality, making it intolerably woolly.

Backing off bias with TDK *SA* (chrome) to get subjectively correct tonal balance revealed the speed problem which proved serious enough to affect even non-critical programme like electric bass, altering its character . On piano, it could not always hit the notes correctly sounding 'drunken' at times.

Speed instability was just as obvious with ferric, adding a distorted, polluted quality to the sound (due to flutter) which rather negated any positive attributes.

Musicassettes replayed at a noticeably fast speed, due to the +2% error noted earlier. Tonal balance was essentially neutral, but there was a mildly 'honky' quality, noticed especially on cello. Speed stability was again poor, with high rate wow and flutter polluting the sound, except on very uncritical programme.

Summary

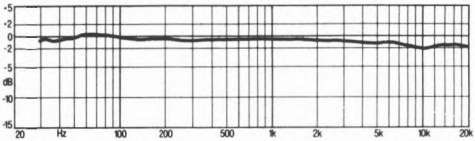
Simply and neatly styled, this unidirectional (non-auto-reverse) deck felt quite solid. Operationally, it has some annoyances though, such as manual tape type selection using a very small slide switch, and a self-zeroing counter. Dolby B and C are included, plus manual fine-adjustment of bias for ferric and chrome tape (but not metal) to ensure accurate tape matching.

Sound quality from musicassettes reached a reasonable if not exceptional standard, but they obviously played too fast and were polluted by wow and flutter. Recordings were blighted by some speed stability problems, and metal tape additionally sounded woolly and dull with Dolby, due to significant tracking error. All in all, this machine's performance was considered poor.

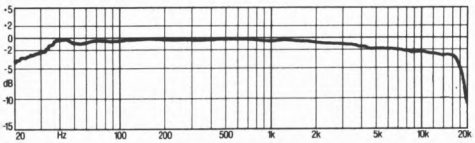
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	20Hz-20.0kHz	very good
Speed accuracy	+2.0%	very poor
Noise	−61dB	good
Record/replay using blank tape		
Frequency response, ferric	30Hz-12.0kHz	good
Frequency response, chrome	20Hz-18.0kHz	very good
Frequency response, metal	20Hz-19.0kHz	very good
Stereo separation	−49dB	average
Distortion	0.4%	very good
Noise	−53dB	good
Speed variation	0.08%	good
Modulation noise	−37dB	poor
Flutter energy (band level)	−24dB	average
MOL, ferric, 315Hz/10kHz	+3.5dB/−8.5dB	average
MOL, chrome, 315Hz/10kHz	+1.5dB/−8.0dB	good
MOL, metal, 315Hz/10kHz	+5.0dB/−0.5dB	poor
Input/output performance		
Line in sensitivity/overload	65mV/>3V	
Mic input sensitivity/overload	0.26mV/36mV	
Output	360mV	
Typical price inc VAT	£200	

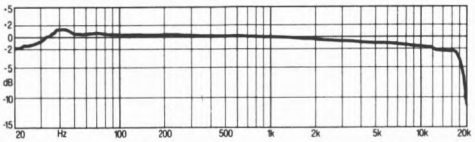
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



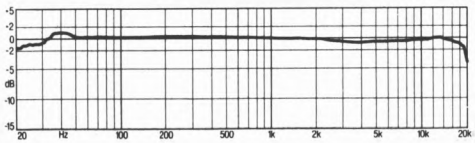
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

Yamaha K320

Natural Sound Systems Ltd, Unit 7, Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 36740

Yamaha's K320 is a simple machine of sober appearance, in contrast with many Japanese cassette decks. Apart from a backlit cassette holder, nothing lights up when it is switched on (if Dolby is off) which can be a bit disconcerting. Three buttons are provided for tape type selection, an arrangement that is easier to understand than twin interdependent buttons. The type selected — ferric, chrome or metal — is not displayed, though, which can allow errors. Yamaha fit a simple mechanical tape counter which is unlit.

The tape transport is controlled by a four-way 'touch plate' rocker switch. It rocks left and right for fast reeling backwards and forwards, up to select play and down to select stop. The control looked neat and was pleasant to operate. Associated logic allowed immediate transfer from play into wind and back. An intro-scan facility is operated by a rocker switch to the left of the main function controls.

Bargraph record level meters had seven LEDs each, which gave mediocre resolution. Yamaha have not been able to resist the deceptive trick of putting a grid over them, giving an appearance of double the number of LEDs, 14 per channel. Peak record level (OVU) has been put −6dB below Dolby level. This is very low for peak reading meters; it encourages under-recording which increases tape hiss. They read transients accurately.

Both microphone inputs and a headphone socket are provided. Record level is adjusted with a friction ganged control that can be awkward if channel levels are to be altered individually.

Although sombre in styling, the K320 has a purposeful air about it and worked smoothly. Its simplicity is an asset, making it easy to understand, without compromising its function.

Lab report

An extremely flat replay response was one notable feature of the K320. This had the affect of minimising Dolby B replay tracking error, which results in fairly well defined, solid images from pre-recorded tapes and minimises the dullness/vagueness that is usually associated with them. Replay speed was correct.

Low OVU level resulted in very poor noise figures, even though Dolby C is incorporated. Yamaha should put OVU up to Dolby flux, like Hitachi, with peak reading meters. Other noise tests did, however, show 2dB more erase noise with metal tape than is possible. Erasure of low frequencies was reasonably good.

Low OVU level, plus lack of head saturation, resulted in a very low average distortion figure of 0.7%. Bias was well set too, providing relatively high maximum output levels with all three tape types.

RECOMMENDED

Record/replay frequency responses were exceptionally flat with IEC Primary Reference Tapes — as the graphs show. I have been assured that Yamaha are paying special attention to meeting IEC Standards, which are World Standards after all. They are successful with the K320, having ensured that it matches all modern high-performance tapes, which have now been reformulated to themselves match the IEC Primary References in most respects.

Under test a regular slow wow problem was heard. Analysis showed it was due to a cyclic speed variation occuring approximately once per second (wow at 1.15Hz), with strong components at 3Hz and 6Hz. High level flutter was evident too, at around 12Hz and 18Hz. It was low frequency wow that was most obvious though and this will certainly be heard as pitch 'trembling' on instruments like piano.

Sound quality

Low record level allowed orchestral crescendos or continuous high rock levels to be reproduced very cleanly on metal tape. There was a slightly bright tonal character and some sibilant splash, but this wasn't offensive. Unfortunately, low rate wow threatened to submerge instrumentalists beneath the pitch 'burbling' it produced.

High level programme still sounded very clean on TDK SA, although as usual we noticed the characteristic softer sound of this tape. Wow was less pronounced, but still discernable.

Ferric tape sounded bright in tonal balance and had a sharpness about it. Tape hiss was obvious, but recordings maintained their clean, open quality.

Replay fidelity was generally good, possessing plenty of attack and good, solid imaging. Speed instability was noticed even here though, especially on harpsichord.

Conclusion

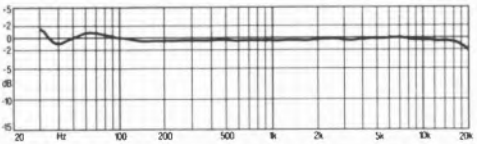
The K320 is an excellent deck, sadly marred by low indicated peak record level and slow rate wow. Without these problems, it would easily stand head and shoulders above its rivals. In fact, a second sample, which arrived just before going to press, had better speed stability, and we feel confident in recommending the K320.

(Note: test results in the table relate to our later production sample)

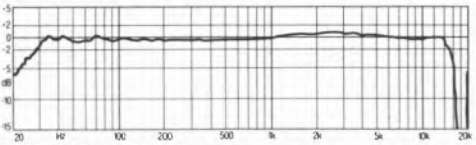
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	31Hz-18kHz	very good
Speed accuracy	+0.1%	very good
Record/replay using blank tape		
Frequency response, ferric	20Hz-20kHz	very good
Frequency response, chrome	20Hz-20kHz	very good
Frequency response, metal	20Hz-0kHz	very good
Stereo separation	–49dB	average
Distortion	0.7%	good
Tape hiss, ferric	–63dB	good
Tape hiss, chrome	–65dB	average
Tape hiss, metal	–61dB	poor
Speed variations (wow and flutter)	0.04%	very good
Modulation noise	–35dB	poor
Flutter energy (band level)	–26dB	good
MOL, ferric, 315Hz/10kHz	+3.4dB/–8.0dB	good
MOL, chrome, 315Hz/10kHz	+0.8dB/–7.0dB	average
MOL, metal, 315Hz/10kHz	+3.0/+1.0dB	good
Input/output performance		
Line in sensitivity/overload	40mV/—V	
Mic input sensitivity/overload	0.24mV/24mV	
Output level	240mV	
Typical price inc VAT	£155	

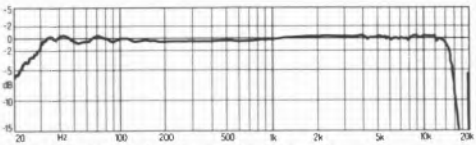
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



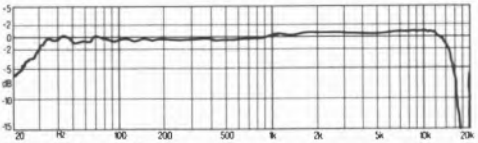
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I ('ferric' or 'normal')



Type II ('chrome' or 'pseudochrome')



Type IV ('metal')

Yamaha K520

Natural Sound Systems Ltd, Unit 7, Greycaine Road, Watford, Herts WD2 4SB
Tel (0923) 36740

Yamaha's *K520* is very similar to the basic *'320* model, but it does have some extra gadgets. The mechanical tape counter is replaced by an LED display that shows elapsed time, and it has a memory. This and the cassette compartment back-light come on when the mains switch is pushed, giving clear indication that the deck is on. But the main additional feature of the *'520* is the provision of various microprocessor based functions such as 'intro scan', which senses the beginning of music tracks — providing there is the usual 4 second gap before them — and plays the first 10 seconds of each.

There is next/last song search, repeat playback of an entire cassette, repeat between zero and a memorised position on the counter and what have you. Note that as usual the scan system relies upon gap sensing, so it doesn't apply to much else other than rock/pop music — it won't work very well on classical programme.

This system and an automatic fader apart, the *K-520* is at heart very similar to the *'320*. It has comprehensive logic control that made it easy to operate, but the solenoids clanked somewhat. Automatic tape type selection is fitted, with status indicators — a very useful feature.

I was surprised to see that Yamaha have retained the poor record level indicators of the *'320*. These have poor resolution, OVU set −3dB lower than usual and a maximum indication only +3dB above Dolby flux (200nWb/m) — which is far too low to show the peak levels that can be used with metal tape. Nearly all decks now put OVU at Dolby flux and indicate peaks up to +6dB higher at least.

Lab report

Recording to stay 'out of the red' will result in at least +3dB more hiss than usual and will not utilise the available dynamic range, especially with metal tape which had a midrange overload level (MOL) around +8dB higher than Yamaha's indicated OVU level, or +5dB higher than the maximum indication of the meters.

Low OVU begs the use of super-quiet tape like BASF chrome. Bias has been set to give reasonable results with it, but sensitivity wasn't quite right, although it should suffice for fairly accurate Dolby tracking using BASF *CR-EII*.

Although inherent circuit-hiss is not a problem with the *'520*, hum at 50Hz is, measuring high at −53dB. Luckily, 50Hz hum is not normally as obvious as 100Hz and 150Hz components, the latter both being below −60dB. We felt that this performance was not very satisfactory all the same.

Replay frequency response proved very flat, but treble output wavered a lot at high frequencies. The transport exhibited flutter on replay-only too, so this phenomenon will affect musicassettes. Further analysis showed extensive flutter, but little wow. Low wow produces a good DIN-weighted speed stability figure, which in this case was 0.08%. Flutter adds roughness and dirtiness to the sound of cassette.

I was surprised to find a DIN socket meeting

the old 'current fed' German standard properly; this is now a rarity, but may be useful to some people. Output from this and the line sockets was low at 310mV.

All recording frequency responses (see graphs) displayed falling treble. It proved possible to compensate for these by use of quality tapes, the following giving flat response: Maxell *XL-IS* (ferric), TDK *SA* and TDK *MA*. Dolby tracking was found to be fair, compromising flatness little at low levels.

Sound quality

Although in outline, sound quality with TDK *MA* metal was fine, due to good tonal balance and basic pitch stability, underlying problems were evident. A rapid 'burr', due to fast wow was detected on sustained piano notes. There was a general lack of clarity too, plus a sense of 'dirtiness' to the sound.

Hum and drone (hum harmonics) were heard when recording with BASF *CR-EII*, the low noise and slightly inferior hum screening of this tape exacerbating the problem. It gave a more even and confident sound than *MA*, but again lacked clarity. Competent, but not exceptional.

Maxell *XL-IS* (which suffered no hum) gave very strong bass dynamics and reasonable treble quality, some cloudiness and diffusion being evident, as usual with ferric tape.

Musicassettes sounded a trifle bright, and 'clattery' against the *ZX-9* reference, doubtless due to the unusual lift in replay response. Treble extension was excellent, imaging sharp and transients had bite. It was a very explicit presentation. Hum was not a problem. Piano displayed good note 'solidity' (steady pitch). Generally an impressive sound.

Summary

Much like the *'320*, but with programme searching abilities and a more sophisticated tape counter, the *'520* again has a conventional single-capstan, unidirectional transport mechanism — operated, via logic control, by a single touch plate.

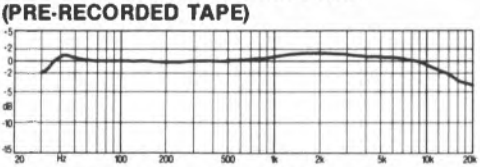
Automatic tape type sensing is a useful addition to the *'520*, since it prevents selection error and ruined recordings, but the poor record level indicators are inappropriate to a deck at this price level.

Measured performance was respectable, but not exceptional, in all areas, and this proved sufficient to ensure competent recordings; but their sound quality was tinged with edginess and coarseness due to flutter. Musicassette reproduction was relatively good.

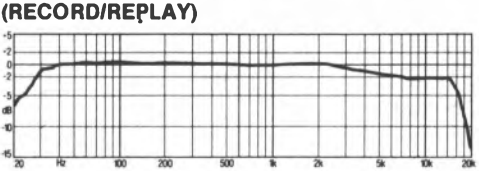
TEST RESULTS

Replay of pre-recorded musicassettes		
Frequency response	28Hz-14.0kHz	good
Speed accuracy	+0.7%	good
Noise	−60dB	good
Record/replay using blank tape		
Frequency response, ferric	28Hz-15.0kHz	very good
Frequency response, chrome	28Hz-16.0kHz	very good
Frequency response, metal	28Hz-14.0kHz	good
Stereo separation	−49dB	average
Distortion	1.0%	good
Noise	−53dB	good
Speed variation	0.08%	good
Modulation noise	−38dB	average
Flutter energy (band level)	−26dB	good
MOL, ferric, 315Hz/10kHz	+4.0dB/−7.0dB	good
MOL, chrome, 315Hz/10kHz	+0.0dB/−6.0dB	average
MOL, metal, 315Hz/10kHz	+3.0dB/+1.5dB	average
Input/output performance		
Line in sensitivity/overload		70mV/>3V
Mic input sensitivity/overload		0.4mV/30mV
Output		310mV
Typical price inc VAT		£200

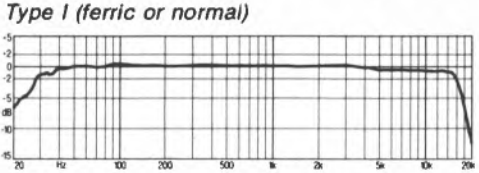
REPLAY FREQUENCY RESPONSE (PRE-RECORDED TAPE)



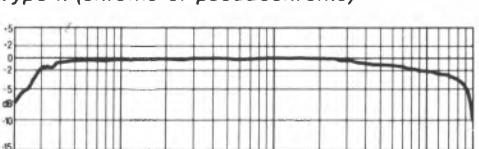
OVERALL FREQUENCY RESPONSES (RECORD/REPLAY)



Type I (ferric or normal)



Type II (chrome or pseudochrome)



Type IV (metal)

BEST BUYS AND RECOMMENDATIONS
CASSETTE DECKS

This page summarises the models which we found to be the best performers, and the reasons for our selection of 'Best Buy' and 'Recommended' ratings. For the full picture, though refer to the reviews themselves.

BEST BUY: AROUND £100
The **JVC KD-X2** has to be a bargain at £99. JVC tell me it is a rack system deck with plenty of market life ahead — not an old model replaced by the V220, as I initially suspected.

BEST BUY: £100–£130
The **Akai HX-A201** outperforms all decks around it. Akai have tailored this one with care, possibly with the European market in mind. It doesn't feel as well built or have the ease of operation of the *HX-A3*, but sound quality — especially with musicassettes — is better and beyond serious criticism at the price. The **Akai HX-A3** (cosmetically updated version of the *HX3*, tested last year) continues to be a 'Best Buy' being especially well designed from the user's point of view. However the *HX-A3X* is poor value in my opinion (see *Technical Introduction* on dbx).

RECOMMENDED: £100–£130
Marantz's SD-152, at the low price of £104, is reasonable value, though not up to Akai's *HX-A201*, nor better value than the JVC *KD-X2*.

The **Sony TC-FX320**, like the Akai *HX-A3* is another nice deck to use. Although it lacks the latter's automatic tape selection facility it is still fair at around £120.

BEST BUY: £130-£170
At around £160 there's hardly another auto-reverse deck to touch **Aiwa's AD-R450**, with the exception of those made by Akai.

RECOMMENDED: £130-£170
Onkyo TA-2027 turned out to be one of the few generally competent unidirectional decks tested this year in this price range, recording performance and sound quality with musicassettes both reaching a high standard.

Yamaha's K-320 remains recommended (from last year) also as a competent, unidirectional design meeting proper IEC Standards, instead of Japanese misinterpretations of the same. It is beginning to look pricey, though.

BEST BUY: £170-£250
A gadget packed auto-reverse deck, the **Aiwa AD-R550** works extremely well and gives fine sound quality from musicassettes and recordings. In my opinion, this is the most expensive cassette machine anyone need buy for high quality general purpose use. For critical listeners, though — audiophiles or musicians — it is arguably the cheapest they should consider.

Complete with user adjustable bias **Denon's DR-M22** is one of the least expensive dual capstan decks available. It has a very stable 'solid' sound and provides fine recordings. Replay quality is good, but not up to the standards of any Nakamichi.

RECOMMENDED: £170-£250
The **Nakamichi BX-100E** gives fine results providing high quality, low hiss tapes are used. It has Dolby B only.

Another good all rounder, the **NAD 6155**, is distinguished by flexibility provided by 'play trim' and adjustable bias for tape matching.

BEST BUY: £250-£300
A little more expensive than the *DR-M22*, the **Nakamichi BX-125** has better musicassette quality, Dolby C and excellent speed stability.

At £290 the **Denon DR-M33HX** is a really good allrounder. It has better replay quality than the *DR-M22*, plus more overload headroom.

BEST BUY: £300-£400
With fine sound quality, plus every gadget conceivable, the **Aiwa AD-F990** is a bargain at £350.

A very easy to use deck, the **Denon DR-M44HX** has more gadgets than the *BX-300* but is arguably undermined by Aiwa's *AD-F990*.

RECOMMENDED: £300-£400
Nakamichi's BX-150 has little more to offer than the *BX-125* but it is still a good deck, though slightly overshadowed by the *DR-M33HX*. And, only for those who insist on having a deck that looks like this, the **B & O 5000** can also be recommended.

BEST BUY: £400-£500
At around £499 the **Nakamichi BX-300** is the quintessence of what a cassette deck should be.

RECOMMENDED: £400-£500
The **Harman Kardon CD491** has plenty of gadgets and fine sound quality.

RECOMMENDED: Above £500
Although too expensive to be included as 'Best Buys' the following decks can certainly be recommended.

I felt that the **Pioneer CT-A9X** was a bit pricey when compared to Nakamichis and Denons, but it is still a very good deck. The **Nakamichi ZX-9** however, must be included as a top deck for professional use. A Euro rival for the *ZX-9*, the **Revox B215**, is very good too and is easier to operate than the *ZX-9*.

Finally, **Nakamichi's Dragon** at £1250 must be recommended for listening to musicassettes properly!

DEALER GUIDE

DEALER GUIDE

These cassette decks are available for demonstration from

Moorgate Acoustics Limited

AIWA, TEAC, DENON
YAMAHA, TECHNICS, JVC

2 WESTGATE, ROTHERHAM
Tel: 0709 370666
FINANCE AVAILABLE

CHICHESTER HIGH FIDELITY

Appointed stockists of
A&R Cambridge, Castle, Celestion, Creek Audio, Goldring, Kef, Linn, Mordaunt-Short, Naim, Quad, Rega, Rogers, SME, Nakamichi, Ackroyd, Tannoy

40 Little London, Chichester, W. Sussex
Telephone 0243 776402
(Closed all day Monday)

PETER ELLIS AUDIO

Always a wide range of superior audio products in stock, including:

Loudspeakers: Castle, Rogers, Kef, Mordaunt Short, Wharfedale, Mission
Amplifiers: A&R, Quad, QED, Creek
Cassette Decks: Teach, Technics, Sony, Hitachi
Turntables: Dual, Thorens, Walker, Ariston, Michell
Compact Disc Players: Akai, Trio, Phillips

SINGLE SPEAKER DEMONSTRATION ROOM
BY APPOINTMENT ONLY
29 KIRKGATE, NEWARK, NOTTINGHAM
(0636) 704571

Image Hi-Fi

8 St. Annes Road, Headingley, Leeds LS6 3NX
Telephone (0532) 789374

Stockists of most of the world's leading hi-fi products.
Demonstrations by appointment please

NAKAMICHI IN IRELAND

Ten years experience with Nakamichi cassette decks has proved to us that they are not only the best engineered but also the best sounding machines available.

In line with this commitment to quality, your new Nakamichi can now be delivered pre-biased for your favourite tape type.

Both two and three head models are available for demonstration at our Blackrock showrooms; together with full service facilities for all Nakamichis.

With a little help from Nakamichi we would be happy to show you just how good cassettes can sound. Our showrooms are open through lunchtime, from ten am to six pm — Tuesday, Wednesday, and Saturday. On Thursdays and Fridays we are open late 'till nine.

CLONEY Audio

34a Main Street, Blackrock, County Dublin
Tel: Dublin 889449

P.J. EQUIPMENT LTD.

