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HI-FI CHOICE

CASSETTE DECKS AND TAPES 1987

BY ALVIN GOLD

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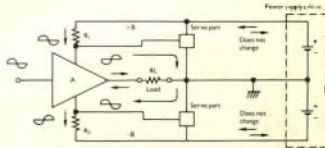
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EDITORIAL INTRODUCTION

The hi-fi cassette deck market worldwide is currently a little depressed, since much of the spotlight has shifted towards its so-called DAT 'replacement' (a status I will accept when digital audio tape players come fitted standard in GL Ford Sierras). Over-enthusiastic media coverage has brought over-anticipation of a new format that is still not officially available outside Japan and Professional circles. However, although it will take at least a decade for DAT to become anywhere near properly established, there has certainly already been a shift of resources towards the new spinning-head/digital audio VCR/CD-style technology.

Though tempted to jump on the media bandwagon by testing as many 110 volt Japanese DAT players as we could get our hands on, on reflection this would be largely meaningless for the reader. The first-generation models launched this Spring in Japan will certainly undergo substantial development before exporting is undertaken. Their only relevance is to establish a benchmark of quality comparison. So with commendable restraint we have restricted ourselves to testing just the one DAT machine, the Pioneer D1000, and emphasise that it is unlikely to be representative of machinery that eventually reaches the UK (copyright politics permitting) sometime in the next twelve months.

If the cassette deck marketplace is a trifle flat, our decision to change the author of this *Hi-fi Choice* series should add some fizz of interest. Obtaining a completely fresh perspective on the topic is fascinating in itself, and will ensure that this is one of the most discussed *Choice* editions for some time.

Previous *Choice: Cassette Deck* reviewers Angus McKenzie and Noel Keywood are both engineers for whom I have great respect, and who did much to create the esteem in which *Hi-Fi Choice* is now held. Their efforts over the years improved both the standards of the machinery itself and helped establish proper standardisation and compatibility between tapes and

machines.

However, Alvin Gold has different talents. He is less an engineer as such, so the more 'difficult' measurements have been carried out elsewhere (in Martin Colloms' laboratory, for example). But his expertise and experience on the subjective side of hi-fi is probably unequalled, and it is in this area that I believe he contributes most strongly to this latest volume.

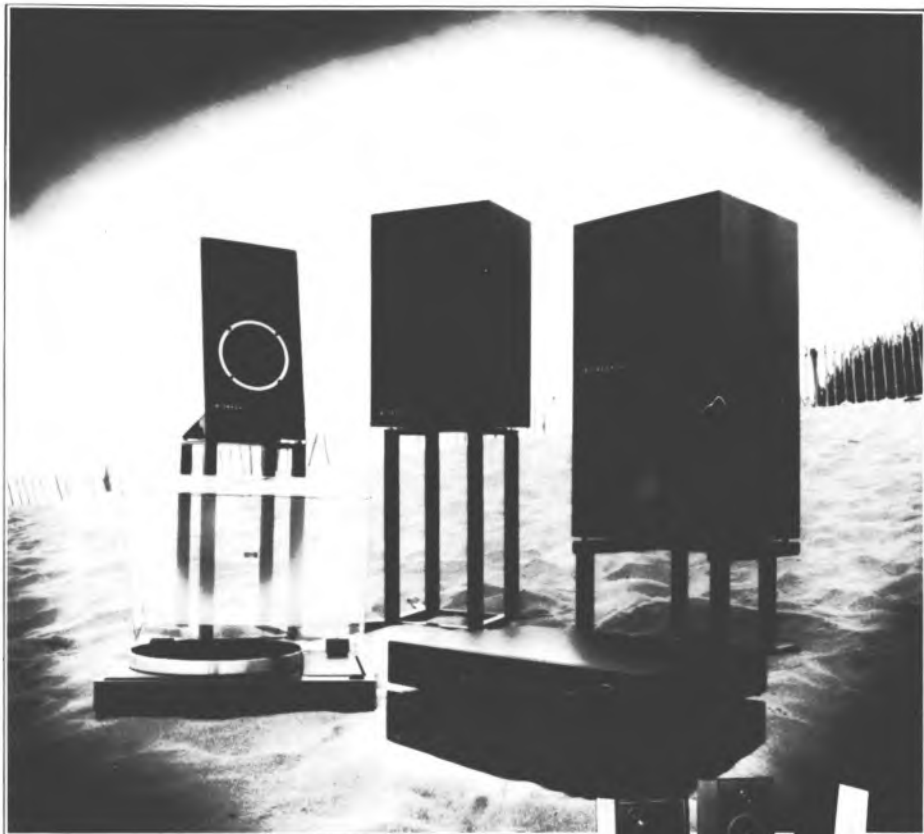
One by-product of changing the reviewer is that a number of previously tested machines have to be re-tested. Even allowing for differences in measurement techniques, and the fact that we have deliberately expanded the vertical scale of the penchants to emphasise response anomalies, in some cases there are significant differences between the new findings and the results obtained last year on ostensibly the same model.