GUILDFORDS ORIGINAL HI-FI DEALER

If you believe you need a helpful decision on your hi-fi needs and have a quiet (mostly) demonstration of the equipment. Then have free local delivery and the chance to change you loudspeakers in seven days, then call in at P.J. and sample our service.

3 BRIDGE STREET, GUILDFORD
Tel: 0483 504801

G.E. MANDERS

For Nakamichi, Quad, Dual, Hafler, Luxman, Denon, Revox, Sansui, Harman-Kardon, A + R, Thorens, Sondek, QED, Spendor, Technics etc.

2 Edward Street, Grimsby,
S. Humberside
0472-51391

Hi-Fi Components Ltd.

84 BATTERSEA RISE
LONDON SW11
01-223 1110

TOP PRICES AT BOTTOM PRICES

For all your Hi-Fi needs at discount prices.
Access & Barclaycard welcome.

CHOOSING CASSETTE TAPE

Ferric, chrome or metal? To find the most suitable tape for a particular deck or application, first look at the different performance characteristics of the major tape types.

In the first cassette tapes, the magnetic coating material was ferric oxide, but by the early 1970s chromium dioxide formulations had been introduced as an alternative. Around 1980, manufacturers started to produce tapes which made use of pure metal particles in the coating instead of oxides. We have tested all types.

Ferric, 'normal' or 'I' tapes

With the obvious advantage of low price, ferric tapes vary widely in quality, from very poor to highly respectable. There is a sharp dividing line between the cheap 'cooking' ferrics and those suitable for hi-fi use.

Cheap ferrics suffer high hiss, which has a coarse quality about it. They also overload easily, especially at high frequencies, resulting in a dull and muddled sound. Clarity is poor.

High-performance 'IEC I' ferric are specifically for hi-fi cassette decks. By conforming closely to the performance of the IEC I Primary Reference Tape (a world standard), they have excellent compatibility with current decks, producing recordings of even tonal balance — neither too much nor too little treble. Hiss is usually much lower than with the 'cooking' ferrics, and overload ceilings improved too. On a good deck they can give very respectable sound quality.

Super-ferrics usually cost nearly as much — sometimes more — than chromes. Also, they will give very bright treble on most decks, making them most suited to those with tape tuning or user-adjustable bias. Their main benefit lies in raised overload levels. Properly tuned-in and working on a good deck, super ferrics can give excellent sound quality.

Chrome or 'II' tapes

The term 'Chrome' tends to include any tape types designed to be used in the 'chrome' or IEC 'II' position, although many are not in fact chromium dioxide formulations.

True chromes, from the European manufacturers Agfa, BASF and Philips, have very low hiss, but less overload headroom than the so-called 'pseudochromes'. These are the cobalt-doped ferric types produced by the Japanese tape companies (TDK, Maxell, Fuji, Sony and others). They have better overload headroom but more hiss than true chromes — almost as much hiss as good ferrics — and because of this they need higher recording levels.

There are exceptions to these generalisations, though, notably the appearance of cobalt ferrics (such as the latest TDK *SA*) that are as quiet as true chromes.

Metal tapes for use in the 'II' position (TDK *HX-S* and That's *EM-X*) are as hissy as ferrics but have very high overload levels, and give a bright sound. So far, their sensitivity is always too high for accurate Dolby operation.

Low-hiss chrome tapes are preferable to high hiss cobalt doped ferrics in my opinion, even when overload margins move up commensurately, because the lower recording levels they require induce less head distortion.

Moreover, in practice it seems that most people record to OVU on their record-level meters, whereupon the advantage of low hiss is realised, whereas high overload margins are not. The only qualification to this is that the tape must be able to accept OVU level (now Dolby flux of 200nWb/m) in the first place.

Ferrichrome tapes, using both ferric and chrome coatings in a dual-layer construction, are now obsolete. Modern decks do not cater for them, hence the absence of IEC 'III' switch settings.

Metal or 'IV' tapes

Metals are expensive, limiting their appeal to fairly well-heeled enthusiasts. Their main benefit is that of very high treble overload margins, around +6dB higher than ferrics and chromes. They give bright, clean and well differentiated treble as a result. Their midband overload ceiling is high too, but most budget decks are unable to exploit this, because head overload occurs before tape overload!

Apart from cost, metals also suffer from hiss, the only exception being Sony *ES*. Treble output stability and modulation noise are not up to BASF chrome standards either, except in the case of Maxell *MX*.

People sometimes find that metal tape sounds gritty and coarse, but this failing will not be entirely due to the tape. Most cassette decks are set up with the IEC IV Primary Reference tape, usually to give a slightly bright 'enhanced' sound. Unfortunately, when an inherently bright sounding metal like TDK *MA* is used, treble output becomes fierce. This accentuates deck problems like flutter and upper midband distortion (1% at 3kHz), causing the grittiness. Anybody experiencing this problem is advised to try Maxell *MX* metal, since its particular properties very much favour smooth, unaccentuated treble.

Agfa LNX

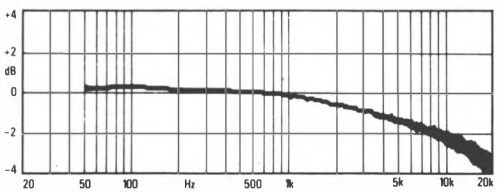
Apparently, *LNX* is a tape manufactured for quantity sale through a large group of stores, so I presume it is meant to be just a decent ferric rather than a hi-fi tape.

It had less treble than any other ferric tested in this book, the frequency response clearly showing it to be −2dB down at 10kHz, this being subject to some variation between samples. Sensitivity was a bit low, effectively contributing to Dolby mistracking, which will make the sound even more dull unless *LNX* is used with simple decks having low bias.

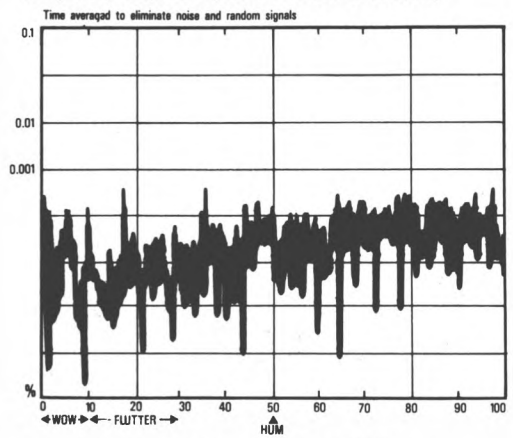
Hiss was quite low −49dB and mid-band overload reasonable at +2dB. The mechanics obviously flutter, as shown by the spectrum, but wow and hum are low.

At a low price, this is a reasonable ferric, though characterised by a very dull sound in hi-fi use. It is not really a hi-fi tape.

Treble level (10k)	−2dB
Sensitivity	−0.5db
Bias noise (hiss)	−49dB
Modulation noise	−35db
Overload 315Hz MOL	+1.9dB
Overload 10kHz MOL	−3dB
Wow & flutter energy	−40dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Agfa Ferrocolor HD

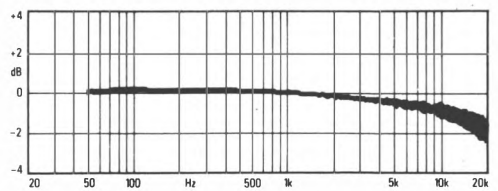
Ferrorcolor HD has a marked treble fall in its frequency response, which will give it a dull sound with modern hi-fi decks. Slightly low sensitivity will emphasise the effect by causing Dolby mistracking.

Overload margins were about average for a budget ferric, being fair in the mid-range at +2.dB but somewhat low at high frequences at −2.5dB. This puts Ferrocolour about on-par with a tape like TDK D, although it will sound duller due to its more strongly falling treble.

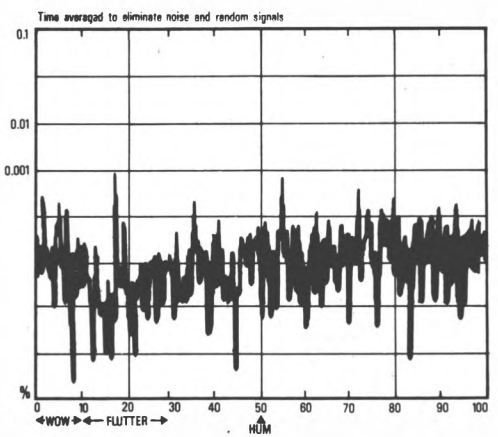
At −49dB hiss was at a respectably low level and will not be a nuisance. Modulation noise was on the high side at −37dB, reducing clarity a bit. Both wow and flutter were on the high side.

Overall, then this tape is a reasonable budget ferric, but it is characterised by a noticeably dull sound.

Treble level (10k)	−1.3dB
Sensitivity	−0.6db
Bias noise (hiss)	−49dB
Modulation noise	−37db
Overload 315Hz MOL	+2dB
Overload 10kHz MOL	−2.5dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: FERRIC

Agfa HD-X

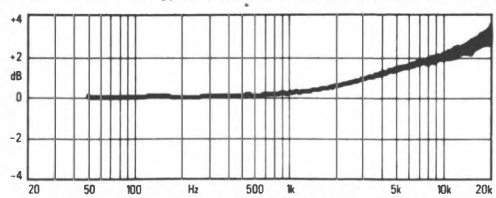
Distinguished by its steeply rising treble output this tape will — potentially — give a very bright sound. However, very low sensitivity of −1.9dB will temper this a bit with Dolby operative, due to mistracking. Compatibility of *HD-X* is comparatively poor.

Mid-band overload measured a very low 0dB, but treble overload was actually higher at +0.8dB! This is a strange set of properties, as comparison with any other ferric tape shows.

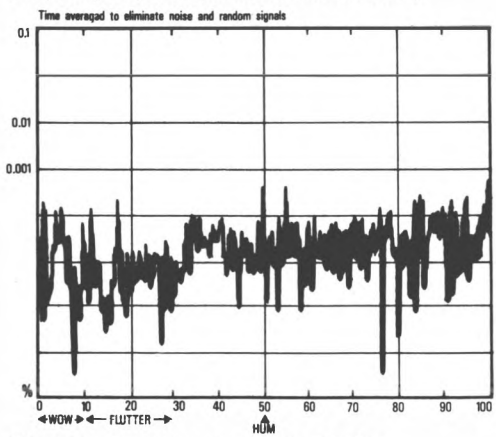
A strong point in favour of *HDX* is its fairly low hiss (bias noise) floor of −51dB. Modulation noise has been improved over *Fel-S* it replaces, now being a normal −39dB, improving clarity. High flutter made speed stability poor, but hum and wow were quite low.

Although low in hiss, *HDX* is still damned by limited dynamic range and low sensitivity, compared to tapes like BASF *LH-MI* or Maxell *XL-IS*.

Treble level (10k)	+2dB
Sensitivity	−1.9db
Bias noise (hiss)	−51dB
Modulation noise	−39db
Overload 315Hz MOL	0dB
Overload 10kHz MOL	+0.8dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

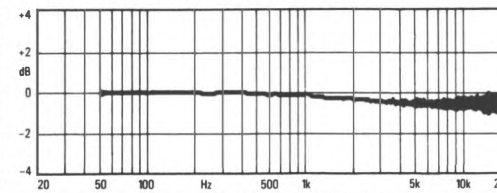
BASF LH-EI

BASF make the IEC I Primary Reference tape and *LH-EI* is meant to be its direct commercial equivalent. It gives a very similar frequency response, as the graph shows. As a result, it will give natural tonal balance on most hi-fi decks, which is a worthwhile property. Sensitivity is very similar to the Primary Reference too, making overall compatibility excellent.

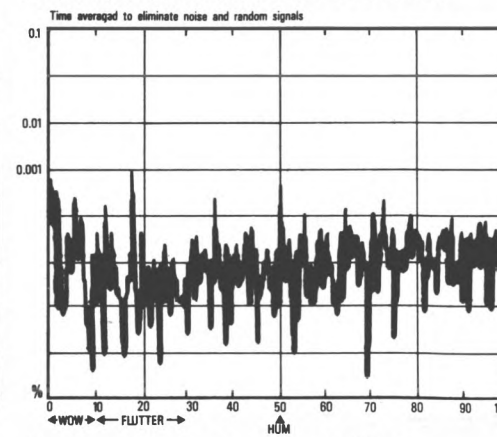
BASF have obviously reformulated since last year, sacrificing a bit of mid-band overload for improved treble overload. Moreover, all four test samples gave similar saturation figures, instead of the variation noted in 1984. Hiss and modulation noise remain about average for a budget ferric. Speed stability proved good and there was little hum sensitivity.

This is now a fine budget ferric tape, with good compatibility.

Treble level (10k)	−0.5dB
Sensitivity	−0.4db
Bias noise (hiss)	−49dB
Modulation noise	−38db
Overload 315Hz MOL	+2.3dB
Overload 10kHz MOL	−1.3dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

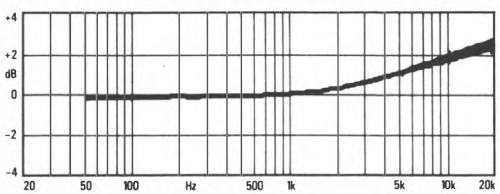
BASF LH-MI

LH-MI is very different from the *LH-SI* it replaces. Whilst *'SI* had a touch more treble than IEC I, *'MI* has substantial treble output in comparison and will sound bright or very bright on most decks, being +2dB up at 10kHz. However, lowish sensitivity will produce some Dolby mistracking compensation.

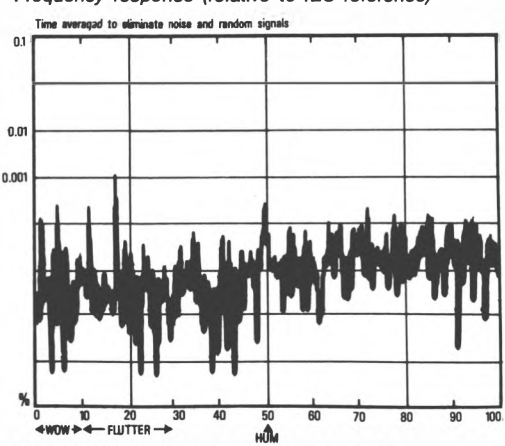
Hiss has been taken down to a low value of −51dB, BASF doubtless keeping an eye on TDK *AD, AD-X* and Maxell *XL-IS* in this area, against which *LH-MI* strongly competes as a super-ferric. And at +0.7dB it has one of the highest treble overload ceilings of any ferric tape, helping retain treble clarity in recordings.

The mechanics exhibit low wow and hum, as the spectrum shows, but a touch more flutter than is possible. Performance is good in this area though. *LH-MI* is an excellent super-ferric, but it will give strong treble and a bright sound.

Treble level (10k)	+1.9dB
Sensitivity	−0.7db
Bias noise (hiss)	−51dB
Modulation noise	−40db
Overload 315Hz MOL	+2.2dB
Overload 10kHz MOL	+0.7dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

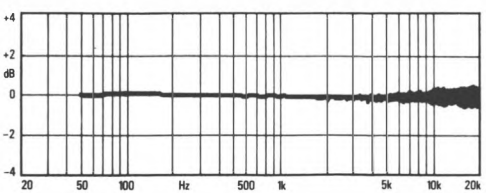
Fuji FR-I

FR-I is obviously meant to be a near-perfect IEC I tape, since it has an extremely flat frequency response, much like that given by the two Primary References used. Sensitivity was a bit low at −0.5dB, but this is not enough to seriously upset what should be a pleasantly smooth tonal balance.

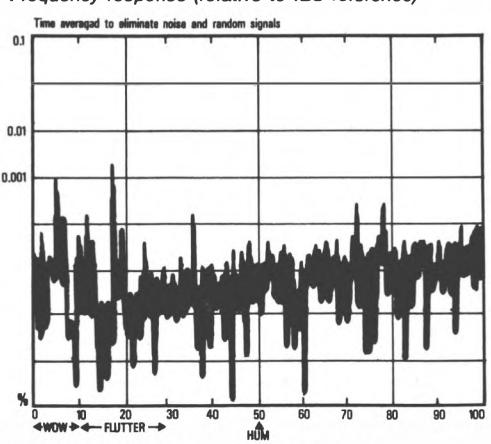
At −50.5dB hiss has been well suppressed. It is complemented by a reasonable modulation noise figure of −39dB. A maximum treble overload level of −0.6dB puts this tape up amongst the best of the IEC I types, making *FR-I* a good competitor for TDK *AD*. It has a slightly higher mid-band overload value of +2.7dB though, but this is still not enough to challenge the dynamic range of *AD*. Some wow is evident in the speed stability trace too.

FR-I is a high quality ferric tape with excellent compatibility, low hiss and good overload margins. It is recommended.

Treble level (10k)	−0.2dB
Sensitivity	−0.5db
Bias noise (hiss)	−50.5dB
Modulation noise	−39db
Overload 315Hz MOL	+2.7dB
Overload 10kHz MOL	−0.6dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

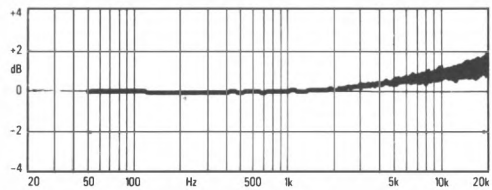
CASSETTE TAPES: FERRIC

Fuji GT-I

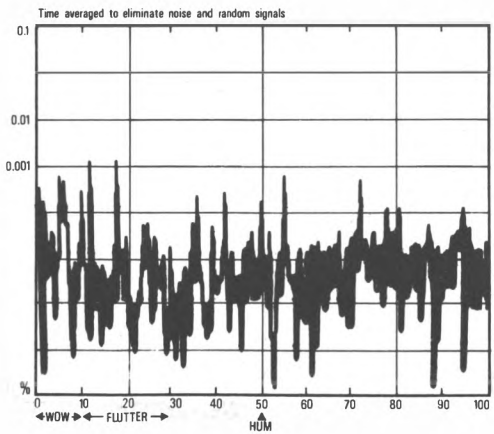
GT-I is advertised as a tape made for car players, its shell being able to withstand extreme dashboard temperatures without warping. Cooking tapes is something I haven't got around to yet, so this claim wasn't tested!

I was prepared though, for an unusual electrical performance from *GT-I*, expecting Fuji to have used a different coating to withstand high temperatures, forsaking hi-fi requirements like low hiss. But it turned out that *GT-I* is a perfectly normal hi-fi tape, with very low hiss at −51dB, low modulation noise and just slightly rising treble. I was only surprised to find limited mid-band overload headroom of +1dB. Car tapes are popularly supposed to have high output, which means high sensitivity and overload headroom — *GT-I* has neither. In fact, sensitivity is low. Low hiss makes up for this, and in terms of sound quality, *GT-I* is a very respectable tape.

Treble level (10k)	+0.5dB
Sensitivity	−1.2db
Bias noise (hiss)	−51dB
Modulation noise	−40db
Overload 315Hz MOL	+1dB
Overload 10kHz MOL	−0.5dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Maxell UL

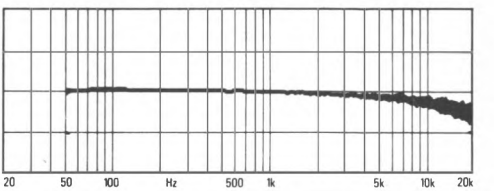
Like most budget ferrics, *UL* has falling treble output compared with the IEC I Primary Reference. It measured −0.7dB at 10kHz, placing it between TDK D and BASF *LH-EI* in this respect. On most decks, *UL* will sound a bit dull, an effect emphasised by low sensitivity and, therefore, Dolby tracking error.

Comparisons with TDK *D* and BASF *LH-EI* continue with overload margins, where *LH-EI* wins by a hair's breadth, *UL* being marginally inferior in the mid-band and treble regions, TDK *D* being an also-ran here. Hiss with *UL* is low and modulation noise average. Although a budget tape, it is not hissy — unlike many.

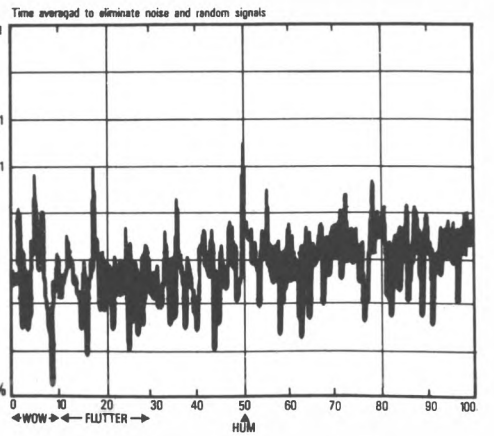
The mechanics exhibited less wow but a bit more flutter and hum than the BASF tape, TDK *D* again being an also-ran.

UL is what I would term a quality budget ferric tape.

Treble level (10k)	−0.7dB
Sensitivity	−0.5db
Bias noise (hiss)	−50dB
Modulation noise	−38db
Overload 315Hz MOL	+1.8dB
Overload 10kHz MOL	−1.5dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Maxell UD-I

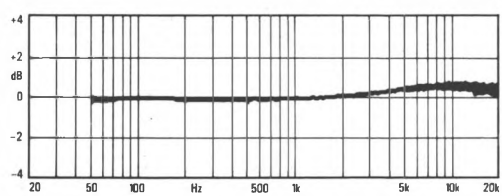
Of Maxell's ferrics, this one is closest to the IEC I Primary Reference tape in both frequency response and sensitivity. As a result, it has excellent compatibility with cassette decks and should in most cases give even tonal balance. The frequency response exhibits just slight treble lift above 2kHz, but without any sign of peaking at 20kHz, avoiding treble sharpness.

Overload margins are very high in the mid-band and at high frequencies, so *UD-I* will sound less fluffy than many 'flat-response' ferrics. Additionally, Maxell have kept both hiss and modulation noise down, enhancing dynamic range.

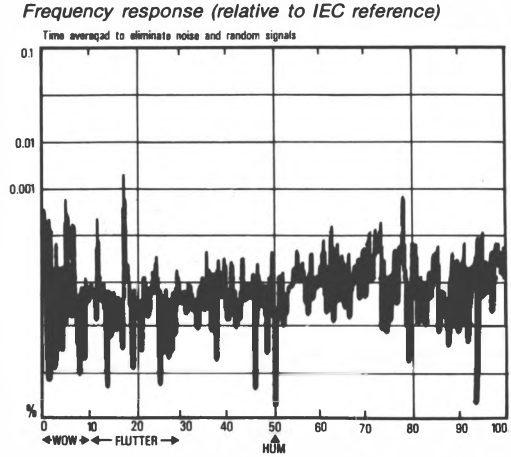
The speed stability spectrum reveals a bit more wow and flutter than *XL-I*, but negligible hum.

UD-I is highly recommended as a first class ferric having even tonal balance, low hiss and high overload.

Treble level (10k)	+0.7dB
Sensitivity	0db
Bias noise (hiss)	−51dB
Modulation noise	−40db
Overload 315Hz MOL	+3dB
Overload 10kHz MOL	0dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Maxell XL-I

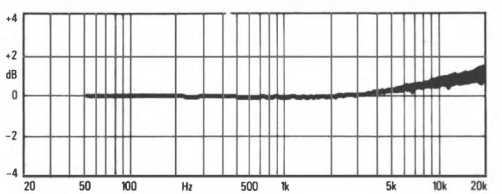
XL-I is very close in performance to IEC I, having just a shade more treble, as the frequency response shows. Level is up +0.7dB at 10kHz, giving *XL-I* a slightly bright sound on decks adjusted for IEC I — as most are. Sensitivity is on the high side, promoting further emphasis of treble by Dolby action. These deviations are small though and in general the brightness should not be unpleasant.

Both hiss and modulation noise are well suppressed. The tape also has healthy mid-band and treble overload margins, giving it good dynamic range. Maxell have traded some mid-range overload for improved treble overload in this latest formulation.

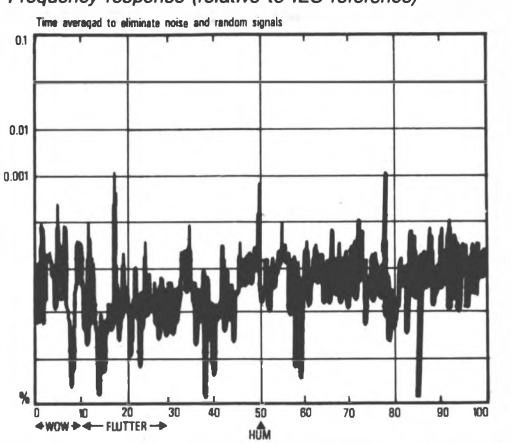
Although looking spiky, the speed stability spectrum actually shows that wow and flutter levels are low.

This is a fine tape capable of delivering excellent treble quality in particular.

Treble level (10k)	+0.7dB
Sensitivity	+0.5db
Bias noise (hiss)	−49.5dB
Modulation noise	−41db
Overload 315Hz MOL	+3.8dB
Overload 10kHz MOL	0dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: FERRIC

Maxell XL-IS

This tape gives more treble than its stablemate, *XL-I*, and will give a noticeably bright sound on most decks. On samples of the latest formulation, sensitivity has now been reduced though, by −1dB, introducing some compensation through Dolby tracking error.

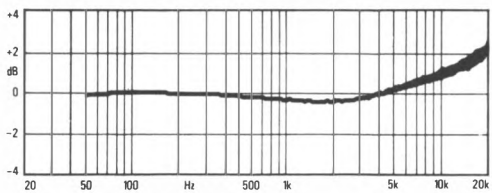
Overload margins are lower than those of *XL-I*, but remain healthy at +2.5dB in the mid-band and −0.5dB at high frequencies. However, due to a low hiss level of −52dB, the tape has fine dynamic range.

Modulation noise is about normal at −40dB.

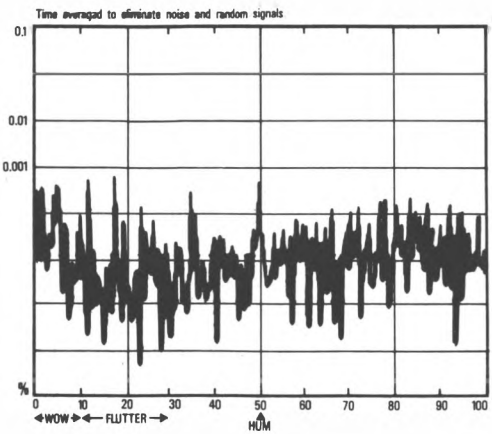
The speed stability spectrum shows the presence of a bit more wow and flutter than *XL-I* tape.

Maxell *XL-IS* is a high performance ferric, giving low hiss but a bright sound. It is therefore a tape that is really suited for use with dull-sounding decks.

Treble level (10k)	+1dB
Sensitivity	−0.4db
Bias noise (hiss)	−52dB
Modulation noise	−40db
Overload 315Hz MOL	+2.5dB
Overload 10kHz MOL	−0.5dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

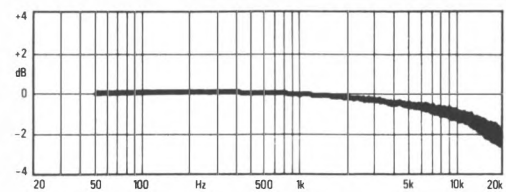
Memorex dB Series

As an inexpensive ferric, this tape inevitably has falling treble when compared with the IEC Primary Reference. It is −1dB down at 10kHz. Sensitivity is low too, measuring −0.8dB. Both falling treble and low sensitivity cause Dolby to mistrack, which further emphasises dullness, so *dB* tapes are likely to sound dull on modern hi-fi recorders.

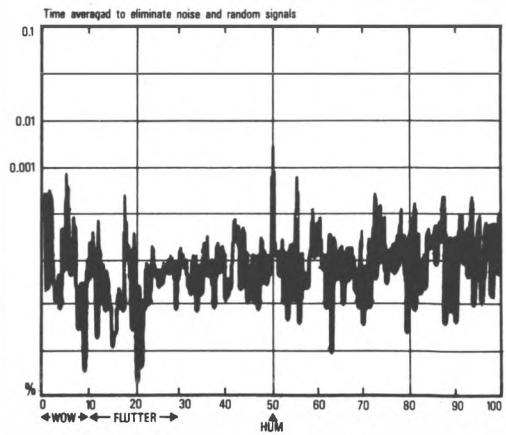
At −49dB hiss level is fair, being much like that of other budget ferrics. Modulation noise proved unexceptional at −37dB, reducing clarity. Overload margins have been kept to the usual budget-ferric levels of +1.7dB in the mid-band and −2.5dB at high frequencies, the latter contributing to dullness through self-erasure, like all saturation limitations. Raised wow, hum and flutter were evident.

This is a typical budget ferric tape, with dull treble. It doesn't hiss badly, though, and is a reasonable tape at a low price.

Treble level (10k)	−1dB
Sensitivity	−0.8db
Bias noise (hiss)	−49dB
Modulation noise	−37db
Overload 315Hz MOL	+1.7dB
Overload 10kHz MOL	−2.5dB
Wow & flutter energy	−40dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Memorex MRXI

MRXI produces a near-flat IEC I frequency response and has similar sensitivity to the Primary Reference too, giving it fine general compatibility.

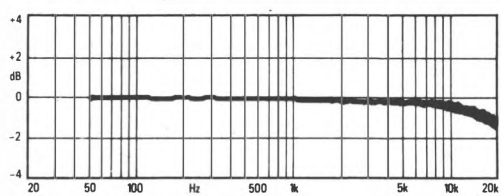
Like so many other tape manufacturers, Memorex have now re-balanced the tape's overload ceilings, bringing the mid-band down in favour of improving it at high frequencies.

With a 10kHz saturation value now of −1.7dB, *MR-XI* still leaves something to be desired here, but its +3dB mid-band result and low hiss floor of −50dB combine to give this tape a very useful blend of properties.

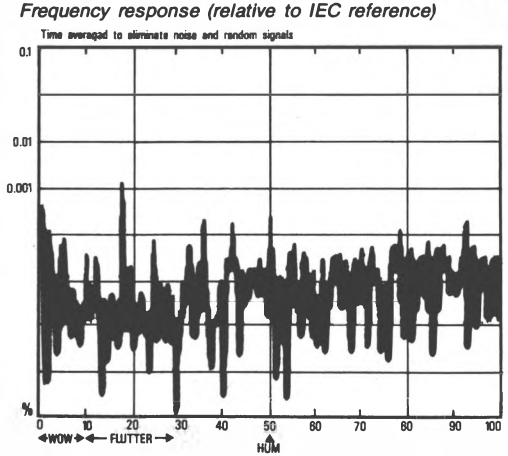
Modulation noise was low too and the mechanics measured quite well.

MRXI has been re-balanced but remains a good all-rounder, having low hiss, a flat frequency response, fine compatibility and reasonable overload ceilings.

Treble level (10k)	−0.5dB
Sensitivity	−0.4db
Bias noise (hiss)	−50dB
Modulation noise	−41db
Overload 315Hz MOL	+3dB
Overload 10kHz MOL	−1.7dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Philips FE-I

FE-I has almost perfect IEC I frequency response, which means it will have smooth, natural sounding tonal balance when used for recording on modern hi-fi decks.

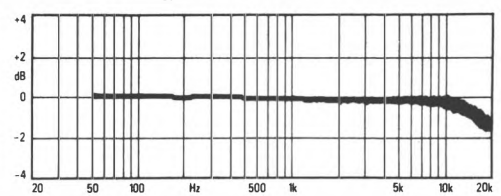
Slightly less treble lift than *UF-I* takes hiss down by 1dB too, putting *FE-I* on a level with tapes like BASF *LH-EI*, against which it can be closely and validly compared.

Overload in the mid-band is high at +3.5dB, but at high frequencies some of this advantage is lost, the figure dropping to a reasonable −1.6dB. Nevertheless, *FE-I* still performs very respectably, combining a useful set of properties for a budget ferric.

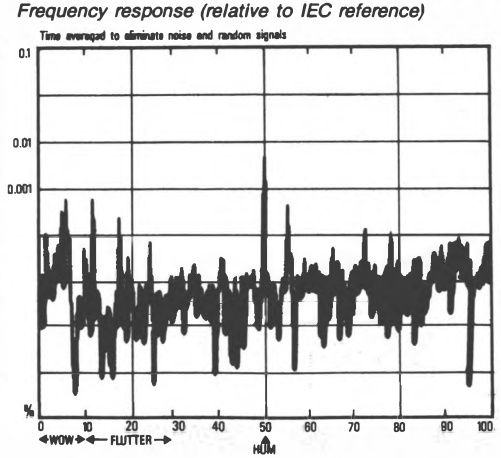
Flutter was well suppressed, but both wow and hum are evident in the speed stability spectrum.

Philips *FE-I*, then, can be described as a very compatible ferric cassette tape with low-ish hiss and good overload margins.

Treble level (10k)	−0.5dB
Sensitivity	+0.2db
Bias noise (hiss)	−49dB
Modulation noise	−40db
Overload 315Hz MOL	+3.5dB
Overload 10kHz MOL	−1.6dB
Wow & flutter energy	−39dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: FERRIC

Philips UF-I

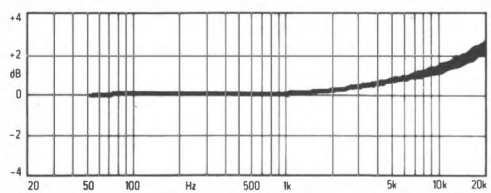
Philips have completely reformulated *UF-I* since last year. It now has a different and, in my opinion, improved overload balance with 2dB less in the mid-range, but +2.4dB more headroom at high frequencies. This puts it on-par with the better ferrics, except that dynamic range remains compromised by a relatively high hiss level of −48dB. However, the treble overload margin of +0.6dB is excellent.

Frequency response exhibits rising treble, like so many quality ferrics. As a result, *UF-I* will generally give a bright sound, but with fine treble clarity. Philips have kept sensitivity close to that of the IEC I Primary Reference tape, for accurate Dolby action.

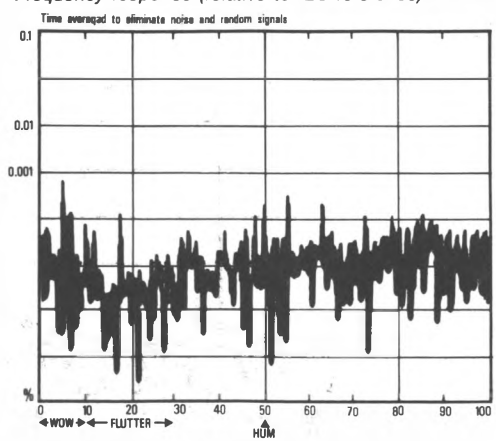
Wow was low, but flutter was a bit up, as the spectrum shows.

This is a bright-sounding quality ferric with fine overload margins, but is still compromised by hiss.

Treble level (10k)	+1.3dB
Sensitivity	−0.4db
Bias noise (hiss)	−48dB
Modulation noise	−40db
Overload 315Hz MOL	+2.1dB
Overload 10kHz MOL	+0.6dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Scotch BX

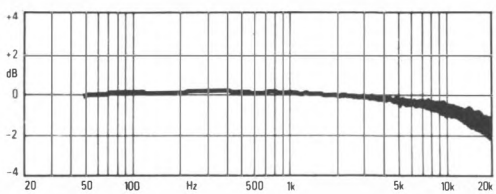
Falling treble, high hiss and poor overload margins mark out *BX* as a typical budget ferric tape that will in practice be certain to give a dull sound on most hi-fi decks.

The low treble overload margin of −3dB promotes saturation and self-erasure with strong treble signals. Falling treble in the frequency response is heard as dullness and the Dolby mistracking it promotes only makes matters worse.

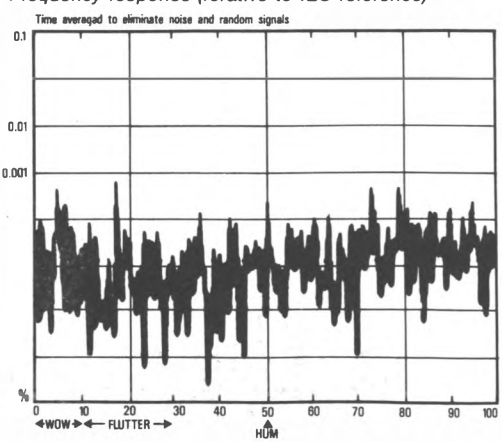
To cap it all, *BX* has low sensitivity, measured at −1.5dB relative to the reference which encourages further reduction of treble by Dolby. The speed stability spectrum exhibits obvious wow and flutter, but little hum breakthrough is visible in the analysis.

This straightforward budget product from Scotch isn't really to be regarded as hi-fi tape, but it may be appropriate for simple recorders if offered at a low price.

Treble level (10k)	−1dB
Sensitivity	−1.5db
Bias noise (hiss)	−48dB
Modulation noise	−40db
Overload 315Hz MOL	0dB
Overload 10kHz MOL	−3dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

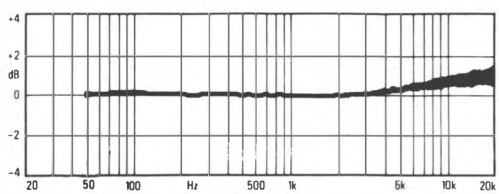
Scotch CX

As the frequency response trace shows, *CX* gives slightly more treble than *XS-I* and, therefore, a brighter sound. The difference is quite small though, measuring just +0.6dB at 10kHz. Sensitivity is adequate for accurate Dolby tracking.

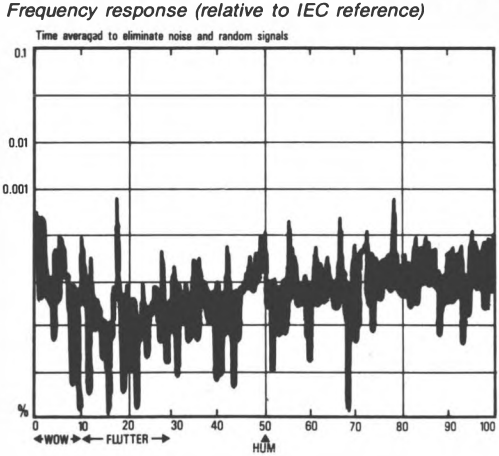
A weakness of *CX* is its comparatively high hiss level of −48dB — no less than 3dB higher than *XS-I*. Modulation noise is reasonable at −39dB and overload margins fairly high in both the mid-band and at high frequences. These good points unfortunately don't make up for the extra hiss through, and dynamic range is fair but not exceptional in a competitive field. Speed stability was fine, both wow and flutter being low.

CX has good dynamic range, but unless recording level is increased it will not be utilised and the tape will sound hissy. Otherwise, it is compatible.

Treble level (10k)	+0.6dB
Sensitivity	−0.4db
Bias noise (hiss)	−48dB
Modulation noise	−39db
Overload 315Hz MOL	+2.8dB
Overload 10kHz MOL	.0dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Scotch XS-I

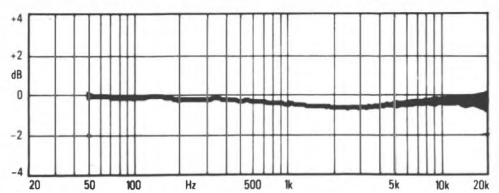
Scotch have made *XS-I* a very close match to the IEC I Primary Reference. Frequency response is identical, but sensitivity of this latest formulation just a bit low at −0.7dB. Nevertheless, *XS-I* remains a compatible tape, giving smooth tonal balance on most decks.

Compared with some other ferrics mid-band overload is not impressive, the +1.6dB value being adequate. With the latest formulation Scotch have, however, improved treble overload of *XS-I*, bringing it up to a respectable, if not exceptional value of −1dB.

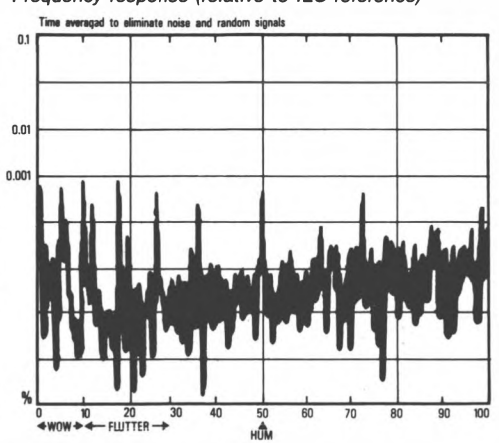
This tape still scores by having low hiss. It measured −51dB, well up amongst the quieter ferrics, although now bettered by a few. Speed stability was very satisfactory.

XS-I remains a broadly compatible ferric, exhibiting low hiss, but suffering limited overload margins.

Treble level (10k)	−0.2dB
Sensitivity	−0.7db
Bias noise (hiss)	−51dB
Modulation noise	−41db
Overload 315Hz MOL	+1.6dB
Overload 10kHz MOL	−1dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: FERRIC

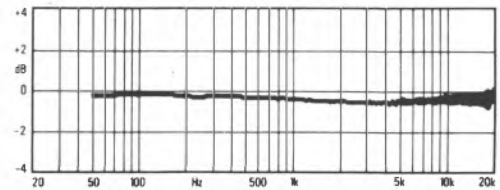
Sony HF

Now with a perfectly flat IEC I frequency response, Sony *HF* will have a smooth, even sound with most hi-fi decks which are accurately adjusted for the IEC I Primary Reference tape. But, surprisingly for a good Japanese tape, it has low sensitivity at −1dB, which introduces slight dullness with Dolby in operation. This compromises compatibility, which is mediocre as a result.

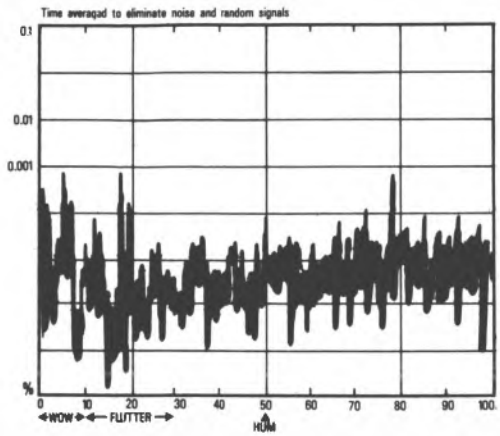
Overload headroom values were adequate at +1.8dB in the mid-band and −1dB at high frequencies, some re-balancing being effected here to improve the high frequency performance over earlier samples. They remain compromised by a high noise floor, hiss measuring −47.5dB. Modulation noise was low at −40dB. Some flutter is evident in the oscillogram, plus wow.

This is a mediocre ferric which suffers high hiss but is otherwise competent.

Treble level (10k)	−0.3dB
Sensitivity	−1db
Bias noise (hiss)	−47.5dB
Modulation noise	−40db
Overload 315Hz MOL	1.8dB
Overload 10kHz MOL	−1.1dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Sony HF-S

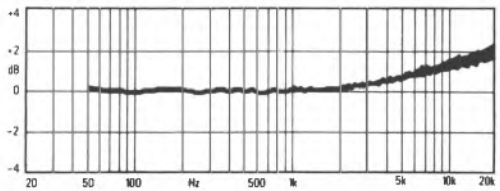
Sony's *HF-S* gives more treble than *HF*, as the frequency response graph shows, and so, compared with many other ferrics will give a bright sound. Its sensitivity is close to the IEC requirement though. Rising frequency response compromises compatibility, unless extra treble is needed.

Like many other manufacturers, Sony have decided to lower mid-band overload for better treble overload, the latter being improved by +1.6dB over earlier samples. These results were not compromised by a high noise floor.

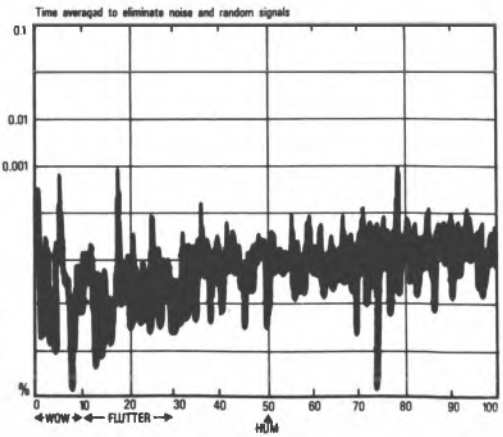
Hiss measured −51dB, giving *HF-S* better dynamic range and less audible hiss under OVU recording limitations. Modulation noise was low too.