Although some of the differences will come down to the individual priorities assigned to different aspects of performance by the reviewer concerned (ie the relative importance of pre-recorded tape replay against record/replay performance), the repeat testing again raises the serious question of sample consistency — a question mark that has hung over cassette decks for decades, and which still appears relevant. More than most sectors of hi-fi the cassette deck is a complex piece of mechanical engineering that also needs precise electronic alignment. And it has always been something of an Achilles heel that we can only test a single sample (which in some cases has probably been carefully tweaked by the importer to ensure all is well).

The final warning therefore is to use our findings as a guide to the potential of the machines tested, but also exercise your own judgement on the sample you are offered in the shop. Remember too that the more reputable dealer is interested in providing satisfaction to gain your longterm repeat custom. He may well have the experience and equipment to keep an eye or ear on sample consistency, and knows more than us about field reliability too.

Paul Messenger

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CHOOSING AND USING CASSETTE DECKS

Though the Compact Cassette is very much hi-fi's 'bastard' medium, at least on ethical grounds, there is no disputing its success, its convenience, or the high standards of sound quality that can be achieved nowadays — at its best, fully comparable with CD or LP disc. The unique feature of the medium is, of course, the ability to record. But it should also be stressed that musicassettes are a major source of pre-recorded music, now outselling LPs and growing (in numbers terms) faster than CDs! Versatility and compactness are the twin pillars of the cassette's success. All audio systems have begun in the home, but the cassette has done for the music industry what the transistor did for radio, providing 'go anywhere' flexibility in portables, personals and in-car variations.

The most obvious recent trend in domestic mains machines has been towards the double 'dubbing' deck, fitted with two transport mechanisms. *Choice* has tended to steer clear of these, less for moral reasons, discussed shortly, than because there is no way such a machine can out-perform a single transport machine at a similar price. However, the market share of dubbbers continues to increase, particularly in budget and system/stack sector, so we have included a number of new examples this time around. By and large, they have done little to change our opinions significantly. However, those who do want this extra facility can now decide for themselves whether the price penalty is worthwhile.

MORALITY & HYPOCRISY

Happy enough to sell ever increasing quantities of pre-recorded tapes for all applications, particularly back-catalogue re-issue compilation material, the music industry still cannot come to terms with the fact that many people use their cassette machines to record friends' LPs on blank tape, or to record music programmes from the radio, so by-passing the significant copyright element in the price of pre-recorded material.

The paranoia surrounding DAT in particular, with threats to damage all recorded music with a Copycode spoiler system, sits inconsistently alongside imminent Government intentions to

legislate a 10% copyright surcharge on blank cassettes.

REPLAY

Nowdays the best musicassettes can give very respectable quality, so pre-recorded material certainly deserves to be taken seriously, and the replay-only performance of a cassette deck must be considered important too. Theoretically, pre-recorded cassettes could be as good as or even better than those made on all but the very best domestic decks, as the equipment for mass duplication ought to be superior mechanically and electronically. However, in practice quality and quantity often conflict, and the profits are created by the latter. Nevertheless the end result can be good enough to show up limitations in even the very best cassette decks, so the ability to get the best from musicassettes is a valid assessment for a cassette deck.