In essence this is a fine tape. However, like other quality ferrics it does give a very bright sound, **compromising compatibility.**

Treble level (10k)	+1.4dB
Sensitivity	−0.5db
Bias noise (hiss)	−51dB
Modulation noise	−40db
Overload 315Hz MOL	+2.6dB
Overload 10kHz MOL	+0.6dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

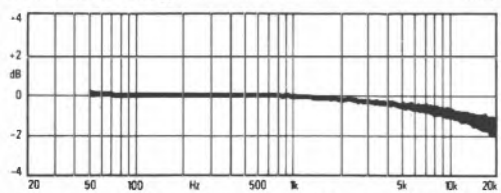
TDK D

Falling treble relative to IEC I (see frequency response) and lowish treble overload headroom classify *D* as a typical budget ferric tape. So does its raised hiss level of −49dB, which is quite a lot worse than *AD* in particular. As a result, you can expect *D* to give a softish and hissy sound on hi-fi cassette decks.

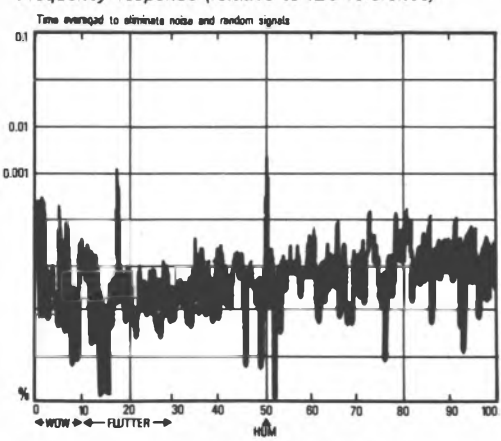
The limited overload figures are worse than other budget ferrics, like BASF *LH-EI* and *Maxell UL* and *UD-I*, so *D* is not so hot by budget ferric standards, having less dynamic range than many. The speed stability spectrum shows a raised hum level (seen as the central spike at 50Hz), plus some wow, but little flutter.

Sensitivity is a trifle low at −1dB, promoting Dolby tracking error in a direction that will reinforce dullness. This tape is competent, but not very appropriate for hi-fi work.

Treble level (10k)	−0.9dB
Sensitivity	−1.1db
Bias noise (hiss)	−49dB
Modulation noise	−40db
Overload 315Hz MOL	+1.1dB
Overload 10kHz MOL	−2.3dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

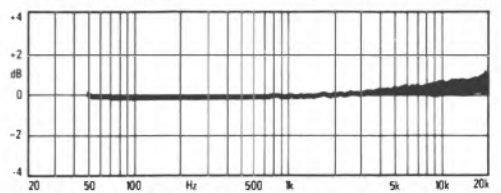
TDK AD

TDK *AD* meets the IEC I frequency response, but with a shade more treble than the Primary Reference — seen in the frequency response. It has a slightly bright sound. Sensitivity is now also identical to the Primary Reference, giving excellent Dolby tracking, since in any case current cassette decks are set for this sensitivity.

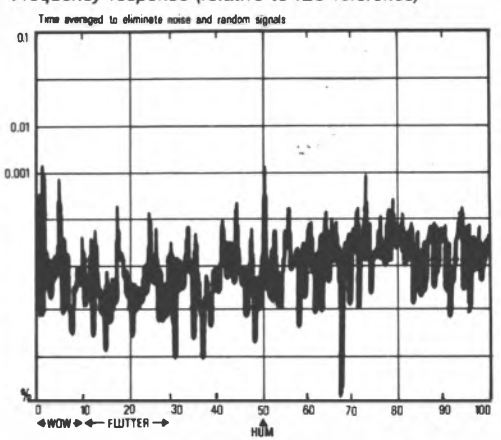
Maximum output at 315Hz was reasonable at +2dB. However, treble performance has always been *AD*'s strength, 10kHz overload (saturation) measuring a high −0.5dB. The tape can accept strong treble signals. Hiss remains low, being reduced by −1dB in the samples of *AD* which we measured most recently. Modulation noise is high, having deteriorated on the latest samples. Mechanical performance proved good.

This is a good, compatible ferric tape with low hiss and fine treble.

Treble level (10k)	+0.5dB
Sensitivity	0db
Bias noise (hiss)	−52dB
Modulation noise	−37db
Overload 315Hz MOL	+2dB
Overload 10kHz MOL	−0.5dB
Wow & flutter energy	−39dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: FERRIC

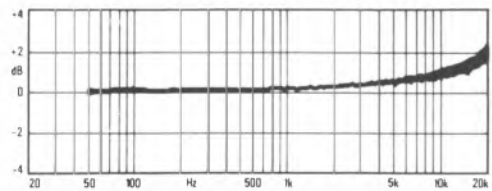
TDK AD-X

This doped-ferric tape is distinguished by its remarkably high mid-band and treble overload levels, the 315Hz figure being equivalent to metal tapes. But although treble overload (saturation) has improved by +1dB on recently-tested samples of *AD-X*, as seen in the results below, it is now challenged in this respect of measured performance by super-ferrics. The overload figures are complemented by lowish noise at −50.5dB, giving wide dynamic range. Modulation noise is now reasonable at −39dB.

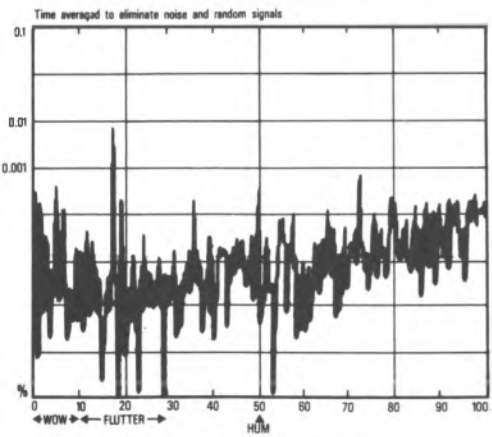
Like other super-ferrics, *AD-X* has rising treble and a bright sound — see frequency response. Sensitivity is similar to IEC I. Speed stability spectrum shows raised flutter, some wow, but low hum due to good shielding.

This is an excellent, high performance ferric tape, but it will give a bright sound on most decks.

Treble level (10k)	+1dB
Sensitivity	−0.5db
Bias noise (hiss)	−50.5dB
Modulation noise	−39db
Overload 315Hz MOL	+4.4dB
Overload 10kHz MOL	+0.6dB
Wow & flutter energy	−38dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

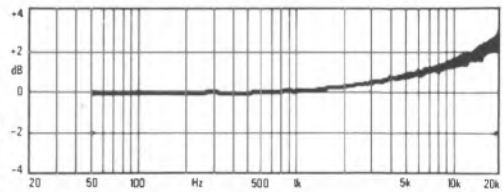
That's FX

In the UK, *FX* is the only ferric offered by Taiyo Yuden under the That's brand name. *FX* has a strongly rising treble, and a relatively high treble overload value of +0.9dB. The tape will accept a lot of treble but it will also sound very bright on most machines — and often not very pleasantly so, because like all tapes with rising treble, it will emphasise machine problems such as flutter.

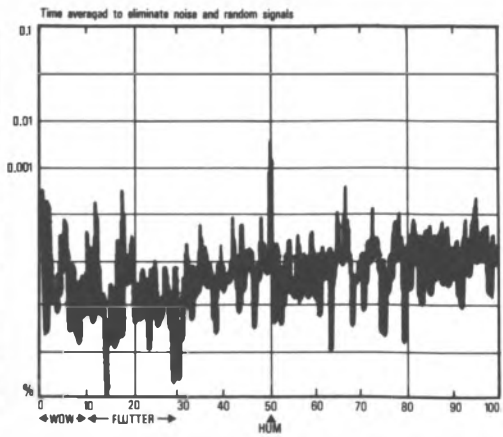
Sensitivity is identical to IEC I so, rising treble apart, Dolby tracking will be good. This is most relevant to decks with tape matching adjustment that can 'flatten' *FX*'s peak. Midband overload is also high, so the tape will accept high overall recording levels. With low hiss (−50.5dB), this gives good dynamic range. Modulation noise was well suppressed too, aiding clarity.

This is a good, high performance, low hiss ferric, but with a very bright sound.

Treble level (10k)	+1.6dB
Sensitivity	−0db
Bias noise (hiss)	−50.5dB
Modulation noise	−40db
Overload 315Hz MOL	.3.6dB
Overload 10kHz MOL	+0.9dB
Wow & flutter energy	−40dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

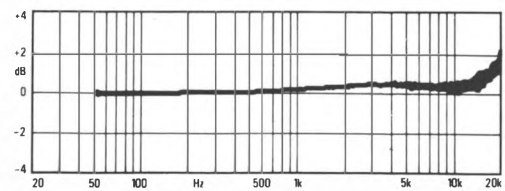
Agfa Stereochrom HD

This year, Agfa's standard chrome had relatively stable output. It remains close to the IEC II frequency response, so will sound tonally balanced or just a bit bright in most decks. Sensitivity, at −0.9dB, is still very low for Japanese recorders, promoting Dolby tracking error which will introduce dulling of treble.

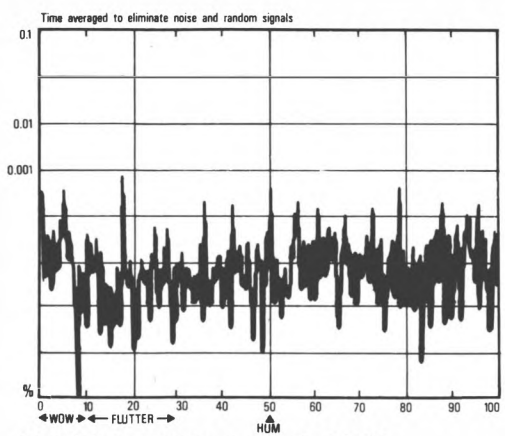
Mid-band overload was low at −0.8dB and treble overload at 10kHz very poor, measuring −5.5dB — the worst of any chrome/pseudo-chrome tape. Low bias noise and modulation noise make up for this to some extent. Mechanical performance proved satisfactory.

In practice this tape gives reasonable results, being redeemed by low noise and a flat response. However, insensitivity and low overload margins still make Agfa's HD inferior to similar BASF product.

Treble level (10k)	+0.2dB
Sensitivity	−0.9db
Bias noise (hiss)	−56dB
Modulation noise	−42db
Overload 315Hz MOL	−0.8dB
Overload 10kHz MOL	−5.5dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



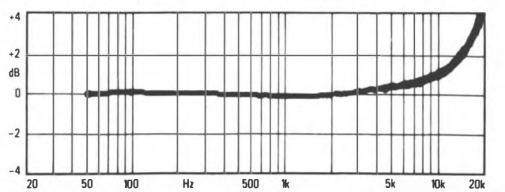
Wow & flutter spectrum analysis, 0-100Hz

Agfa Superchrom HD-X

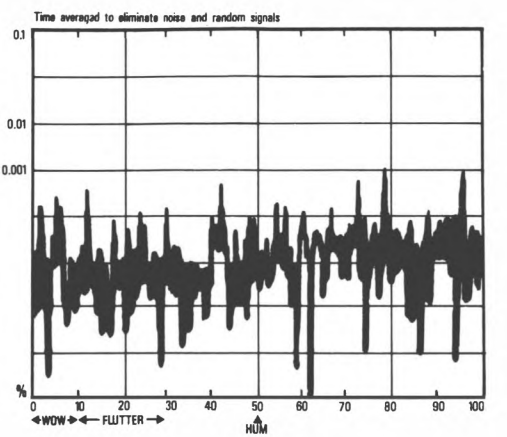
Agfa's super-chrome has rising treble and will therefore give a very bright sound on most decks. Sensitivity was low at −1dB, so the Dolby mistracking this causes will introduce some compensatory treble loss at levels well below OVU. I was surprised to find that mid-band overload has decreased compared with last year and at −1.1dB is the lowest of any hi-fi tape, including ferrics! Treble overload was still very poor at −5.1dB. However, *HDX* now has the merit of also being the quietest tape on the market, hiss reaching a record low of −57dB. Unfortunately, whilst low hiss is more useable and valuable than high overload margins, Agfa's still isn't low enough to give adequate dynamic range.

HD-X will nearly always give a bright sound, but with low hiss. It suffers limited dynamic range, especially when compared to BASF *CR-MII*.

Treble level (10k)	+1dB
Sensitivity	−1db
Bias noise (hiss)	−57dB
Modulation noise	−41db
Overload 315Hz MOL	−1.1dB
Overload 10kHz MOL	−5.1dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

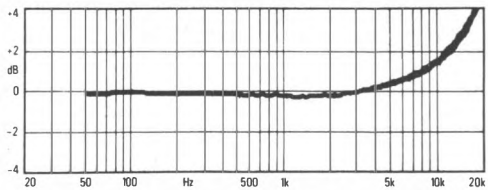
CASSETTE TAPES: CHROME

BASF CR-MII

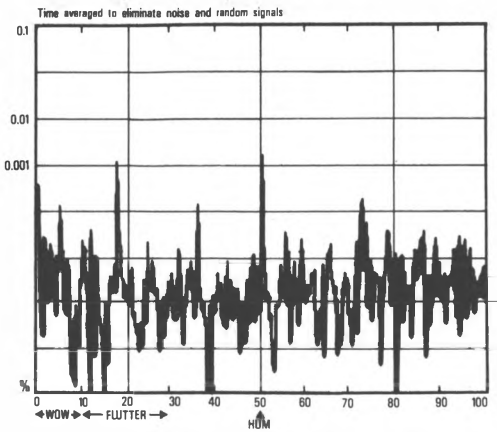
Recently reformulated, *CR-MII* retains strong treble lift, but this is its only serious drawback. With +1.6dB lift at 10kHz and +5dB at 20kHz *CR-MII* usually sounds far too bright unless used with tape tuning or adjustable bias.

Sensitivity is now up to pseudo-chrome levels — necessary for good deck matching. Hiss remains very low at −56dB and overload creeps up to a high value of +3dB. This gives *CR-MII* more mid-band dynamic range than most metal tapes and much less hiss when recording to OVU. Treble overload remains high at −2.6dB and modulation noise sinks again to reach an all-time low of −44dB. BASF's mechanics have extremely low flutter and wow too. This tape provides exceptional results if it matches the recorder. Unfortunately, it often sounds over-bright under conventional bias/record-eq conditions.

Treble level (10k)	+1.6dB
Sensitivity	+1db
Bias noise (hiss)	−56dB
Modulation noise	−44db
Overload 315Hz MOL	+3dB
Overload 10kHz MOL	−2.6dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

BASF CR-EII

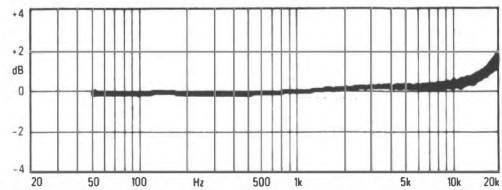
Since the IEC II Primary Reference is BASF chrome, it is not surprising in comparison, that *CR-EII* has a flat frequency response and identical sensitivity. Sensitivity is low for Japanese cassette decks and induces Dolby tracking error, dulling treble slightly though barely noticeable.

Mid-band overload is now fair at +2dB, but treble overload remains low at −4.3dB. As BASF state, bias noise (hiss) is lower than that of pseudo-chromes, giving −2.5dB less hiss below OVU record level and fine dynamic range, without high recording levels.

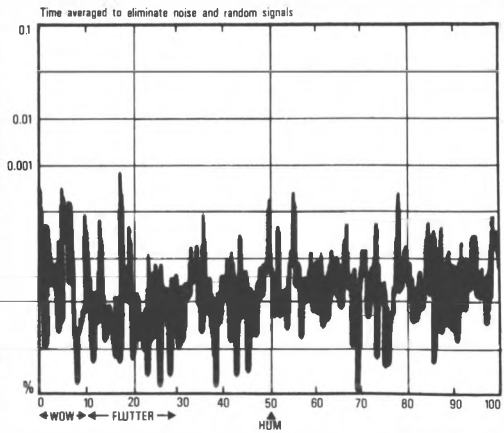
Modulation noise is now down to −44dB which, with little flutter, provides fine clarity. Some wow is visible in the spectrum.

This is a fine tape if not over-recorded. The low noise floor gives more dynamic range below peak record level (OVU) than many rivals.

Treble level (10k)	+0.5dB
Sensitivity	0db
Bias noise (hiss)	−55dB
Modulation noise	−44db
Overload 315Hz MOL	+2dB
Overload 10kHz MOL	−4.3dB
Wow & flutter energy	−43dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

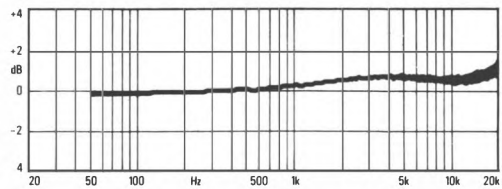
Fuji FR-II

FR-II is Fuji's answer to the pseudo-chromes of TDK, Maxell and the like. Fuji appear to keep a close eye on IEC standards, since all their tapes meet IEC requirements closely and *FR-II* is no exception. Frequency response shows just slight treble lift (+0.5dB at 10kHz) and sensitivity has been set to a good median value of +1.4dB for accurate Dolby tracking. A compatible tape that will generally provide even tonal balance.

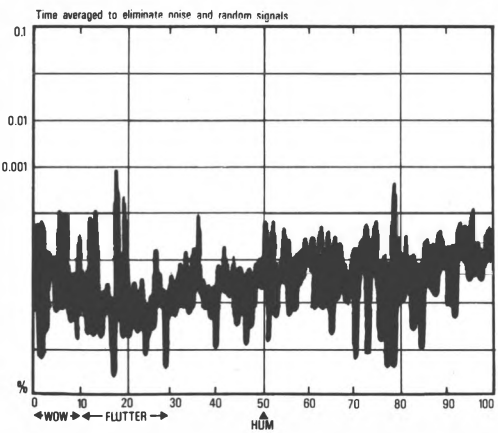
Fuji have managed to get hiss down to a typical pseudo-chrome value of −54dB, a figure that this year is beginning to look inadequate. Overload ceilings were healthy, both in the mid-band and at high frequencies. *FR-II* is just a hair's breadth ahead of Scotch *XS-II* in dynamic range, but behind in modulation noise.

This is a competent and very compatible tape, but it is not as quiet as the best.

Treble level (10k)	+0.5dB
Sensitivity	+1.4dB
Bias noise (hiss)	−54dB
Modulation noise	−40db
Overload 315Hz MOL	+2.9dB
Overload 10kHz MOL	−2.6dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

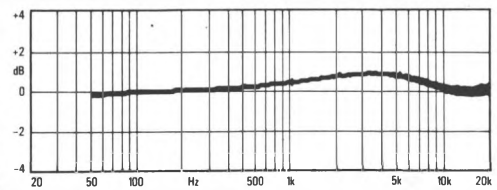
Maxell UD-II

Maxell say that *UD-II* is an IEC II type tape. As the trace response shows, it has a reasonably flat frequency response compared with the IEC II Primary Reference tape, there being more sensitivity around 4kHz which leads to a +0.7dB lift here. In this respect it is much like other pseudo-chromes. Sensitivity has been kept down to +1.1dB, which is about right for accurate Dolby tracking (target value is +1.5dB).

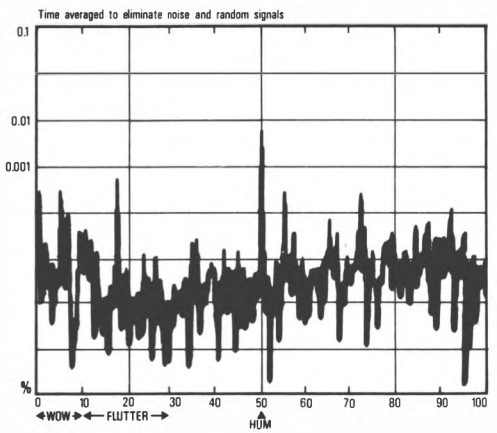
Maxell have decided, with this tape, to opt for low hiss at the expense of overload headroom. Interestingly, with hiss at −55dB they meet *BASF*'s *CR-EII* head on, but *UD-II* has more modulation noise, worse treble output stability and lower mid-band overload than *CR-EII*. Its advantages are a more compatible sensitivity figure and slightly better treble overload margin.

UD-II is recommended.

Treble level (10k)	+0.1dB
Sensitivity	+1.1db
Bias noise (hiss)	−55dB
Modulation noise	−41db
Overload 315Hz MOL	+0.7dB
Overload 10kHz MOL	−3.7dB
Wow & flutter energy	−38dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: CHROME

Maxell XLII

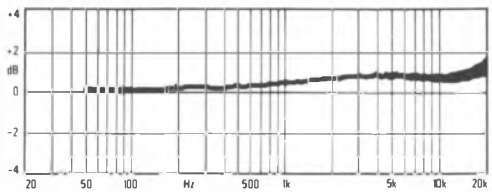
XLII is Maxell's answer to *TDK SA*, the frequency response showing how similar they are. Note also that *XLII* now has a significantly brighter inherent tonal balance than *XL-IIS* (+1.6dB at 10kHz), but lower sensitivity may cause Dolby to balance this out a bit in practice.

Where XLII has always scored over *SA* is in its overload headroom — and it still maintains around a +0.5dB lead here. However, this is more than balanced out by *XLII*'s +2.6dB extra hiss which is likely to be far more noticeable in use.

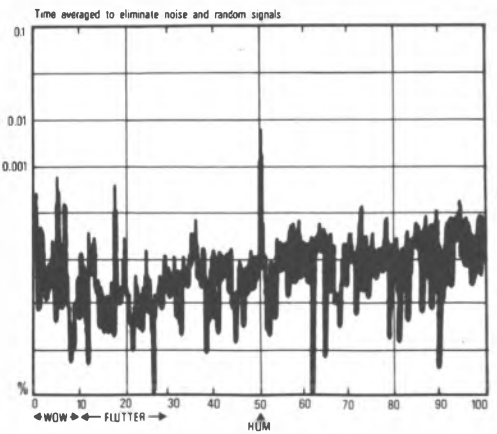
Flutter could have been somewhat lower too and modulation noise for the *XLII* was only fair at −39dB.

Like *XL-IIS*, *XLII* is getting left behind by events. In essence it is a good, compatible pseudo-chrome, but now looks hissy against strong competitors.