The task requires a good quality tape transport mechanism and replay head, plus careful alignment of heads and electronics. Although international tape equalisation and noise reduction standards do exist, not all manufacturers are equally good at adhering to them. The result is that many decks perform less well on replay only than they do within the 'closed loop' of record/replay, and our reviews pay attention to this.

RECORD/REPLAY

In some ways record/replay is easier than replay only, insofar as head alignment, Dolby tracking and equalisation errors can cancel out and compensate for each other. However, any inherent transport problems are likely to be exaggerated, and there is now a still greater premium on the quality of the record head, particularly if metal tape is likely to be used. To get a decent quality recording, a deck needs to be accurately aligned electronically for a sensible range of different tape types; some machines offer variable bias for 'fine tuning' to specific tapes — a useful facility for those prepared to take the trouble.

Good quality metering set to the right sensitivity level can be a boon, though in time and with practice a cassette deck owner will

probably gradually come to learn the 'right' meter level for getting most signal without compression onto a specific type of tape.

It is worth carrying out a few practice runs to explore the limits of the deck with a particular tape. Try increasing the record level by a specific amount at specific counter intervals during recording, then back off the volume setting at the same time intervals during replay so that the overall sound level remains reasonably constant. You should then be able to hear the sound balance and/or distortion start to change as either machine or tape reaches overload, and so deduce the right peak meter levels to use for the best balance between background noise and recording quality. It may also be worth trying a similar subjective run through with and without noise reduction circuitry, as some listeners prefer an unprocessed if noisier sound, and noise reduction circuits are not always properly adjusted for different tape sensitivities.

TAPE TYPES

A full comparative analysis of different brands

and types of tape will be found in the *Cassette Tapes* section. Though there are three formal groups of tapes, Types I, II and IV, there are variations within each group which further confuse. In brief, the best advice is to find a tape in each group which suits the set-up of the recorder, and then stick to it. (But note that the tape manufacturers have an annoying habit of re-mixing formulations regularly without changing the brand identity.)

The very cheap ferric tapes are not hi-fi quality, so it is better to go for premium Type I ferric from a reputable brand for general purpose use. A Type II chrome or pseudochrome will give a step-up in quality, while Type IV metals can turn out to be the cat's whiskers on some decks — but may not work too convincingly on others. Perversely, the very best decks can produce stunning results on the better quality Type I ferrics.

FEATURES

No other component fulfills a button pusher's dream like a cassette deck. The bare essentials boil down to tape selection (which can be auto-

MEMOREX

FOR PEOPLE WHO TRULY CARE



matic), and Dolby B noise reduction (necessary for musicassette replay but optional for record/replay).

A host of imaginative inessentials will either enhance the enjoyment or baffle the user, depending upon temperament. Microphone inputs are fast disappearing, with better quality microphones commonly containing battery pre-amps to provide a line-level signal for normal deck or amplifier connection, but headphone sockets remain. Extra noise reduction may be Dolby C and dbx, with headroom extension from Dolby HX Pro.

Electronic logic control may supervise an almost silent transport system, giving the potential for microprocessor-controlled track search and programming systems; for auto-reverse to extend play or record times; and for automatic tape tuning in the more expensive machinery. Bias 'tweaking' enhances tape matching, while replay EQ may be trimmed for optimum replay response on some machines.

The manufacturer can choose to spend money on a better quality single transport, with a closed-loop double-capstan system perhaps, or

slot in a second dubbing transport with all the attendant extra complexity.

Styling is clearly a matter of personal taste, but the whole gamut exists from the garish clash of multicoloured illuminated displays shouting 'buy me' off the shop shelf, through to the deliberately understated or the daringly unconventional. Ergonomics vary from the crass and confusing to the subtle and effective, though take heart from the fact that a purchaser will soon learn to use his own particular deck, as he would learn to drive a new car.

Having weighed up the pros and cons of your own priorities and requirements, and having studied our reviews, it's not a bad idea to audition one or two likely contenders. A comparison with something really good is almost essential to establish a quality yardstick when trying to assess how much you will need to spend to achieve the desired level of performance. The enthusiast may not take the purchase of a cassette deck as seriously as he would the selection, of turntable, arm and cartridge, but audible differences between cassette machines are no less obvious.