Treble level (10k)	+0.4dB
Sensitivity	+2db
Bias noise (hiss)	−53dB
Modulation noise	−39db
Overload 315Hz MOL	+3.3dB
Overload 10kHz MOL	−2.5dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



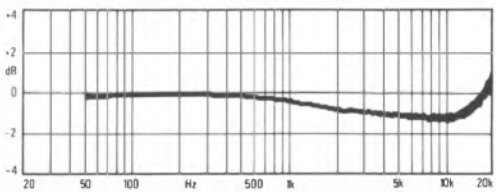
Wow & flutter spectrum analysis, 0-100Hz

Maxell XL-IIS

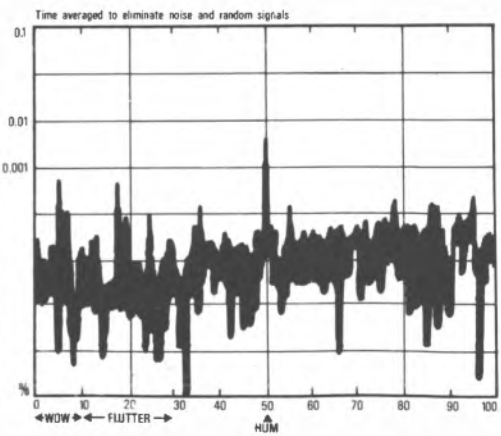
This unusual high performance 'chrome' (cobalt ferric) tape has a slightly soft sound compared to other pseudo-chromes we have found, and the reason can be seen in its peculiar frequency response trace. Treble output above 1kHz falls away slowly to become −1.2dB down at 10kHz. This is around 1.5dB less treble than most chrome-bias tapes. Above 10kHz, output starts to rise again.

XL-IIS is peculiar in other areas too. It has excellent mid-band overload, but poor treble overload and very low hiss. In these areas it is much like BASF's chromes! However, unlike their chromes, sensitivity is now up to a high +2.7dB, introducing brightness through Dolby mistracking. *XL-IIS* is a quiet pseudo-chrome, now with mediocre compatibility. Other, less expensive tapes have caught it up.

Treble level (10k)	−1.2dB
Sensitivity	+2.7db
Bias noise (hiss)	−55dB
Modulation noise	−40db
Overload 315Hz MOL	+3.3dB
Overload 10kHz MOL	−4dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



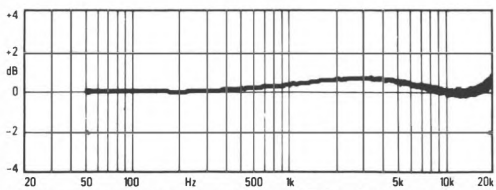
Wow & flutter spectrum analysis, 0-100Hz

Memorex HBII

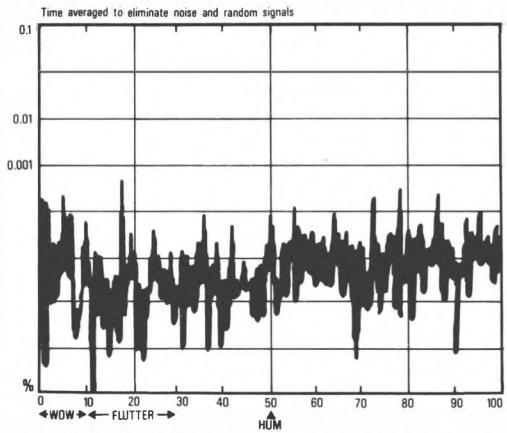
Memorex have improved treble output stability of *HBII* substantially. It no longer has the shaky output complained of last year and, predictably, modulation noise has improved dramatically, falling to a low level of −43dB. This is due to the improved surface smoothness of the oxide coating, which lessens random am/fm modulation noise effects. Frequency response remains commendably flat, giving even tonal balance. Sensitivity is still a trifle low at +0.6dB and the mid-band overload figure of 0dB also remains weak, even though it is better than before. With low hiss at −55dB, *HBII* is effectively a head-on competitor for BASF *CR-EII* and Maxell *UD-II*. It has higher treble overload headroom than both tapes, to balance the mediocre mid-band result.

HBII is a very compatible and quiet tape, and will give good results if not over-recorded.

Treble level (10k)	+0.2dB
Sensitivity	+0.6db
Bias noise (hiss)	−55dB
Modulation noise	−43db
Overload 315Hz MOL	0dB
Overload 10kHz MOL	−3.2dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

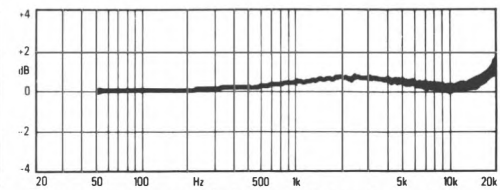
Memorex Chrome Bias II Super

Like *HBII*, this tape offers a flat IEC II frequency response. It is more sensitive though, by +1dB, which with regard to Dolby tracking, makes it just a bit more compatible with Japanese cassette decks.

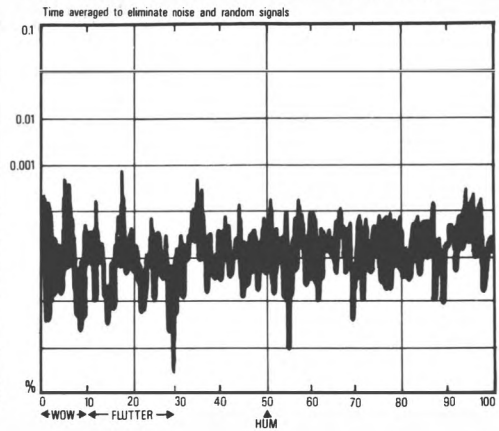
Mid-band overload has been substantially improved up to +2.4dB and like *HBII*, this tape retains the ability to accept strong treble signals. Saturation at 10kHz was quite good at −3.2dB. The tape accepts higher mid-band record levels than *HB-II*, has identical ability at high frequencies, but suffers just +1dB more hiss as well. Modulation noise was average at −39dB but the mechanics suffered both wow and flutter, as the spectrum analysis shows.

CB-II really is very similar in performance to *HBII*, except in mid-band headroom. It is compatible and will generally give good results.

Treble level (10k)	−0.2dB
Sensitivity	+1.6db
Bias noise (hiss)	−54dB
Modulation noise	−39db
Overload 315Hz MOL	+2.4dB
Overload 10kHz MOL	−3.2dB
Wow & flutter energy	−40dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: CHROME

Philips UC-II

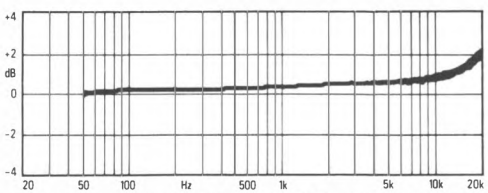
Reformulated since last year, *UC-II* now has near-perfect IEC II frequency response.

The good news with *UC-II* is that hiss has been reduced further to a very low value of −56dB and mid-band overload has been pushed up at the same time, improving dynamic range. Philips have produced a two-way improvement here, *UC-II* now being one of the few tapes capable of competing with new *SA*.

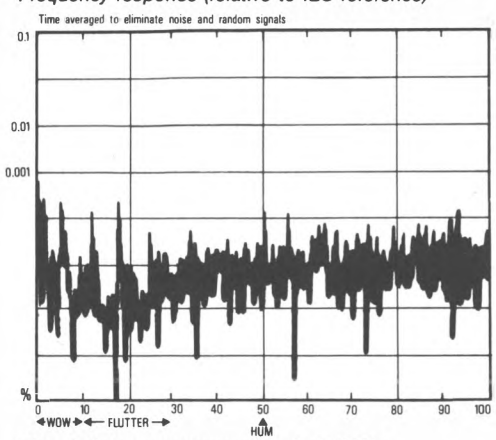
Splitting hairs over this comparison, *UC-II* has −0.7dB less hiss and +0.4dB extra mid-band overload, giving it 1dB more dynamic range than new *SA*. It only falls back in treble overload.

UC-II has become an impressive tape by any standards. There's going to be a lot of reformulating in rival labs next year to meet this one! However, recording level is best restrained to avoid treble overload.

Treble level (10k)	+0.5dB
Sensitivity	+0.4db
Bias noise (hiss)	−56dB
Modulation noise	−39db
Overload 315Hz MOL	+2.9dB
Overload 10kHz MOL	−4dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Philips MC-II

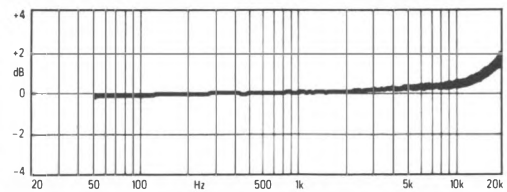
MC-II used to be Philips' 'super-chrome', but like *TDK SA-X* it now appears to be becoming an adjunct to its cheaper stablemate, providing only a variation of a theme.

The frequency response trace clearly shows how *MC-II* now matches *UC-II* in this respect, but a higher sensitivity value of +2.3dB will give more accurate Dolby tracking on most Japanese cassette decks. This alone will give *MC-II* just a slightly brighter sound.

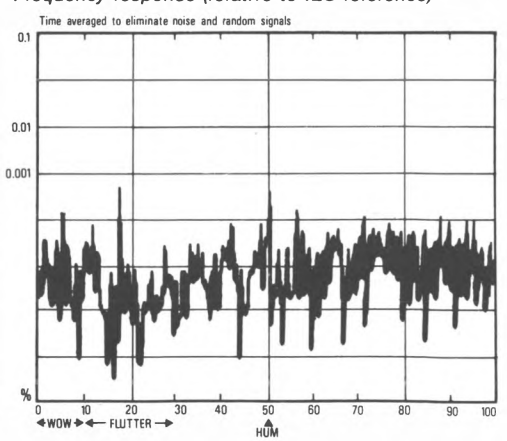
Somewhat reinforcing the brighter sound is improved treble overload headroom, which assumes a respectable value of −2.8dB. The tape is +0.5dB better than *UC-II* in the mid-band too, but counterbalancing this is +2dB more hiss. This alone negates *MC-II*'s advantages.

Very similar to *UC-II*, this tape provides slightly improved and more obvious treble, plus more hiss.

Treble level (10k)	+0.3dB
Sensitivity	+2.3db
Bias noise (hiss)	−54dB
Modulation noise	−41db
Overload 315Hz MOL	+3.4dB
Overload 10kHz MOL	−2.8dB
Wow & flutter energy	−43dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

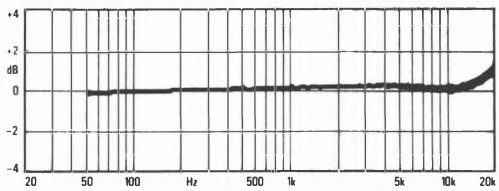
Scotch XSII

A combination of flat frequency response and reasonably high sensitivity of +2dB give *XSII* good compatibility with most cassette recorders. It will, in most cases, give fairly even tonal balance as a result.

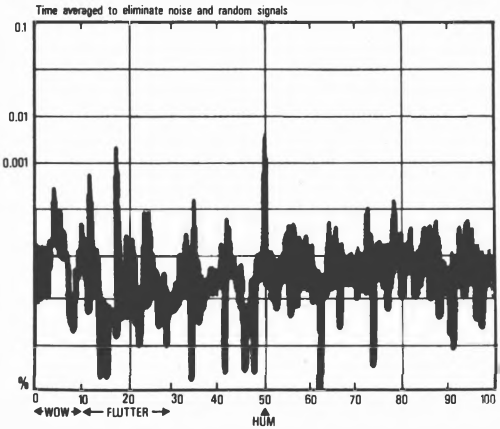
Maximum overload level in the mid-band was high at +2.8dB, but at high frequencies it fell back a bit to a mediocre −3.2dB. With no less than +3dB more hiss than *Philips UC-II, TDK SA* and others, *XSII* falls back in terms of dynamic range and recording range below OVU. It is not alone in losing ground like this as, for example, Maxell and Sony tapes are suffering the same fate this year. Modulation noise remains low and the shell produced little wow or flutter, but hum is evident in the analysis.

This is a competent and very compatible Type-II tape, but it suffers a bit more hiss than usual.

Treble level (10k)	0dB
Sensitivity	+2db
Bias noise (hiss)	−53dB
Modulation noise	−42db
Overload 315Hz MOL	+2.8dB
Overload 10kHz MOL	−3.2dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

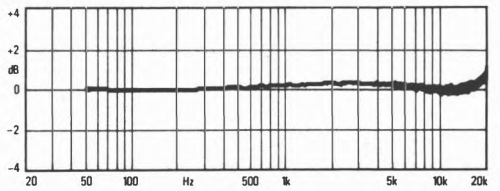
Sony UCX

UCX is now very similar to IEC II, giving a flat frequency response against it as shown. Comparison with last year's samples show Sony have raised treble output a lot to achieve this. As a result, *UCX* cannot now be used so effectively for balanced results where other chromes sound bright, although it does still have less treble than TDK *SA* or Maxell *XL-II*. At +2dB sensitivity it is about right for good Dolby tracking.

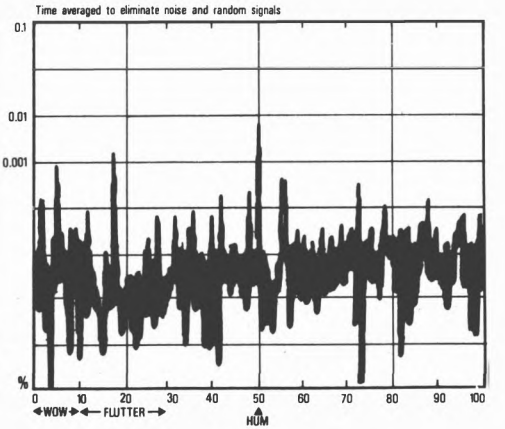
This tape is much like many other Japanese pseudo-chromes, being a bit hissy (−53dB, like Maxell *XL-II*) but with a high mid-band overload ceiling, but a somewhat mediocre treble equivalent. Modulation noise proved low at −41dB and the mechanics displayed quite low flutter and wow, but some hum is evident.

UCX remains a competent tape, best chosen for a softer sound than its competitors.

Treble level (10k)	0dB
Sensitivity	+2.1db
Bias noise (hiss)	−53dB
Modulation noise	−41db
Overload 315Hz MOL	+3.6dB
Overload 10kHz MOL	−3.3dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: CHROME

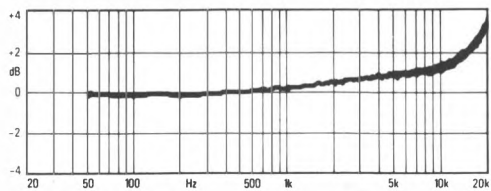
Sony UCX-S

Sony have also altered *UCX-S*, giving it stronger treble output than *UCX* or last year's *UCX-S* samples. The new coating gives an improved treble overload headroom value of −1.8dB, but mid-band overload stays the same at a healthy +3dB.

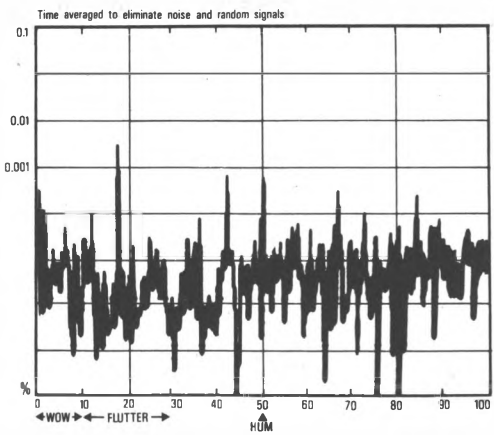
Like so many other pseudo-chromes though, *UCX-S* comes a bit unstuck when its hiss level is inspected. At −53dB this is now +2dB worse than so many other good equivalents that Sony, like others, will have to think again. Rising frequency response and good sensitivity of +2dB mutually assure a bright sound, but treble will stay clean, because the overload limit is high. Mechanically the tape housing performed well, generating little flutter.

UCX-S is a good, but not exceptional pseudo-chrome, with a bright sound and some hiss.

Treble level (10k)	+1.2dB
Sensitivity	+2db
Bias noise (hiss)	−53dB
Modulation noise	−41db
Overload 315Hz MOL	+3dB
Overload 10kHz MOL	−1.8dB
Wow & flutter energy	−43dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

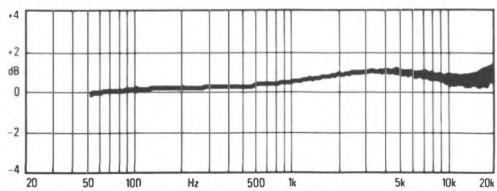
TDK SA

SA has just been significantly reformulated to reduce hiss. Hiss measurement spotlighted new samples amongst the old, the noise level dropping to −55.6dB from −54dB, putting *SA* level with BASF *CR-EII* on this important parameter.

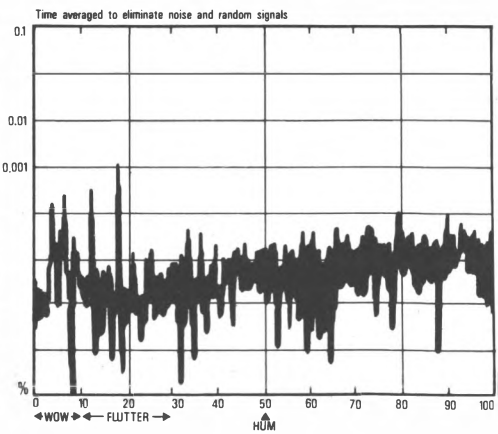
Mid-band overload has gone down slightly to +1.5dB, so there has been little change of dynamic range. Surprisingly, treble overload remains unaltered, but there was no surprise in finding slight boost in treble output, especially around 4kHz, rather than higher up. The frequency response plot clearly shows *SA*'s presence band lift, relative to so many other tapes. *SA* matches most cassette recorders very well. However, the mechanics still flutter and jerk a bit.

New *SA* is better than ever and can be recommended.

Treble level (10k)	+0.6dB
Sensitivity	+1.4db
Bias noise (hiss)	−55.6dB
Modulation noise	−39db
Overload 315Hz MOL	+1.5dB
Overload 10kHz MOL	−2.9dB
Wow & flutter energy	−39dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

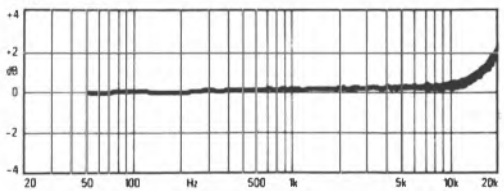
CASSETTE TAPES: CHROME

TDK SA-X

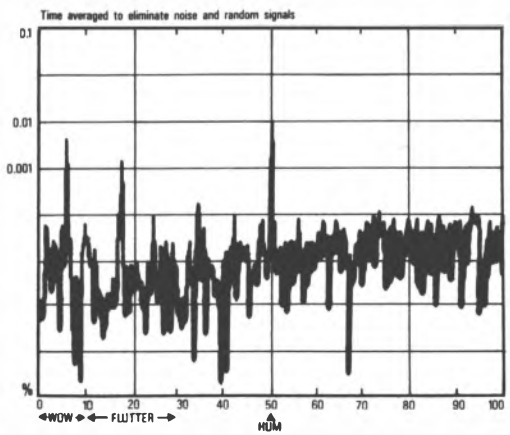
This dual-layer tape now gives a notably flat response except above 10kHz, where there is a sudden rise in high treble. Sensitivity remains high at +2.3dB which on many decks will cause Dolby to further emphasise treble. The net result is that *SA-X* will sound brighter, but the subjective impact should not be great.

With overload levels now little above *SA*, but hiss higher by 1.5dB, *SA-X* has even less to offer against its cheaper stablemate. In effect *SA* has caught it up and I think that in practice few people would be aware of any advantages conferred by using *SA-X*. The speed stability spectrum showed levels of flutter which were above other good competitors. *SA-X* remains a high-sensitivity version of *SA*, with marginally better overload headroom, but more hiss. On most decks it will sound slightly bright.

Treble level (10k)	+0.4dB
Sensitivity	+2.3db
Bias noise (hiss)	−54dB
Modulation noise	−41db
Overload 315Hz MOL	+3.1dB
Overload 10kHz MOL	−2.3dB
Wow & flutter energy	−37dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: CHROME

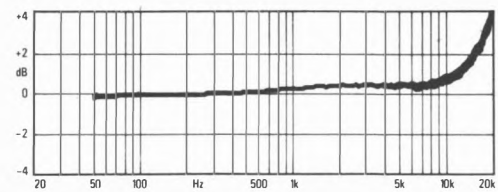
TDK HX-S

This metal tape operates on the chrome bias setting, the main benefit being greatly improved overload headroom, especially at high frequencies. *HX-S* will take around +4dB more treble than pseudo-chromes. However, it also has a lot of hiss and a top end 'sting' caused by steeply rising treble above 10kHz.

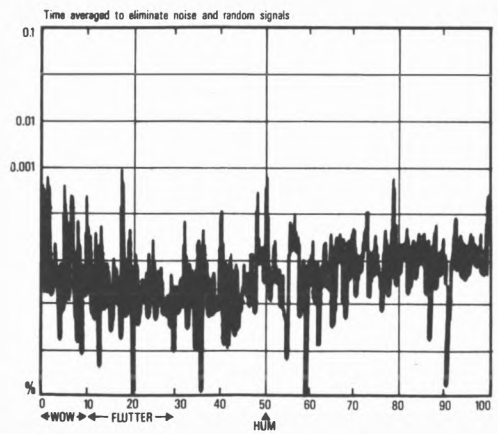
Very high sensitivity of +3dB will nearly always induce Dolby tracking error, causing the system to emphasise treble further. Add this to the top end lift and you get a bright sound with Dolby in use. *HX-S* is really best suited to auto-tune decks, like Aiwa's that self-adjust sensitivity, as well as bias and record eq. Some low rate wow was evident from the mechanics.

TDK *HX-S* gives clearer treble but much more hiss than other chrome-bias cassettes. Its compatibility is poor and sound over-bright.

Treble level (10k)	+0.7dB
Sensitivity	+3db
Bias noise (hiss)	−51dB
Modulation noise	−41db
Overload 315Hz MOL	+3.7dB
Overload 10kHz MOL	+1.3dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



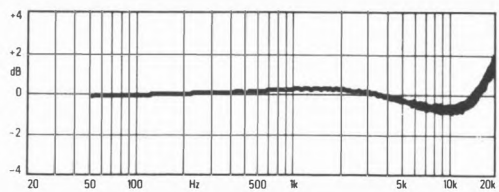
Wow & flutter spectrum analysis, 0-100Hz

That's EM-X

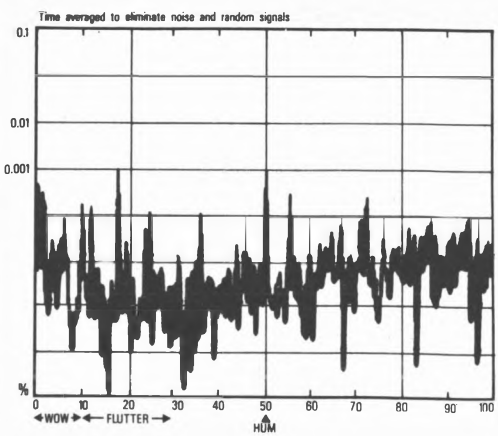
Like TDK *HX-S*, this is a metal tape operating at chrome bias. However, Taiyo Yuden appear to have juggled with their formulation a bit harder to keep treble level down; it gives less aggressive treble, but very high sensitivity of +3dB still induces Dolby to mistrack and bring up low level treble signals unduly. Moreover, *EM·X* has high hiss (like *HX-S*) and mis-tracking emphasises the problem. Treble overload was a bit lower than that of *HX-S* but *EM·X* is still better than pseudo-chromes here. Treble output was a bit ragged and so I wasn't surprised to measure a mediocre modulation noise performance.

EM·X has fairly even tonal balance and very high overload levels, but suffers excessive hiss. Like *HX-S*, it has less dynamic range than good chromes and pseudo-chromes, except at high frequencies. What range it has is also less usable.

Treble level (10k)	−0.7dB
Sensitivity	+3db
Bias noise (hiss)	−52dB
Modulation noise	−39db
Overload 315Hz MOL	+3.3dB
Overload 10kHz MOL	.0dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

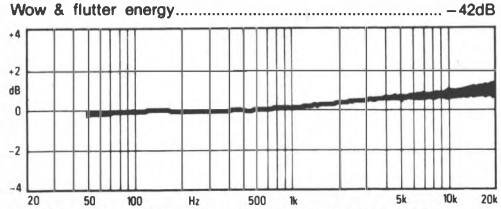
Fuji FR Metal

As always Fuji appear to have kept a weather eye open for the IEC Primary Reference tape and have matched their metal tape fairly closely in terms of frequency response and sensitivity. Both err toward treble emphasis though, so *FR Metal* will not sound as tonally balanced and smooth as some of the tapes covered here — most notably Maxell *MX Metal*.

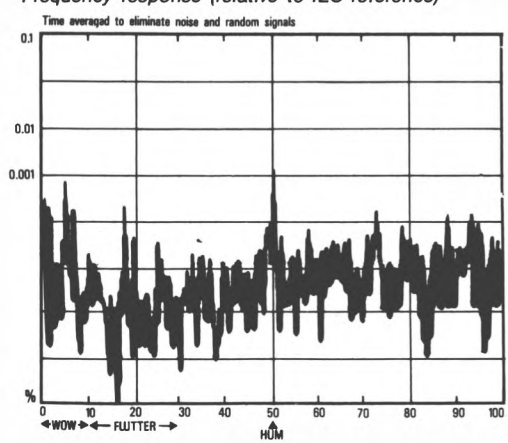
Hiss is a problem as usual, level measuring −51.5dB, a value way above chromes. Balancing this out to some degree are healthy overload headroom margins of +5dB in the mid-band and +3dB at high frequencies. Treble stability proved better than is often the case and modulation noise reasonably low.

FR Metal combines good headroom with flat frequency response and in doing so strongly challenges TDK *MA* in particular.

Treble level (10k)	+0.5dB
Sensitivity	+0.5dB
Bias noise (hiss)	−51.5dB
Modulation noise	−40dB
Overload 315Hz MOL	+5dB
Overload 10kHz MOL	+3dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

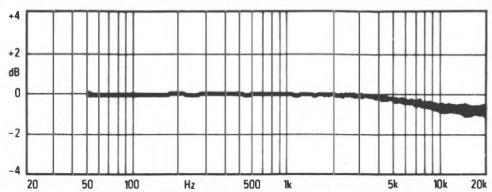
Maxell MX

MX has slightly less treble output than all other metals, including XSM-IV. All through the deck tests we refer to the use of *MX* to get rid of excessive, gritty treble that is so often heard with metal tapes, due to a combination of treble lift, flutter and upper midrange distortion.

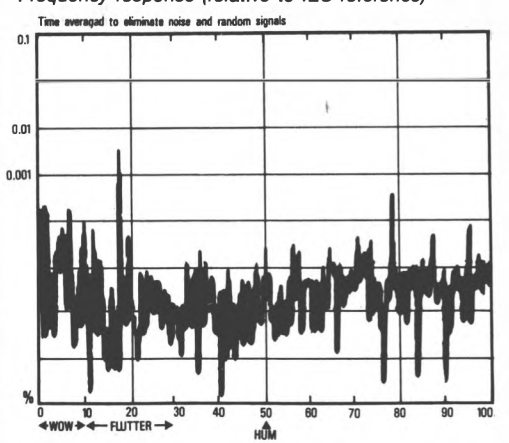
We consistently noted the smoothness of its treble character in listening tests. Detailed analysis reveals why. The tape has very low flutter (significantly lower than TDK *MA-R* by the way), and unusually stable treble output, and very low modulation noise at −43dB. It is the only tape that comes close to running as smoothly as BASF chromes. Overload levels are good, but hiss as high as that of other metals.

For smooth, clean treble and a relaxing, open quality Maxell's *MX* can't be beaten. It's a fine tape.

Treble level (10k)	−0.8dB
Sensitivity	+1dB
Bias noise (hiss)	−52dB
Modulation noise	−43dB
Overload 315Hz MOL	+5.6dB
Overload 10kHz MOL	+2dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: METAL

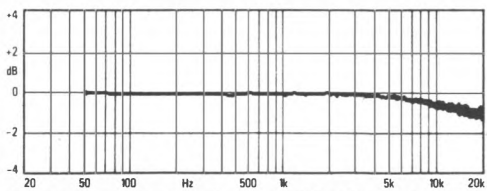
Memorex Metal IV

Metal IV from Memorex adheres closely to the IEC IV Primary Reference tape. It has similar frequency response and sensitivity, ensuring excellent compatibility with most cassette decks.

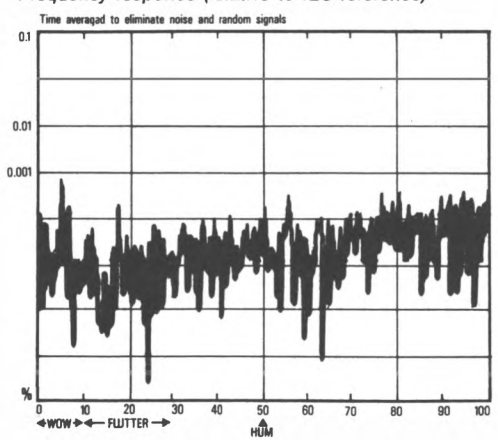
Overload headrooms have been improved over last year's samples, the mid-band figure now rising to a respectable +4dB, whilst treble reaches +2dB. These figures are −1dB below the best and hiss is +1dB higher too, giving *Metal IV* 2dB less dynamic range than for example, *TDK MA*. However, it is more compatible than *MA* and its smoother tonal balance is, I feel, more valuable in real life. Memorex could look to improve modulation noise and treble stability, though.

This is a reasonably good, smooth sounding metal tape of excellent compatibility. However, without identifying slots, it cannot be used on decks having auto-tape type selection.

Treble level (10k)	−0.4dB
Sensitivity	0dB
Bias noise (hiss)	−51dB
Modulation noise	−39dB
Overload 315Hz MOL	+4dB
Overload 10kHz MOL	+2dB
Wow & flutter energy	−39dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

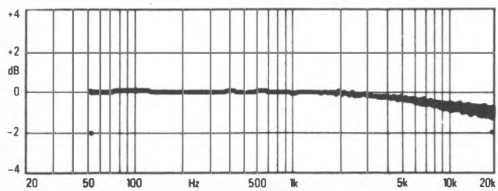
Scotch XSM IV

The *XSM IV* is notable, I feel, as a metal without treble lift and of precise IEC IV sensitivity. It has fine compatibility as a result and does not give the bright and often gritty sound of 'treble-lift' metals, because recorder-generated flutter, hiss and distortion are not brought to one's attention on this tape.

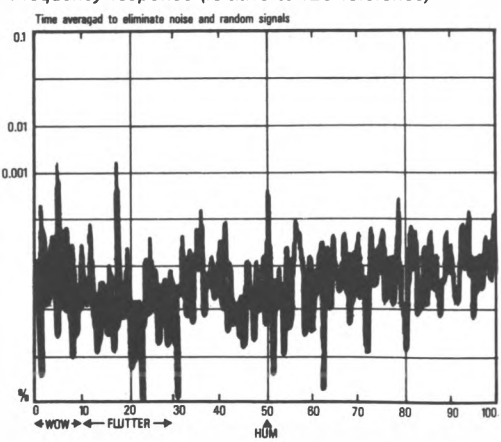
In comparison with *Maxell MX* it suffers from lower overload headroom and higher hiss, having 3dB less dynamic range because of this. I'm afraid that good chromes now challenge and improve on metals like this, so it is no wonder that many manufacturers are giving up metal. The speed stability spectrum shows some flutter and some wow.

XSM remains a broadly compatible metal tape free from emphasised treble, but with mediocre performance by the best standards.

Treble level (10k)	−0.7dB
Sensitivity	0dB
Bias noise (hiss)	−51dB
Modulation noise	−40dB
Overload 315Hz MOL	+3.6dB
Overload 10kHz MOL	+1dB
Wow & flutter energy	−43dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

Sony ES

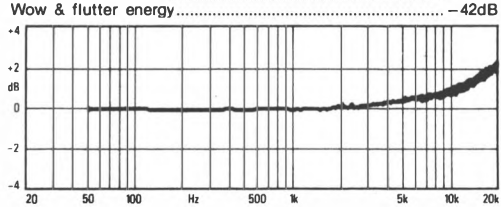
ES is an interesting metal tape, with some unusual qualities, most notable of which is its low hiss. It is −2.5dB quieter than other metals, which is significant, because metal tapes are generally hissy. It is also much easier to use without noise reduction.

Treble stability of *ES* is poor and well below that of *Maxell MX* or *BASF* chromes. A digital store revealed significant short term hf variation, which gives treble slight vagueness and "character".

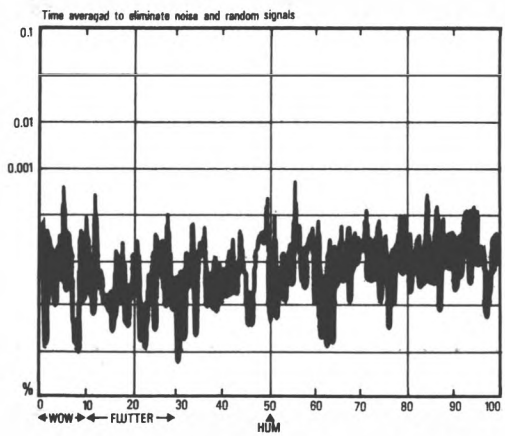
Due to high overload margins, *ES* does have excellent dynamic range though, but also rising high treble and a bright edge — emphasised by Dolby mistracking due to high sensitivity. Above 7Hz flutter becomes a problem.

This is the only low hiss metal available. It has a bright sound but excellent dynamic range. Treble quality could be improved.

Treble level (10k)	+0.8dB
Sensitivity	+0.6dB
Bias noise (hiss)	−54.5dB
Modulation noise	−39dB
Overload 315Hz MOL	+5.3dB
Overload 10kHz MOL	+2.8dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

TDK MA

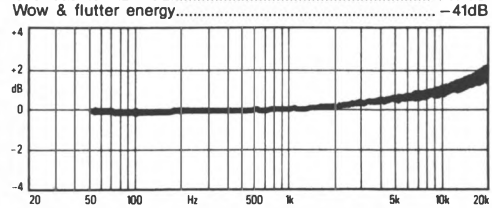
Improved yet again since last year, *MA* now has even higher overload ceilings and will soon be nudging +6dB above IEC level, or about +8dB above the now common OVU level (Dolby flux) on most recorders. TDK get this performance without any sacrifice at high frequencies. *MA* takes all honours here too, achieving a headroom value of +3.4dB — about 6dB better than good chromes!

Like most metal tapes though, it is hissy, hiss being +4dB higher than the quietest chromes.

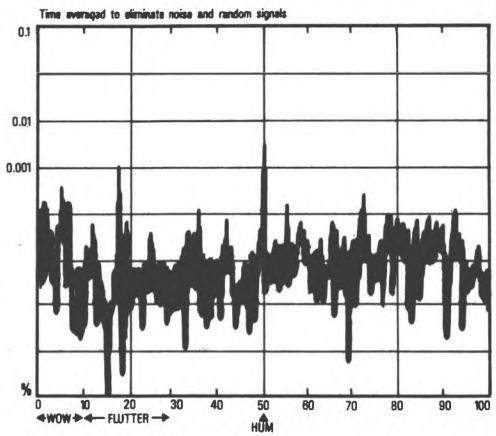
Frequency response progressively moves away from the IEC IV reference TDK manufacture, as the trace shows. This, plus high sensitivity, usually results in a bright sound.

MA is a bright sounding metal, but with masses of headroom for recorders capable of exploiting it. The brightness isn't always pleasant though.

Treble level (10k)	+0.8dB
Sensitivity	+0.6dB
Bias noise (hiss)	−52dB
Modulation noise	−40dB
Overload 315Hz MOL	+5.7dB
Overload 10kHz MOL	+3.4dB
Wow & flutter energy	−41dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

CASSETTE TAPES: METAL

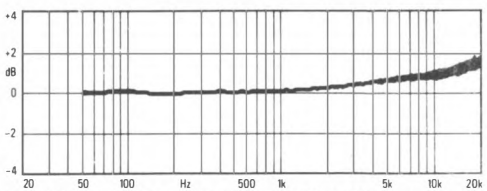
TDK MA-R

This reference metal cassette has a diecast zinc housing with transparent sides that allow a clear view of the tape. The tape is *MA*, but with improved mechanics for smoother running. Our review samples had the same tape inside as ordinary *MA*, so a direct comparison was possible.

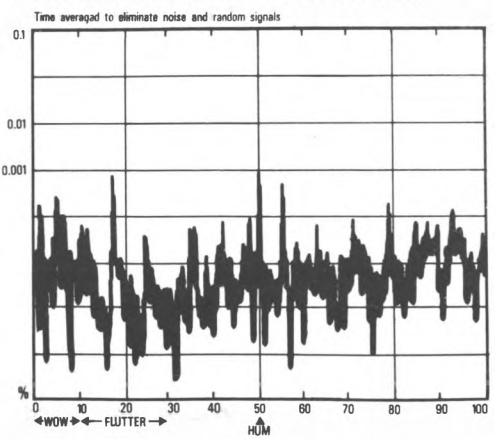
Electrical performance was identical to *MA*. New and more searching tests this year only confirm my comments last year — that *MA-R* is just a slight improvement over *MA* in terms of speed stability. Close comparison of the spectrum analyses clearly shows less flutter with MA-R and less wow above 7Hz. Low rate wow was not better suppressed though and BASF cassettes still have less flutter than MA-R.

MA-R looks good and it's heavy enough to dent your toe if you drop it, but this is about the only extra impact it makes over *MA*, price apart.

Treble level (10k)	+1dB
Sensitivity	+0.6B
Bias noise (hiss)	−52dB
Modulation noise	−39
Overload 315Hz MOL	+5.6
Overload 10kHz MOL	+3.5
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

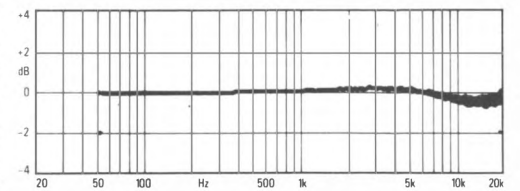
That's MG-X

Said to be made using a shortened production process, *MG-X* does display some unusual properties as metals go. It has −1dB less hiss than TDK *MA*, but −3dB less midrange overload headroom and 2dB less treble headroom, so dynamic range is limited.

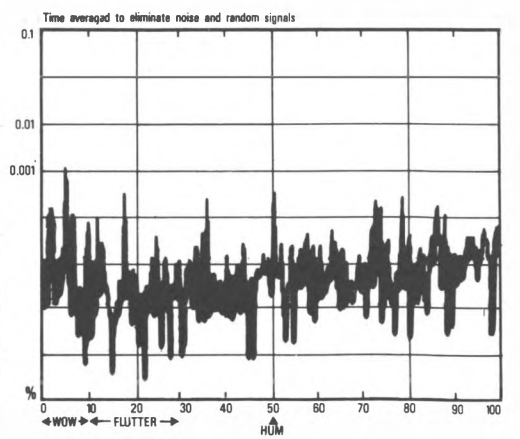
This does put it in the sticky position of being little better in terms of overload than the best chromes, most benefit being in treble leeway where *MG-X* is around +3dB better. It has no headroom advantage at all in the mid-band, and the same amount of hiss as typical pseudo-chromes like Maxell *XL-11*, resulting in identical dynamic range! Treble stability and modulation noise were both unimpressive.

Flat frequency response and lowish sensitivity conspire to give *MG-X* a smooth tonal balance, wwhich is valuable with metal tapes.

Treble level (10k)	−0.6dB
Sensitivity	−0.5dB
Bias noise (hiss)	−53dB
Modulation noise	−38dB
Overload 315Hz MOL	+2.6dB
Overload 10kHz MOL	+1dB
Wow & flutter energy	−42dB



Frequency response (relative to IEC reference)



Wow & flutter spectrum analysis, 0-100Hz

BEST BUYS AND RECOMMENDATIONS
CASSETTE TAPES

This selection of the best-performing tapes covers ferric, chrome and metal tape categories, and incidentally confirms something many buyers already instinctively know: chrome-position tapes are the best value. For this reason, they are dealt with first here.

CHROME TAPES

The chrome-position tapes I would pick as best of the crop this year are as follows:

TDK SA remains very compatible, as always, but now has low hiss too. Treble output instability and mediocre clarity are weak points. Generally, SA gives a slightly 'creamy' opaque sound, becoming soft and cloudy in overload, which is good, since it causes little offence.

Maxell's new *UD-II* proved to be the joker in this year's pack. It meets TDK *SA* head-on for low hiss and compatibility, but may be available at a lower price. Philips *UC-II* is not as common as its rivals but it is now a very good buy. It is selected for low hiss and higher overload, plus good compatibility.

The unusual strength of BASF *CR-EII* chrome is its super-smooth surface, providing uniquely low modulation noise, low flutter and unrivalled output stability at high frequencies. As a result, it is free of the slightly jittery and coarse treble of pseudo-chromes and provides a very natural, easy sound with fine clarity.

BASF *CR-MII* has strong treble, so is best used in decks with variable bias or tape tuning, or where other chromes give a dull sound. *CR-MII* has all the benefits of *CR-EII*, plus more headroom, giving it excellent dynamic range. With care, it can give better sound than most metals, free of their slight high frequency jitteriness. Usually little more expensive than *CR-EII*, but outperforms all other chromes. Current price £1.80 to £2.30.

Most of the super-chromes are poor value; cases in point are Maxell *XL-IIS* and TDK *SA-X*, both of which are very expensive 'super tapes' that just do not appear super any more.

TDK *HX-S* and That's *EM-X* chrome position metals need high recording levels, which increases head distortion. The recommended low hiss tapes are much easier for a deck (especially budget types), to drive, yet have the same or superior dynamic range, except at high frequencies.

FERRIC TAPES

Among the ferrics closely meeting IEC I standards, the following tapes are all very similar, have good compatibility and are recommended: Maxell *UD-I*; Maxell *XL-I* (with a brighter sound); TDK *AD*; Memorex *MR-XI*; BASF *LH-EI*; Fuji *FR-I*.

The high performance 'super' ferrics give stronger and clearer treble. Those recommended are as follows:

BASF *LH-MI*; Maxell *XL-IS*; Sony *HF-S*; That's FX.

Of the budget ferrics, first choice is Maxell *UL*, if available at a price lower than the above.

METAL TAPES

The field has thinned in metal tapes this year.

Memorex *Metal IV* is a good, compatible metal recommended for general use. Without the rising treble of Sony *ES* and TDK *MA*, it gives a less fatiguing sound on many decks. Use *Metal IV* when TDK *MA* or Sony *ES* are too bright, but Maxell *MX* a bit too 'laid back'. Scotch *XSM-IV* is very similar to *Metal IV*, so the same comments apply.

Maxell *MX* has the distinction of being the only metal tape to have falling treble. It also has far more stable treble output than all other tapes except BASF chromes. The two effects combine to give a soft, smooth but stable sound that usually provides relaxing listening.

On budget decks in particular, the brightness of TDK *MA* throws into prominence deck problems like distortion and flutter, resulting in over-strong tizzy or gritty treble. This is why many people complain about metal tape having harsh treble. *MA* is only good value with decks that have been well adjusted for it, even though it is an inherently good tape.

Sony *ES* has rising treble and a bright sound like TDK *MA*, though with a tizzy sounding 'sting' rather than glassy hardness. Unpleasantness in this tape's treble quality will again be due to deck problems. *ES* has less hiss than all other metals which, with high overload headroom, gives it superb dynamic range. Low hiss makes this range more useable too. In my local shops it is incredibly expensive though (£5!). On matching decks Sony *ES* gives a fine sense of clarity, but there's nearly always a slight edginess to treble compared with a tape like Maxell *MX*.

Fuji *FR* is slightly less bright than TDK *MA* and Sony *ES*, but has good overload headroom.

Of the rest, That's *MG-X* has fairly uneven treble but is meant to be a low priced metal. I have yet to see it in the shops, so cannot comment on its value. TDK *MA-R* is *MA* in flashy packing — good for those who feel their tapes should look good as well as sound good, until they drop one on their toe. Comments about *MA* apply equally to *MA-R*, except that at £6 for *C90* any notions of 'value' are best forgotten.

SELECTED DEALER DIRECTORY

Choosing a good hi-fi dealer is the most vital step in acquiring the system that is right for you. This unique directory gives full information on dealers in your area whose demonstration facilities and dedication to customer satisfaction meet the very highest standards.

Conventional technical specifications, admirable though they may be, do not tell you how hi-fi will sound. Plenty of equipment can be made to jump through the technical hoops, and sounds 'very hi-fi', but will still reproduce music in a way that is inaccurate, coloured, tiring, and subtly unsatisfying.