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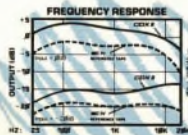
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CASSETTE DECK BUYER'S CHECKLIST

Some decks don't have microphone inputs at all. Quality with regards to noise and distortion can be surprisingly poor. Microphones of the appropriate output and impedance should be used, or powered high quality mikes through the amplifier.

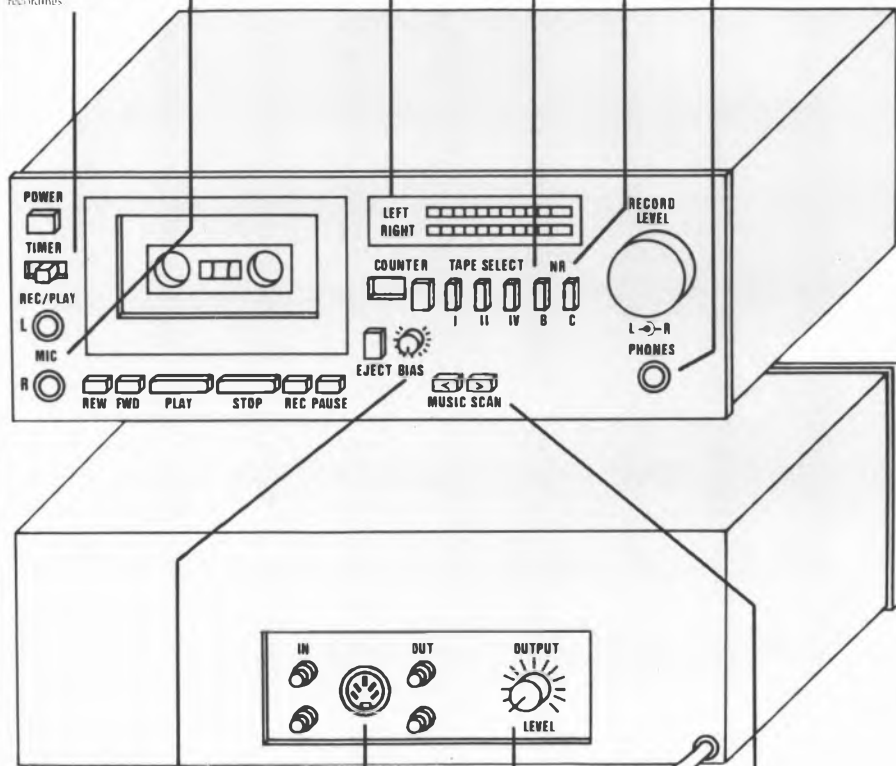
Do the meters respond fast enough to be called peak meters? Are they suitably calibrated to enable you to use the maximum headroom available on peaks without distortion, or will you lose signal in the tape noise floor through over-riding?

Various noise reduction systems may be fitted.

Some decks are not able to drive less sensitive headphones to even acceptable levels and a check should be made for compatibility. A level control is useful; sometimes a line output level control also controls headphone level.

If not automatic, tape selection can be confusing; a status display can help avoid errors.

The machine must have a Timer switch to make unattended recordings.



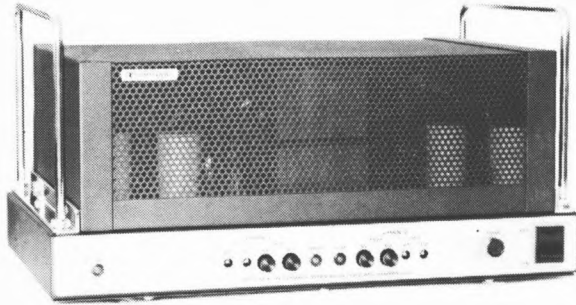
A bias trimmer allows fine tuning of the deck for the tape in use. Computer bias adjustment is an option on some machines.

Is the output impedance and level suitable for your amplifier? If a DIN socket is fitted this may be to DIN standards or simply to phono levels and impedance, as is the case with several UK amplifiers.

A variable output can help match the deck into a system.

Search facilities can find tracks by detecting periods of silence during fast wind or rewind.

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TECHNICAL INTRODUCTION

The true value of any *Hi-fi Choice* project derives from covering a wide enough range of equipment to be fully representative of the market as a whole, and in reporting on them using common techniques and criteria, so that once the reader has learned to interpret the author's personal idiosyncrasies and prejudices, he can apply this knowledge to a large database of review information.