Such equipment offers an insidious long-term disincentive to music listening. Ask people who have recently bought a new hi-fi system whether they are pleased with it, and they will almost always say yes — after all, they felt it was the right decision at the time, and it may have sounded 'impressive' in a very brief, loud demonstration. Ask the same people whether they now spend more time listening to music than before, and you will find out if the system is really any good.

The split between 'mass market' audio and 'specialist' hi-fi has now become almost total. All-in-one 'rack' and 'midi' systems now tend to compete on looks, features and price rather than on sound quality, though claiming adequate technical performance; on the other hand, the specialist manufacturers have tried to make products that sound better, leaving out superfluous facilities and paying attention to aspects of the design which they find have audible effects on the sound, not just those which produce better paper specifications.

Of course, anything which can be heard must ultimately be technically explicable, even if the explanation is not currently to hand, and the *Hi-Fi Choice* reviewers have always led the way in developing new measurements which really do relate to the audible performance of the equipment. But the quality of any hi-fi component is determined by the balance of many more or less measurable factors, in what the designer judges to be the best possible compromise. When components are put together, the interactions and subtle blendings of their characteristics contribute to the overall system sound in extremely complex ways. And in any case, the final quality of the music played through the system will depend fundamentally on the room it is being used in! There really can be no substitute for listening to the system for yourself.

This is why *Hi-Fi Choice* has always insisted that the hi-fi buyer should never rely uncritically on equipment reviews — even its own! — but should seek the fair unpressurised demonstration which is available only at a good dealer. It is not merely coincidence that the dealers who offer this kind of service are usually those who stock a good range of equipment from the 'specialist' manufacturers, and they will be ready to demonstrate the audible superiority of a carefully-chosen 'separates' system to the run-of-the-mill rack or midi system.

Of the dealers who are genuinely dedicated to hi-fi excellence, a growing number are members of BADA, the British Audio Dealers Association. BADA was established in 1982 on the premise that the retailing of quality hi-fi products is a specialist service which requires more expertise than the selling of less sophisticated goods. BADA recruits dealers who are 'serious about hi-fi' and who have been in business for at least three years. Member retailers are committed to offering the best possible demonstration facilities and advice; to offering (with certain conditions) exchange or refund on goods that prove unsatisfactory in use at home; and to providing a two-year labour and parts guarantee, transferable to any other BADA dealer if the customer moves home more than 30 miles after purchase. Virtually all BADA members are included in the Directory.

Make an appointment

Before visiting any shop, check whether an appointment is necessary — so that the dealer will be able to give you his full attention when you arrive for a demonstration. Take some of your own records along — they will save you wasting time getting used to strange material and wondering how it would have sounded on your old equipment. Don't worry if you feel you are ignorant of technicalities — just take your ears along with you, and don't be afraid to believe them. Don't go in with fixed ideas about equipment, which may make you pre-judge what you hear. Realise that any system will sound different in your home listening room — do use home trial facilities, remembering that this service costs the dealer time and trouble but also be aware that it may put just a little more pressure on you to buy. Don't worry if you have only a limited budget — 'real' hi-fi certainly need not always be more expensive than a package system.

A good system will make all your records sound better and give years of pleasure. The first step is to seek out the genuine hi-fi specialists in your area. With the Selected Dealer Directory, you will find them.

SELECTED DEALER DIRECTORY

AVON

ABSOLUTE, 65 Park St, Clifton, Bristol. (0272) 24975. A&R, Denon, Dual, Meridian, Mission, NAD, Quad, Rotel, Technics, Yamaha, etc. (cl. Weds)
BADA MEMBER

AUDIO BRISTOL LTD,8 Park Row, Bristol 1. (0272) 291931. AKG, Beyer, Dual, Mordaunt-Short, Revox, Sansui, Tannoy, Toshiba,Trio, Quad. Open Mon-Fri, 9-5.30, Sat 9-4.30Home trial facilities, free installation, credit facilities,service dept .

PAUL GREEN HI-FI LTD., Kensington Showrooms, London Rd, Bath.(0225) 316197. A&R, Creek, Dual, Heybrook, Linn, Musical Fidelity, Rotel, Systemdek, Wharfedale. Dem facilities available, ring for appointment. Open Tues-Sat, 9-5.30. Home trial facilities, free installation, instant credit up to £1000. Credit cards:Access, Barclaycard.

BERKSHIRE

FRASERS, HI-FI & VIDEO, 67 Dedworth Rd,Windsor, (07535) 59662. Aiwa, Dual, Mitsubishi, Mordaunt Short, Pioneer, Sansui, Trio, Wharfedale, Sharp. Dem facilities available. Open 9.30-6p.m. Home trial facilities, free installation, credit facilities. Credit cards: Access,Barclaycard, Visa. Service dept .

READING HI FI CENTRE. 4-6 Harris Arcade,Friar St, Reading. (0734) 585463. 'The best equipment, advice and service from Berkshire's premier Hi Fi emporium'.
BADA MEMBER

BUCKINGHAMSHIRE

AUDIO INSIGHT LTD , 53 Wolverton Rd,Stony Stratford, Milton Keynes. (0908) 561551. A&R, Audiolab, Heybrook, KEF, Linn, Mission Cyrus, Musical Fidelity, Nakamichi, Nytech, Rotel. Dem facilities available. Open Tues-Sat. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

AYLESBURY HI FIDELITY, 98 Cambridge St, Aylesbury, . (0296) 28790. Dual,Heybrook, Linn arms, Musical Fidelity, Mission, NAD, Nakamichi, Quad, Rotel. Dem facilities available, ring for appointment. Open 10-6 Mon-Fri, 9.30-5.30 sat. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Amex, Diner,visa. Service dept.

CHILTERN HI-FI,146 High St, Aylesbury,Bucks. (0296) 31020. A&R, Aiwa, Akai, A.R., B&W, Bang & Olufsen, Dual,Nakamichi,Technics, Yamaha. Dem facilities available. Open 9.30-5.30 Mon -Sat, Fri 9.30-7.00 closed thurs. Home trial facilities, free installation, instant credit up to £2,000. Credit cards: Access, Barclaycard. Service dept .

JCV HI-FI SUPER STORE, 1 Viscount Way,Dukes Drive, Bl (0908) 36734 . Everything from specialist hi-fi to midi-systems all at the best prices.
BADA MEMBER

CAMBRIDGESHIRE

CAM AUDIO, 110 Mill Road, Cambridge.(0223)60442 . A&R, Creek, Linn, Mantra,Mission, Naim, Nakamichi, Rega, Revolver, Teac. Dem facilities: 3 single speaker rooms. Appointment required for one not for 2. Open 9.30-6.30 Mon-Sat 9.30-3.00 Thurs. Free installation, interset free credit. Credit cards: Access, Amex, Barclaycard, Diners.

HI-FI PEOPLE, 42 Cowgate, Peterborough. (0733) 41755. 'Shop and home demonstrations from friendly people'.
BADA MEMBER

STEVE BOXSHALL AUDIO, 41 Victoria Rd, Cambridge. (0223) 68305. Audiolab, Gale, JBL, Marantz, Mission, Nakamichi,Quad,Rogers,Rotel, Tannoy. Dem facilities 2 rooms, ring for appointment. Open 10-6. Mon-Sat. Free installation, credit facilities. Credit cards: Access Barclaycard. Service dept .

CHESHIRE

ASTON AUDIO, 4 West St, Alderley edge, (0625) 582704 . Celestion, KEF, Musical Fidelity, Opus, Pink Triangle, Quad, Robertson, Spendor, Sondex, Tannoy. Dem facilities:4 dem rooms, appointment required. Open 10-6 Tues-Sat. Home trial facilities, free installation. Instant credit up to £1,000. Credit cards: Access, Amex, Diners, Visa. Service dept.
BADA MEMBER

DOUG BRADY HI-FI, Kingsway Studios, Kingsway North, Warrington. (Hadgate 0925) 828009. 'Largest choice of specialist Hi-Fi in N.W. £100-£20K'. All c.cards. dem.rooms.
BADA MEMBER

CHRIS BROOKS AUDIO, 29 Gaskell St, Stockton Heath, Warrington.(0925) 61212. Single speaker pair dems. Speialising in Linn, Rega, etc. Sytems from £350.00.
BADA MEMBER

NEW DAWN HI-FI, 1-3 Castle St., Lower Bridge St., Chester. (0244) 24179. Linn, Quad, Technics, National Panasonic, Denon, Rotel, Dual, Meridian, Aiwa, Philips. Dem facilities: 2 dem rooms. Open 9.00-5.30 Mon-Sat,closed Wed. Free installation, instant credit. Credit cards: Access, Barclay card, trustcard. BADA MEMBER

SWIFT OF WILMSLOW, 4-8 St Annes Parade, Wilmslow, (0625)526213. A&R, Aiwa, Denon, Dual, Marantz, Mission, Monitor-Audio, Pioneer, Yamaha, NAD. Dem. facilities available. Open Mon-Sat 9.15-5.45. Closed 1-2 Lunch. Home trial facilities, free installation, instant credit up to £1,000. Credit cards:Access, Barclaycard. Service dept.

CORNWALL

TRURO HI-FI, ETS Ltd, 25 King St, Truro (0872) 79809. A&R, Denon,Dual, Heybrook, Mission Cyrus, Quad, Rotel Teac/Tascam, Thorens. Dem facilities: Single speaker studio. Open Mon-Sat 8.45-5.30. Home trial facilities,free credit up to £1,000. Credit cards: Access, Barclaycard, ETS . Service dept .

DERBYSHIRE

ACTIVE AUDIO 12 Osmaston Rd, The Spot, Derby. (0332) 380385. 2 studios. Open Mon-Sat 9.30-6.00. All major credit cards. Finance available.
BADA MEMBER

DORSET

BLACKMORE VALE, The Square, Gillingham Dorset. (07476) 2474. A&R, Ariston, Boston, Dual, Kef, Marantz, NAD, Nagaoka, Sennheiser, Yamaha. Dem facilities available. Open Mon-Sat 9-5.30 Closed for lunch 1-2. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access Barclaycard. Service dept .

ESSEX

A.T.LABS , 442/4 Cranbrook Rd, Gants Hill, Ilford, (01) 518 0915. Open Mon-Sat, 10-6. Two single speaker dem. rooms. Access, Amex,Barclaycard.
BADA MEMBER

BEECHWOOD AUDIO, 6 Market St, Braintree,. (0376)

SELECTED DEALER DIRECTORY

29060. A&R,B &W,KEF, Mardidian, Musical Fidelity, NAD, Nakamichi, Pink Triangle, Quad, Sondex. Dem. facilities 2 single speaker rooms. Open Mon-Sat, 9.30-6.00. Home trial facilities. Free installation, instant credit up to £1,000. Credit facilities: Access, Amex, Diners, Visa

BRENTWOOD MUSIC CENTRE, 2 Ingrave Rd, Brentwood . (0277)221210 Acoustic Research, B&W, Dual, JBL, Marantz, Nakamichi, Quad, Sansui, Tannoy, Yamaha. Dem. facilities available. Open Mon-Sat 9.30-5.30. Home trial facilities, free installation. Credit cards: Access, Visa. Service dept.

RUSH HI-FI & VIDEO, 5/6 Cornhill, Chelmsford.(0245) 57593. Akai, Aiwa,JVC, Marantz, Nad, Quad, Rotel, Sansui, Sony, Technics. Dem. facilities available, ring for appointment. Open Mon-Fri 9.30-6.00 Sat 9.00-5.00. Home trial facilities, free credit. Credit cards: Access, American express, Barclaycard, Diners. Service dept.

GLOUCESTERSHIRE

ABSOLUTE, 40/42, Albion St, Cheltenham. (0242) 583960. A&R, Denon, Dual,Linn, Meridian, Mission, NAD, Rotel, Technics,Yamaha, etc. (Cl. Wed)
BADA MEMBER

ETTLES AND BUMFORD, Brewery Court, Cirencester.(0285) 3946. ADC, Aiwa, Ortofon, Celestian,Grundig,Harman-Kardon, Hitachi, JBL, Teac, Trio. Dem. facilities: One single speaker dem. room. Open Mon-Sat 9.00-5.30. Home trial facilities, free installation, instant credit up to £1,000. Credit cards Access, Visa. Service dept.

HAMPSHIRE

ANDOVER AUDIO, 105 High St, Andover,. (0264) 58251. Bang & Olufsen,Fisher, Aiwa, Marantz, NAD, Philips (CD), Proton, Rotel, Trio, Yamaha. Open Mon-Sat 9-5.30. Weds 9-1.00. Fri 9-8.00. Home trial facilities, free installation, credit facilities available. Credit cards: Access, Amex, Diners, Visa. Service dept.

HAMPSHIRE AUDIO Ltd, 2-12 Hursley Rd, Chandlers Ford, . (04215)2827/65232. Quality CD and analogue agencies, 5 Dem. studios. Large free car park.
BADA MEMBER

TRU-FI SOUND AND VISION, 10/12 Grosvenor Rd, Aldershot.(0252) 26390. Akai, Aiwa, B &W , Nakamichi, Hitachi, JPW, Mission, Mordaunt-Short, Nagaoka, Sony Technics. Dem. facilities available. Open 9.30-6.00 Mon-Sat. Free installation, instant credit up to £1,200. Credit cards accepted. Access, Barclaycard. Service dept.

HERTFORDSHIRE

ACOUSTIC ARTS Ltd, 101 St. Albans Rd, Watford Herts. (0923) 45250. A&R, Audiolab, Beard, Conrad-Johnson, Denon, Heybrook, Magneplanar, Mission, Quad, Rogers. Dem facilities: 2 dem studios, ring for appointment. Open Mon-Sat 9.30-5.30. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access,Visa. Service dept.

RADLETT AUDIO, 141 Watling St,Radlet,,WD7NQ. (09276)6497. Audio Innovations, Audio Research, Creek, Krell, Linn, Magnepan, Musical Fidelity, Monitor Audio, ProAc, Rega. Dem. facilities: single speaker dem. room. Open Mon-Sat, 9.30-5.30. Home trial facilities. Free installation, instant credit up to £1,000. Credit cards: Barlaycard, Visa.

KENT

JOHN MARLEY HI FI CENTRES, 2 Station Rd West, Canterbury, (Canterbury) 69329. B&W, Heybrook, Magnum, M.Y.S.T. Nakamichi, Pink Triangle, Rotel, Sansui, Technics, Quad. Dem. facilities available. Open Mon-Sat,9.00-5.30 cl. Wed. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Barclaycard, Creditcharge. Service dept.

PHOTOCRAFT HI-FI , 40 High St, Ashford Kent.(0233) 24441/2. Open Mon-Sat 9.00-5.30. Wed-1.pm. Free delivery. Int. free credit. Access, Visa.
BADA MEMBER

LANCASHIRE

MONITOR SOUND, 54 Chapel St, Chorley, .(02572) 71935. A & R, Dual, Mission, Quad, Rogers, Rotel, Spendor, Thorens, Nakamichi, Yamaha. Dem. facilities. 2 dem. rooms. Open Mon - Sat, closed Weds. Home trial facilities, free installation, instant credit up to £1,000. Credit cards Access, Visa. Service dept.

PRACTICAL HI-FI, 198 Church St, Blackpool, (0253) 27703. 'Free five year garantee on all systems. Buy with confidence'.
BADA MEMBER

PRACTICAL HI-FI, 84 Penny St, Lancaster. (0524) 39657. '14 days option of exchange available. Buy with confidance'.
BADA MEMBER

LEICESTERSHIRE

MARKWELL ELECTRONICS Ltd, 76 Leicester Rd, Wigstone (0533) 882758. Akai, Celestion, JVC, Hitachi, Marantz, Ortofon, Sansui, Sennheiser, Sony, Toshiba .Open Mon-Sat 9.00-8.00. Free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

SOUND ADVICE, The Sound Factory, Duke St,Loughborough LE11 1ED (0509) 218254, A&R, Creek, Linn Products, Manticore, Naim Audio,Nakamichi,Nytech,Rega,Revox,Yamaha. Dem. facilities: 2 studios-domestic size and furnishings. Appointment required. Open Mon-Sat, 9.30-6pm. Free installation, credit facilities available. Credit cards: Access, Barclaycard. Service dept.

LINCOLNSHIRE.

YATES & GREENHOUGH, 11-14 Emery Lane Boston, Lincs PE21 8QA (0205) 55755 B&W, Castle, Dual, Monitor Audio, Mordaunt short, Nakamichi, QED, Quad, Technics, Yamaha. Dem. facilities available. Open 9.00-5.30, closed Thurs. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Creditcharge, Visa. Service Dept.

LONDON

A.T. LABS, 159 Chase Side, Enfield Middlesex.(01) 367 3132. Open Mon-Sat, 10am-6pm. Two single speaker dem. rooms. Amex, Barclaycard, Access.
BADA MEMBER

ANALOG AUDIO, 849 High Rd, London N.12. (01) 445 3267. NAD, Denon, Pioneer, Yamaha, Rotel,Sansui, Dual, Thorens, Tannoy, Marantz. Dem. facilities available. Open Mon-Sat 9.45-6.00. Free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

AUDIO T, 190 West End Lane, London NW6. (01) 794 7848. Open Mon-Sat, 10-6.00 Two single speaker dem rooms. Access, Amex,Barclaycard.
BADA MEMBER

BARTLETTS HI-FI, 175-177 Holloway Rd, London N.7.(01)607 2296 / 607 2148. 'Large range of British & Japanese products available'. 2 bookable single spk.dem. rooms. Service dept. Mail order dept. Export worldwide.Access, Amex, Diners, Visa.
BADA MEMBER

SELECTED DEALER DIRECTORY

BARTLETTS HI-FI, 19 High St North, London E.6. (01) 552 2716.
BADA MEMBER

BILLY VEE, 248 Lee High Rd, Lewisham, London SE13 5PT. (01) 318 5755/ 852 1321. Aiwa, A&R, Creek, Dual,KEF, Linn, Haybrook, Quad, Naim, Rega. Dem. facilities: 2 single system studios ring for appointment. Open Mon-Sat. 10am-7pm. closed Thurs. Home trial facilities, free installation, interest free credit up to £750.00. Credit cards Access, Visa. Service dept.
BADA MEMBER

GRAHAMS HI-FI, 86-88 Pentonville Rd, London, N1. (01) 837 4412. FBA Dealer of the year1985. Linn, Naim, Rega etc. £300-£3,000-£13,000.
BADA MEMBER

H.L.SMITH & CO. Ltd, 287-289 Edgware Rd, London W2 1BE (01) 723 5891. Aiwa, B &W, Denon, Dual, KEF, Ortofon, Panasonic, Sony,Technics, Yamaha. Dem. facilities available. Open Mon-Sat, 9-5.30, Thurs 9-1pm, instant credit up to £1,500. Credit cards: Access, Visa. Service dept.

MUSICAL IMAGES, 45 High St, Hounslow, Middlesex. (01) 570 7512. A.R. , Denon, Dual, Heybrook, Nakamichi, Proton, QED, Quad, Tannoy, Yamaha. Dem. facilities , ring for appointment. Open Mon-Sat 9.30am-6.00pm. Free installation, credit facilities. Credit cards: Access,Amex, Barclaycard,Diners. Service dept.

MYERS AUDIO, 6 CentralParade, Hoe St London E.17. (01) 520 7277/8. Bang & Olefson, NAD, Nakamichi,Sansui, Technics, Hitachi, Panasonic, A&R, B&WMission.Dem.facilities one dem. room. Open Mon-Sat 10am-6pm. Free installation, instant credit up to £1,000. Credit cards Access, Visa, Amex, Diners. Service dept.

WRBI HOME DEMONSTRATIONS
13 St Johns Hill, London SW11 1TN (01)228 7126. Alphason, Audiostatic, Beard, Castle, Celestion, Decca, Ear, Elite, Jordan, Pink Triangle. Home demonstrations only. Appointment required. Open Tues-Thurs 10-6pm, Fri 10-7pm,Sat 10-5.30. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Amex, Diners,Visa.

SUBJECTIVE AUDIO 2-4 Camden High St., London NW1 OJA, 387 8281. A.R., Burmester, krell, Magnerplaner, Meridian, Linn,Nakamichi, John Bowers. Dem facilities: 3 single speaker dem rooms, appointment required. 10.00-6.00 Tues-Fri, 9.00-5.00 Sat. Home trial facilities, instant credit up to £10,000. Credit cards: All. Service dept..

TELESONIC Ltd, 92 Tottenham Court Rd, London.(01) 636 8177. A&R, B&O, B&W, Hafler,Luxman, KEF, QED, Quad, Nakamichi, Rogers, Dem. facilities available. Open Mon-Fri, 9.00-6.00pm, Sat, 9.30-4.00pm. Home trial facilities,free installation, credit facilities available. Credit cards Access, American Express, Diners, Visa. Service dept.

THE SOUND ORGANISATION Ltd, No 1, Cathedral St, London Bridge, London SE1 9DE (01) 403 2255/3088. Akroyd, Creek, Dual, Exposure, Linn, Manticore, Mordaunt-Short, Naim, Nytech,Rega. Dem. facilities available, ring for appointment. Open Tues-Sat, 10am-7pm. Home trial facilities, Free installation, instant credit up to £1,000. Credit cards: Access, Barclaycard. Service dept.
BADA MEMBER

UNILET PRODUCTS Ltd, 14 Bute St, London SW7. (01) 5892586. Mon-Sat 9-6. Dem facilities. Large stock. C.cards. Access, Amex, Diners, Visa.
BADA MEMBER

MANCHESTER

CLEARTONE HI-FI, 62 King St, nr. Kendals, (061) 835 1156. Best makes Linn, Creek, NAD, etc. Dem. studio. Compact disc centre, video and T.V.
BADA MEMBER

THE MUSIC ROOM, 50 Bridge St, Manchester. (061) 835 1366. Friendly advice and service. Choose from the widest range in Manchester'.
BADA MEMBER

CLEARTONE HI-FI, 235 Blackburn Rd, Bolton. (0204) 31423. Best makes, Linn, Creek, NAD, Etc. Dem. studios. Laser vision and compact disc centre.
BADA MEMBER

LLOYD PATON (LPM Ltd), 34 Moorfield Walk, Urmston, Manchester. (061) 747 9722. B&W, Dual, Hitachi, Marantz,Pioneer, Quad, Rogers, Tannoy, Techics, Trio. Dem. facilities, 1 dem. room. Open Mon-Sat, 9am-5.30pm, Tues-Thurs 9am-7.30pm. Home trial facilities. Free installation, credit facilities available. Credit cards: Access, Visa. Service dept

MERSEYSIDE

ABOUT SOUND 116 Bold St, Liverpool. L1 4JA (051) 709-4865. Meridian, Mordaunt-Short, Musical Fidelity,Quad, Revox, Sansui, Sugden, Thorens, Walker, Yamaha. Dem. facilities single speaker room. Ring for appointment. Open Tues-Sat, 9.00am-5.30pm. Free installation, instant credit up to £1,000. Credit Cards:Access, Diners,Visa. Service dept.