This *Choice* is the first *Cassette Decks & Tapes* under my authorship; I hope it isn't too hard going. At the outset let me acknowledge the help I received from various sources: Robert King, an able assistant who did much measurement and donkey work; Martin Colloms, who did the spectrum analysis plots on the machines (not tapes), plus sensitivity, overload, azimuth, intermodulation and VU indication at IEC 0dB measurements. All the remaining machine tests and most of the tape tests were done using the author's own facilities. Thanks also to Ken Talbot of Memorex (see *Tape Tests*), and Yamaha UK and Japan, for help with test tapes etc.

I hope that most readers will find a degree of continuity with the standards of the past. At the same time I inevitably have my own ideas (not to mention biases), and make no excuses for having imposed some of them on this issue. Where products have been reviewed here that were also covered in previous issues, the review has been carried out afresh, with a completely new sample of the deck concerned. All the reviews and text published here is new, and you may also notice that changing criteria have sometimes led to rather different value judgements being made.

As in previous projects, the cassette decks were assessed in two distinct ways: first as hardware designed to play commercially recorded musicassettes, and secondly as recording tools. The vital distinction is that for the former the deck must correspond (in physical alignment and electrical equalisation) to the external standards applied during the duplication of pre-recorded material. In the latter case, this stricture doesn't apply in quite the same way.

Although a recorded tape ought still to replay accurately on other cassette decks (the owner's Walkman or ICE players, for example) some of the commonest errors (notably those due to head alignment) are essentially self-correcting with the same machine: they replay with the same error that was used at the record stage.

LAB TESTING

Rec/replay response – 3dB ref 1kHz. The two figures given are simply the –3dB frequency extremes that define the bandwidth (referred to the arbitrary 0dB 1kHz level, and recorded at –10dB ref IEC). These are shown separately for all three tape types.

Wow and Flutter — **Peak DIN wtd/unweighted.** Central to the task of writing to and reading from tape is that the consequence of any lack of absolute speed stability will superimpose itself on the signal, and that you will hear the effect. In an analogue system like compact cassette, the inevitable variations in speed of the tape passing over the heads appear as momentary (and sometimes longer term) pitch variations. This class of variation is known under the blanket term wow & flutter, and is shown in unweighted and weighted form.

Speed error is measured in percentage deviation from the nominal standard (4.75cms/s).

Signal/noise ratios are quoted with CCIR/ARM weighting. The test frequency is 315Hz, the distortion is shown at the same point (0VU on the deck's meters) for each of the three tape types.

Channel separation is measured with reference to a 1kHz signal at 0VU on the deck's meters.

Line input sensitivity/overload. Will it match your amplifier tape feed?

Mic input sensitivity/overload What sort of microphones (if any) can be used?

Line output for 0dB/maximum. Will it drive your amplifier properly? (probably.)

IM distortion 10kHz/11kHz 0dB peak, 1kHz product. This test gives a useful measure of how

Continued on page 14

HI-FI CHOICE

1987 SERIES

FEBRUARY

THE COLLECTION

'State of the art' means the best that we can do with available technology. This special large format edition covers hi-fi equipment which aims at true excellence — with no expense spared. As well as the truly esoteric, this guide covers the very best that is to be found at (fairly) reasonable prices.

SEPTEMBER

LOUDSPEAKERS

Progress brings better-value speakers every year. Hi-Fi Choice puts the important new models through its unique 'blind' listening comparisons to find out which really do represent a step forward. Combined with full lab analysis, they provide a comprehensive guide to speaker sound quality.

APRIL

AMPLIFIERS & TUNERS

At the heart of any system is the amplifier, and its performance is critical. But only a combination of carefully-controlled listening and lab tests can give the true picture of amp performance, and in some cases prove that the best low-cost amplifiers can sound better than many at several times the price.

NOVEMBER

CD & MIDI SYSTEMS

Specially for the buyer who wants an all-in-one system. Presented in a strictly non-technical way, this special edition tests and compares a huge range of one-brand 'midi' or compact systems, with the emphasis on Compact Disc options. Consistent test methods make for fair comparison and clear advice.

AUGUST

CASSETTE DECKS & TAPES

The best cassette decks can give recordings almost indistinguishable from the original. Hi-Fi Choice will help any cassette deck buyer through the jungle of noise reduction systems, fancy facilities and flashing lights, to find the right deck whatever the budget. Virtually all hi-fi tapes are tested too.

DECEMBER

TURNTABLES & CARTRIDGES

Searching comparison tests across the whole range of turntables and cartridges sort the myths from reality to discover which models and combinations really sound best — and find some low-cost 'Best Buys' that out-perform many exotically-priced models. Plus guidance on matching and setting-up.

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well or badly the various machines respond when asked to record two high frequency signals at 0VU level simultaneously. Real life musical signals are much more complex still of course, and an inability to deal with this test cleanly suggest an inability to cope with up-front percussion or other high energy material without sounding hard, splattery or just plain distorted.

Azimuth check R-L phase at 8kHz Expressed in degrees (of treble phase shift), this is a measure of azimuth misalignment. The higher the error, the greater the HF loss when playing commercially recorded cassettes.

VU indication at IEC 0dB. In principle, the 0VU point on a deck's record level meters is arbitrary, but it is usually set around +3dB ref IEC 0dB.

Dimensions (w×h×d) In centimetres, of course.

PLOTS & GRAPHS

In addition, a number of plots and graphs are included with each review. The frequency response plots were run with the highest pen writing speed available, which means that dropouts tend to show up in all their glory, and frequency response errors are not 'sanitized' as is often the case. The chart recorder was used with its greatest vertical resolution. This exaggerates response aberrations by a factor of 2.5 times compared to previous cassette deck tests but brings them into line with CD players, cartridges and amplifiers. The record/replay sweeps were also continued right up to 40kHz. All response plots were run at -10dB, which stresses the machines rather more than the traditional -20dB.

Also included for the first time are similar, comparable plots showing the effects of the noise reduction systems in the frequency domain. The playback only plots were also run in exactly the same way, giving an indication of the frequency response available with pre-recorded material. There is no available sweep test tape for this, so the author made his own, calibrated against the official 120µS Abex IEC calibration test tape. The accuracy of this test tape is not absolute, but error is estimated at around 1.5dB maximum — and is constant from machine to machine.

We took two spectrum analysis plots to investigate the mechanical behaviour of each of

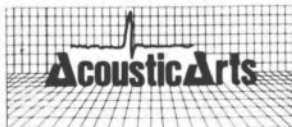
the decks, though space prevented the publication of more than one of these. The (published) noise modulation spectrogram graphically illustrates the mauling endured by a 3150Hz sinewave when recorded and replayed by the deck under test — there are close parallels with a similar analysis carried out in last year's edition. The central peak should be as fine and as thin as possible, any problem here being heard as a lack of pitch stability. The other, a 50Hz fluttergram, is a spectrum analysis of wow and flutter components from 0-50Hz, and is commented upon in the text as necessary.

Then there's the question of test procedure/presentation defaults. With twin cassette decks, all measurements and plots shown are for the main record/playback transport, but both were checked, and any discrepancies reported as appropriate. Response runs were also made using the high speed dub option, but have not been reproduced for space reasons. With auto-reverse decks, all data refers to Side 1, but the reverse side was checked in the same way, and again discrepancies are reported as they arose. In the case of decks with automatic tape alignment, the alignment procedure was followed, and where a bias adjustment facility was fitted, the setting recommended for TDK, AD, SA and MA was used if available. Otherwise the central (usually 12 o'clock) setting was adopted.

LISTENING TESTS

The listening was divided into two sections. The first involved using each deck in turn in a system which included a Sony CDP-552ESDII CD player, Rotel RA-820BX2 amplifier and a pair of Stax *Lambda Pro* headphones. Much routine listening was done with this system, along with all the functional work — which button does what and so on.

Finally, and most important of all, each deck was auditioned in a high grade loudspeaker based system. Equipment used included a Musical Fidelity preamplifier (my own DNM preamplifier has no tape circuit at present!), Krell KSA-50 power amplifier, a Roksan *Xerxes/Rega RB-100/Koetsu Rosewood Signature* record deck, the aforementioned Sony CD player with outboard 703 DAC and a pair of Apogee *Caliper* loudspeakers, all wired with solid core DNM cables.