W.A. BRADY & SON , 401 Smithdown Rd, Liverpool. (051) 733 6859. 'Largest choice of specialist Hi- Fi in N.W. £100-£20K'. All c.cards. 3 dem. rooms.
BADA MEMBER

WEST MIDLANDS

ALTERNATIVE AUDIO Ltd, 95 Hobs Moat Rd. Solihull, (021) 742 0254. A. & R., Audiolab, Denon, KEF, Marantz, Meridian, Mission, M.A., Pink Triangle. Dem facilities available, appointment required. 10.00-6.00 Tues-Sat.,closed Mon. Home trial facilities, free installation, instant credit. Credit cards: Access, Visa, Amex.

FIVEWAYS HI-FIDELITY Ltd, 12 Islington Row,Edgebaston Birmoingham. (021) 455 0667. A&R, Creek, Dual, KEF, Meridian, Philips CD, Quad, Revox, Rogers, Spendor, Etc. Dem facilities. Single speaker dem. room. Open 9.30-6.00 Tues--Sat. Home trial facilities, free installation, credit facilities. Credit cards: Access,Visa. Service dept.

GRIFFIN RADIO LTD, 94 Bristol St, Birmingham.(021)692 1359. Creek, Dean, Denon, KEF,Linn, Mordaunt Short, Nakamichi, Rega. Dem. facilities 2 single speaker rooms. Open Mon-Sat,9.30-6.00. Home trial facilities,free installation, instant credit up to £1,000.Credit cards: Access,Barclaycard.

SOUND ADVICE, 162 Alcester Rd, Mosley, Birmingham. (021) 449 3328. A&R, Creek, Linn , Manticore, Naim, Nakamichi, Nytech, Onix, Rega, Revox. Dem. facilities 2 studios, ring for appointment. Open Mon-Sat, 9.30am-6.00pm closed wed. Free installation, credit facilities available. Credit cards: Access, Barclaycard. Service dept.

WARSTONES HI-FI STUDIO, 54a Warstones Rd, Penn Wolverhampton. (0902) 345114. Dem. facilities : 3 Rooms. Open Mon-Wed 10am-6pm. Thurs- Fri 10am-9pm. Sat10am-6pm. Home trial facilities, free installation. Credit cards: Access, Visa, Eurocheque. Service dept.

NORFOLK

BASICALLY SOUND, Old School, School Rd, Beacon Ash, Norwich. Mulbarton (0508) 70829. A&R, Audiolab,Heybrook, Linn, Mantra, Naim, Nakamichi, Rega, Spendor, Wharfdale. Dem. facilities 2 single speaker rooms. Open Tues-Fri,

SELECTED DEALER DIRECTORY

9.30-5.30 closed for lunch 1pm-2pm. Sat, 9.30-5.30pm. Home trial facilities, free installation, credit facilities. Credit cards: Access. Service dept.

NORTHANTS

HEYWOOD AND HEYWOOD Hi-FI, 38c High St, Corby, .(0536) 61166. A&R, Rotel, QED, KEF, Wharfedale, Dual, Aiwa, Marantz, JVC, Monitor Audio. Dem. facilities: 1 single speaker dem. room. Open Mon-Sat 9.30-5.30 closed Weds. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa, Eurocheque. Service dept.

LISTEN INN, 32a Gold St, Northampton.(0604) 37871. 'Shop and home demonstrations from friendly people . BADA MEMBER

NOTTINGHAMSHIRE

PETER ELLIS AUDIO, 29 Kirkgate, Newark. (0636) 704571. A&R , Ariston, Castle, Hitachi, Panasonic, Thorens, Trio, Technics,Wharfedale, Quad. Open Mon-Sat 9.00-5.30, Thurs 9.00-12.30. Dem. facilities: single speaker dem. room. Ring for appointment. Free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

OXFORDSHIRE

ABSOLUTE, 19 Old High St, Headington,Oxford. (0865) 65961. A&R, Denon, Linn, Mission, NAD, Rotel, Yamaha. Also 256, Banbury Rd. Summertown.
BADA MEMBER

WESTWOOD AND MASON, 46 George St, Oxford. (0865) 247783. Linn, Naim, Rega, A & R, Heybrook, Dual, Mordaunt- Short, Spendor, Tannoy, Quad, etc.
BADA MEMBER

WITNEY AUDIO, 28 High St, Witney, Oxford. (0993) 2414. A.R. Aiwa, Akai, Dual, KEF, Mordaunt-Short, Pioneer, Philips, Sony, Yamaha. Dem. facilities. Open Mon-Sat, 9.00-5.30. Free installation, instant credit up to £1,000. Credit cards:Access, Barclaycard. Service dept.

SHROPSHIRE

AVON HI- FI, 12 Barker st., Shrewsbury, (0743) 55166. A&R, B&W, JBL, Dual, NAD, Nakamichi, Revolver,Trio, Quad, Yamaha. Dem facilities available. Open Mon-Sat 9.00-5.30, cl. Thur. Home trial facilities, free installation, instant credit up to £1,000. Credit cards:Access, Barclaycard. Service dept.

SOMERSET

AVALON HI-FI STUDIO. The Old Nursery, Butleigh, Glastonbury. (0458) 50370. A&R, Audiolab, Goldbug, Helius, Nene Valley, Philips CD,Pink Triangle,Revolver,Spendor. Dem facilities: Studio & Home, ring for appt. Open Mon-Sat 9.30-5.30. Closed Weds. Late night Thurs. Home trial facilities, free installation. Credit cards: Access,Visa. Service dept. .

SUFFOLK

EASTERN AUDIO, 41 Bramford Rd, Ipswich. (0473) 217217. A&R, Aiwa, Celestion, Denon, Dual, Linn, NAD, Philips, Quad, Technics, Thorens.
BADA MEMBER

SURREY

TRU FI SOUND AND VISION, 2 Cromwell Rd, Redhill, Surrey.(0737) 66128. Akai, Aiwa, Band W, Nakamichi, Hitachi, JPW, Mission, Mordaunt-Short, Nagaoka, Sony, Technics. Dem. facilities available. Open Mon-Sat 9.30-6.00. Free installation, instant credit up to £1,200, Credit cards Access, visa. Service dept.

AERCO Ltd, 11 The Broadway, Woking.(04862) 4667. A&R, Ariston, Exposure, HK, A.R.,Heybrook, JBL, KEF, Magnum, NAD, PT, Quad,Revox.
BADA MEMBER

SPALDINGS HI-FI, 352-354 Lower Addiscombe Rd, Croydon, Surrey. (01) 654 1231/2040. Full range of Hi-Fi equipment. Full dem. facilities. Access, Visa, H.P. etc.
BADA MEMBER

UNILET PRODUCTS Ltd, 35 High St, New Malden Surrey. KT3 4BY. (01) 942-9567. Mon-Sat 9-6. Thurs 9-7. C.cards Amex, Access, Diners, Visa. dem. facilities. Large stock.
BADA MEMBER

SUSSEX (EAST)

JEFFERIES HI-FI, 69 London Rd, Brighton, East Sussex. (0273) 609 431. 2 dem. rooms, closed Mon, late night Wed. Parking, bus route. Credit facilities.
BADA MEMBER

JEFFERIES HI-FI, 4 Albert Parade, Green St, Eastbourne, East Sussex.(0323) 31336. 2 dem. rooms, closed Mon, Late night Wed. Parking, bus route. Credit facilities.
BADA MEMBER

HASTINGS HI-FI, 31-32 Western Rd, St. Leonards On Sea. (0424) 442975. A&R, B&W, Mission/Cyrus, NAD, Nakamichi, Quad, Rotel, Systemdek, Tannoy, Yamaha. Dem. facilities. 2 single speaker dem. studios. Open Mon-Sat 9.00-7.00. Home trial facilities, Free installation, Credit facilities. Credit Cards: Access, American Express, Barclaycard/Visa. Service dept.

SUSSEX (WEST)

BOWERS AND WILKINS Ltd, 1 Becket Buildings, Littlehampton Rd, Worthing. (0903)64141. B&W, Dual, JVC, KEF, Nakamichi, Philips, Shure, Quad,Sony, Technics. Dem. facilities 2 dem. Rooms. Open Mon-Sat, 9.00-5.30 Weds, 9.00-1.00. Home trial facilities free installation, instant credit up to £1,000. Credit cards: Barclaycard. Service dept.

TYNE AND WEAR

RED RADIO SHOP AND HI-FI CENTRE, 11 Olive St, (Off Park Lane) Sunderland.(Sunderland) 672087. Aiwa, Bose, Denon, JVC,Luxman, Michell, Pickering , Spendor, Thorens, Trio.Dem. facilities available. Open Mon-Sat 9.00-5.30. Free installation,interest free credit, Credit cards: Advance, Barclaycard. Sercvice dept.

WARWICKSHIRE

JCV HI-FI SUPERSTORE, Units 7/8 Wharf St,Warwick. (0926)493796. 'Everything from specialist hi-fi to midi-systems all at the best prices .
BADA ME MBER

WILTSHIRE

ABSOLUTE, 60, Fleet Street, Swindon, (0793) 38222. A&R, Denon, Dual, Linn, Meridian, Mission, NAD, Rotel, Technics, Yamaha. (Cl. Wed).
BADA MEMBER

We would like to hear from you if you have complaints or praise for any of the shops listed here.

SELECTED DEALER DIRECTORY

YORKSHIRE (NORTH)

THE SOUND ORGANISATION, 36 Gillygate,York, (0904) 27108. Akroyd, Dual, Creek, Dual, Linn, Mordaunt-Short, Naim,Nytech, Sony, Wharfedale.Dem. facilities available. Open Mon-Sat,10am-6pm. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Amex, Barclaycard, Diners. Service dept.
BADA MEMBER

YORKSHIRE (WEST)

AUDIO PROJECTS, 45 Headingley Lane, Leeds. (0532) 789115.A&R, Audiolab, Creek,Heybrook, Linn, Musical Fidelity, Naim, Musical Fidelity Naim, Quad, Rega, Rogers. Dem. facilities available. ring for appointment Open Tues-Fri, 9.30-6.00, Sat 2.30-5.30. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Creditcharge, Visa. Service dept.
BADA MEMBER

ERRICKS, Fotosonic House, Rawson Square, Bradford.(0274)309266. Dem facilities. Sales/service agents for: A&R, Linn, Quad, Naim, Nakamichi, Mission ect.
BADA MEMBER

HUDDERSFIELD HI-FI, 4 Cross Church St, Huddersfield, West Yorkshire. (0484) 44668. A&R, AR, Thorens, Maridian, Rogers, Mission, Mordant-Short,Harman-Kardon,technics,Trio Dem. facilities: 3 dem. rooms ring for appointment. Open Mon-Sat 9.00-5.30 Thurs 9.00-8pm. Cl. Weds. Home trial facilities, free installation, instant credit facilities. Credit cards Access, Visa. Service Dept.

IMAGE HI-FI Ltd, 8 St. AAnnes Rd, Headingly, Leeds.(0532) 789374. 'We stock most of the worlds leading Hi-Fi products'. Dems'. by app. please'.
BADA MEMBER

NORTHERN IRELAND

THE AUDIO CENTRE, 84 Bridge St Portadown, Northern Ireland.(0762) 338059. Aiwa, Akai, Dual, Denon, Fisher, KEF, Marantz, Revox, Rotel, Sony. Open 9am-6pm Mon-Sat closed Thurs. Home trial facilities, free installation, credit terms arranged. Credit cards: Access. Service dept.

SCOTLAND

Aberdeen

HOLBURN HI-FI, 441/445 Holburn St.(0224) 585713/ 57272' 'For the best buy in Hi-Fi consult Holburn Hi-fi'.
BADA MEMBER

Angus

ROBERT RICHIE HI-FI, 102 Murray, Montrose, Scotland. (0604) 73765. A&R, Creek, KEF, Linn, Naim, Quad, Rega, Sony, Technics, Wharfedale. Dem facilities available, ring for appointment. Open 9-1, 2-5 Mon-Sat Wed 9-1.Home trial facilities, free installation,instant credit, credit cards: Access, Barclaycard. Service dept .

EDINBURGH

RUSS ANDREWS HI-FI, 34 Northumberland St. (031) 557 1672. A.R., A&R, Creek, Dual, Heybrook, KEF,Linn, Naim, Nytech, Rotel.
BADA MEMBER

GLASGOW

BILL HUTCHINSON LTD, 43 Hope Street, Glasgow. (041) 248 2857. A.R., Aiwa, Denon, Dual, JVC, Mission, Mordaunt Short, Omar, Technics, Yamaha. Dem facilities available. Open Mon-Sat 10-6.00p.m. Free installation, instant credit. Credit cards: Access, Amex, Visa. Service dept.

MAETO MUSIC, 14 The Toll, Busby Rd, Clarkston. (041) 638 8252. A.R., A&R, Creek, Dual, Heybrook, KEF,Linn, Naim, Nytech, Rotel. (cl. mon.). Open late Thurs.
BADA MEMBER

PRISM AUDIO, 14 West Princes St, Glasgow, G49BP. (041)332 1779. C J Walker, Concordant, Elite Rock, Helius,JPW, Rotel, Sudgen, Systemdek. Syrinx, Teac. Dem. facilities: One large room, ring for appointment. Open Mon -Sat 9.30-5.30. Home trial facilities, free installation, instant credit up to £1,000. Credit cards Access. Service dept.

THE MUSIC ROOM, 221 St. Vincent St, Glasgow. (041) 248 7221. 'Friendly advice and service. Choose from the widest range in Scotland'.
BADA MEMBER

INVERNESS

NESS AUDIO, 1 Greig St, Inverness. (Inverness)220440. A&R, Denon, J.A Michell, KEF,Linn, Monitor Audio, Naim, Quad, Revolver. Dem. facilities: single speaker dem room Open Mon-Sat, 9-5.30. Home trial facilities, Free installation, instant credit. Credit cards: Access, Amex,Barclaycard. Service dept.

KIRKCALDY

ANDREW THOMPSON, 3 Whytescauseway, Kirkcaldy. (0592) 205997. Denon, Dunlop Systemdek, KEF, J.A. Michell, Nakamichi, Quad, Revolver, Tannoy, Yamaha.Dem. facilities: 4 rooms. Appointment required. Open Mon-Sat, 9-5.30. Home trial facilities, free installation, credit facilities up to £3,000. Credit cards: Access, Credit charge, Visa. Service dept.

WALES

GLAMORGAN (WEST)

AUDIO EXCELLENCE, Number 9 High St, Swansea. (0792) 474608. 'South Wales only independant Hi-Fi specialist, dedicated to excellence'.
BADA MEMBER

SOUTH GLAMORGAN

AUDIO EXCELLENCE, 134 Crwys Rd, Cardiff. (0222) 28565. 'South Wales only independant Hi-Fi specialist, dedicated to excellence'.
BADA MEMBER

WALES (NORTH)

ELECTRO TRADER HI-FI, 19 Colwyn Crescent, Rhos-On-Sea, Colwyn Bay. (0492) 48932. B&W, Dual, Musical Fidelity, NAD, Revolver, Rotel, Sansui, Tannoy, Thorens, Yamaha. Demfacilities, ring for appointment. Open Mon-Sat 9.30-5.30 closed for lunch 1-2. Home trial facilities, free installation. Credit cards: Access, Amex, Visa, Diners. Service dept.

GLOSSARY

Azimuth: In the context of this book, the alignment of head gap to tape path. Please refer to the introduction sections.
Bass woodles: Variations in low-frequency output on replay with frequency, caused by replay head countour effects.
Bias: This term, in the context of this book, refers to a high frequency current passing through the record head which allows the audio current also passing through the head to produce reasonably linear magnetisation of the tape at all levels permitted by the combination of each machine with the cassette tape. The lowest level of bias is required for ferric cassettes, a slightly higher one for ferrichrome, an even higher one for chrome or pseudochrome, and the highest for metal.
Clipping: This refers to the level above which bad distortion becomes evident, due to a circuit being overloaded by being overdriven.
Crosstalk: Breakthrough of frequencies from one channel or direction to another.
Decibel (dB): The logarithmic ratio between two volume levels which represents either a difference of level from a nominal one, or the gain or loss in volume of a particular circuit sometimes at a specific frequency. A 1dB change of volume is approximately the lowest change of volume on a programme or tone that can be heard by a fairly expert musician or engineer. 3dB represents double the power and 6dB a doubling of apparent volume which is also equal to doubling the voltage. 10dB represents 10 times the power and 20dB represents 10 times the voltage and 100 times the power. dBs can be used to represent increased or decreased level changes or differences.
DIN: German Standards Organisation.
Dolby processing and deprocessing: This refers to changes introduced in recording and playback in order to achieve noise reduction.
Dolby level (DL): This level represents a record flux equivalent to 206 Nanoweber per metre measured by the DIN method or 200nWb/m by the American method. It is an arbitrary level set by Dolby Laboratories, and serves well as a reference to which almost all the measurements have been taken. It represents very approximately 6dB below peak domestic recording level as would be measured by a very good peak program meter. It also happens to be the level required for calibrating Dolby B.
Dropouts: Momentary reductions of program level due to inadequate head/tape contact caused by oxide particles shedding off the tape onto the head gap, or inadequacies in tape transportor tape.
Dynamic range: The ratio in dBs between the quietest sound that can be successfully recorded and the loudest which can be accepted by the tape without serious distortion on an average programme. The range quoted is reduced slightly if a recorder permits very high levels to be recorded successfully at just middle frequencies only. The figures quoted should only be regarded as a comparison, and should not be compared with figures quoted in other literature as they will probably not have been calculated on the same basis.
Equalisation: This refers to the necessary change in frequency response required of an amplifier so that an overall flat frequency response is obtained from a tape medium. Equalisation is required both on record and replay. Any tape recorded on a good cassette recorder should have the same inherent response when played back on another correctly set up machine, since all playback equalisations should have been standardised. These standards are normally specified by the time constants of the circuits involved, eg 70μs or 120μs (see 'Microseconds').
Erase: The first head over which the tape passes has a very high supersonic frequency (the same as for bias) passing through it at a considerable level, and this should completely remove any trace of a previous recording before a new recording is magnetised onto the tape.
Frequency response: The accuracy with which an amplifier or recorder reproduces high notes and low notes at the same intensity as middle notes. In particular it refers to a reproduction of such intensities identical to the relative intensities that would be measured on the input. It is usually expressed as being a range over which the medium has a fairly constant response with respect to the level at the middle frequencies, ie one lying between 315Hz and 1kHz.
HF: High frequency.
Hum: A low frequency interfering sound produced by break-through or interference from mains wiring or circuitry. If this is audible it can sometimes be produced by bad design, but also through earth loops or bad, or even no earthing. It can also be produced by placing some recorders too close to external mains operated equipment.
IEC: An international standards body, to which national bodies have, in general, agreed to conform.
LF: Low frequency.
Jack socket: A socket into which a jack plug can be inserted. Both mono and stereo types are used on cassette recorders, stereo ones normally only being used to feed headphones. Mono types are in three basic sizes, 2.5mm, 3.5mm and ¼" (6.35mm).
Limiter: An electronic device which limits the recording level to a pre-determined maximum value but allows levels below the set threshold to be reproduced accurately.
Modulation: The amount of volume that the medium can accept and reproduce, or alternatively the actual sound present on the recording.
Modulation noise: An additional noise added to tape noise, which increases with the degree of modulation of the tape, caused by the properties of the magnetic coating. This noise has most of its energy near the modulation frequency.
MOL: Maximum operating level normally referring to 3% distortion of 315Hz or 3.15kHz.
Multiplex filter (MPX): A circuit which introduces severe attenuation at supersonic frequencies to decrease interference encountered with the output from some stereo FM tuners.
Noise degradation: An effect which occurs when hiss, or occasionally hum, is added to the potential best hiss performance of each recorder when the record levels are at minimum. Most recorders produce

noticeable additional hiss when their record level controls are advanced above a certain point.

Noise modulation: An unwelcome breathing effect that can be heard on some programme material, produced by poor noise reduction systems, or circuits.

Peak recording level: A level above which distortion becomes apparent. This distortion is introduced when the oxide particles almost reach magnetic saturation, and thus will accept no more level.

Phono (line) sockets: These sockets are coaxial and accept a special plug (termed phono plug) with a long pin in the centre (live) and a cylindrical section around it providing an earth connection. Inputs are normally high impedance and outputs are low impedance, and are provided for interconnection with many types of external hi-fi equipment.

Stability: Concerns the constancy with which the levels of a programme being recorded are replayed at the appropriate levels. Variations in head-to-tape contact can cause poor stability.

Wow and flutter: Pitch variations due to mechanical imperfections of the tape transport.

5-pole DIN socket: Special socket designed in Germany having two live input connections, and earth and two output connections. On some recorders, the output connections become low sensitivity inputs on record, whereas on most Japanese equipment, two pins provide a monitor signal on record and a replay signal on replay.

New UDII.
MAXELL PROMOTE THE ECONOMY TAPE TO A MORE EXALTED POSITION.

With new UDII from Maxell you can enjoy all the advantages of chrome position recording – but at a far lower cost than you'd expect.

Using Maxell's exclusive Epitaxial particle technology, UDII delivers more volume with less noise, and superb reproduction of high frequencies.

The result: a clear, crisp and lifelike sound.

Backing up the tape is Maxell's latest PA cassette mechanism: one of the most accurate mechanisms ever built.

PA stands for phase accuracy, and means that every component is dedicated to keeping the left and right hand channels of a stereo recording precisely in time with one another.

Everything from the pressure pad to the guide rollers and the slip sheet to the tape hub is designed with this end in mind.

Giving you not just a better sound, but a clearer stereo image – with all the spatial realism of the original performance.

All of which puts you in an excellent position to improve your recording.

maxell® UDII

Break the sound barrier.

Maxell (UK) Ltd., 3A High Street, Rickmansworth, Herts WD3 1HR. Tel: 0923 777171.

MISSION ELECTRONICS

because people like music

PHOTOGRAPHY: STEPHEN ESSBERGER

Mission Electronics Limited, Huntingdon PE18 6ED, England. Phone: (0480) 57477 Telex: 32333