The 'best buy' in this publication having narrowed down your choice in this excellent guide, you now need the help of a good dealer to select the product most suited to your system & listening preference. Acoustic Arts carry many of the Recommendations and Best Buys from this publication which are on permanent demonstration.

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AIWA AD-F260

AIWA UK LTD, DUKES ESTATE, WESTERN AVENUE, LONDON W3 0SY.

TEL: 01-993 1672



Here is a model that fairly oozes desirability in the important market for starter cassette decks. The Singapore-made AD-F260 is cheap and at first sight extremely palatable. After all, there aren't many £90 cassette decks that manage to include Dolby C as well as B, or that allow you to tweak record bias to suit your favourite cassette tape — Type I ferric and Type II chrome only of course.

This Aiwa even includes luxury features such as automatic tape type selection, full cue/review operation, and a quite decent set of record level meters — 30dB dynamic range over 7 steps, best resolution of 3dB, and red LEDs over 0VU. Tell-tales are fitted to confirm record mode, noise reduction, and tape group.

The transport controls are power assisted mechanically latching piano key types which Aiwa describe as 'soft-touch': you are one if you believe them. They work well enough though, aided by the fact that you press down rather than back. The Aiwa also includes a record mute switch, but this does not work like those on many more expensive decks, merely muting the record head feed as long as it is held down.

The deck is cleanly designed and very easy to get to grips with — less because of the split vertical/horizontal fascia than because of the simple lack of unnecessary things to adjust.

Build quality and control feel is no better than it needs to be: construction is lightweight, though it doesn't threaten to fall apart in a hurry. On reflection about the worst feature is the Dolby switch. Can there be other cassette decks that require two hands to select Dolby? I think we should be warned....

LAB REPORT

Given that this is such a cheap machine, some of the measured performance parameters are remarkable — an object lesson to some others. The metal tape record/replay response, for example, is flat within +0.5dB up to 15kHz, with a rapid drop into the MPX rejection area thereafter. The playback only response is superbly optimised, and the low frequency behaviour is very well controlled too. The Type II record/playback response has a top end boost of +2dB, but what is of more concern is that the Dolby response compared to the non-Dolby one suggests considerable mistracking.

Intermodulation distortion at IEC 0VU (a full +6dB on the deck's meters) is astonishingly low, and other figures are satisfactory or better. This includes the wow and flutter figure, but noise modulation is fairly high and close to the centre frequency on the spectrogram. The flutter analysis indicates a complex and messy array of sidebands around -32dB with high, aggregate power.

And it's not just tape noise that's high. The deck's electronics produce an interesting accompaniment of hiss and hum, with the record amps adding their two-pennies' worth at high input levels.

SOUND QUALITY

Not too wonderful, though it seems almost ungrateful to quibble given the price. Pre-recorded tapes sounded very dull and waffly, response shape notwithstanding. It was a toss up whether to replay Dolby cassettes with Dolby switched on or leave it off to try and inject a touch of life into the sound. In the end the noise was just too obtrusive even if the Dolby mistracking wasn't.

Much the same applied to recordings made on this machine too. When the music wasn't noise bound, it sounded soft and woolly. Type II recordings exposed a raw, edgy treble characteristic and the midband was coloured and slurred with all three tape types. Information losses were quite obvious and the sound had a shabby quality. Much of what has been described here may be due to the effects of noise modulation.

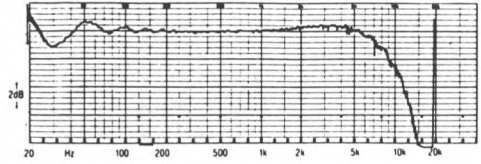
CONCLUSIONS

The outcome is necessarily equivocal. Although about the slickest and most thoughtfully equipped cheapie around, and more than adequate for 'entertainment' use, the sound of the AD-F260 has little to do with modern high fidelity.

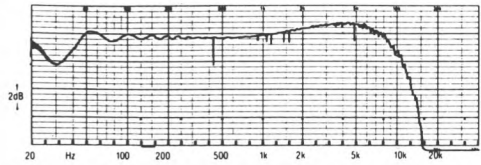
TEST RESULTS

Rec/replay response - 3db ref 1kHz:

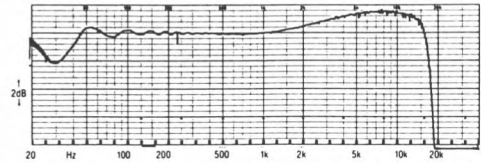
IEC Type I	<20Hz-12kHz
IEC Type II	<20Hz-17kHz
IEC Type IV	<20Hz-18kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.11%/0.24%
Speed error	0.4%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.7%
Type II signal/noise CCIR/ARM 315Hz	48dB
distortion 0db	0.65%
Type IV signal/noise CCIR/ARM 315HZ	50dB
distortion 0db	0.85%
Channel separation 0VU/1kHz	46.5dB
Line input sensitivity/overload	120mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	795mV/2.3V
IM distortion 10kHz/1kHz: 0dB peak, 1kHz: product	0.31%
Azimuth check R-L phase at 8kHz	17 degrees
VU indication at IEC 0db	+6dB
Dimensions (w x h x d)	42 x 11.6 x 27.8cm
Typical Retail Price	£90



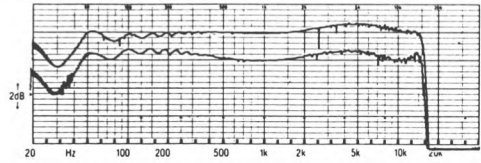
Playback only frequency response (pre-recorded tapes)



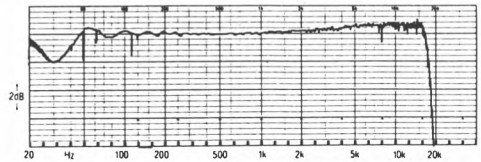
Overall record/replay response. Type I (ferrie) tape



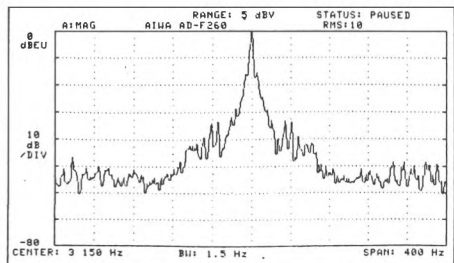
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

AIWA AD-R460

AIWA UK LTD, DUKES ESTATE, WESTERN AVENUE, LONDON W3 0SY.

TEL: 01-993 1672



The AD-R460 is a budget auto-reverse model with Dolby B and C, based around Aiwa's traditional split front panel arrangement. The features are biased towards reducing the number of operations in normal use. Thus tape type sensing is automatic, though Type I and II tapes can have their record bias tweaked using a front panel pot. A very long record level slider is augmented with a tiny balance control, Aiwa having correctly divined that the latter isn't going to be used very often. The record level meters have seven steps with a 30dB range and a rather limited 3dB best resolution.

On balance, ergonomics are something less than the 'triumph in applying human engineering design concepts' claimed by the manufacturer. It's true that the number of controls and displays is strictly limited; but there are signs of muddled thinking in the timer and reverse mode switching, which are difficult to read except from well above, and in the latter case because the associated tell-tales are miles away instead of alongside. Ditto for the Dolby switching and their tell-tales.

The transport makes the most extraordinary clattering noise when going from one mode to another. Versatility, on the other hand, isn't in question: punch-in recordings are possible, and so are cue and review (fast wind with a re-

duced level output from the head). Reversing direction is triggered at the junction of tape and leader, within a claimed 0.3 seconds: certainly this is very quick when it worked, but sometimes the deck failed to reverse at all.

Other features include automatic mutes and timer operation, a mechanical counter and a fixed level headphone socket. There are no microphone inputs. Build quality is adequate in relation to price, though finish is good.

LAB REPORT

Record/replay responses using TDK Type I (AD) tape were adrift at the recommended bias setting, but can be tweaked by using a lower setting. The Type II response was perfectly flat, and Type IV (not under the control of the bias pot) just slightly underbiased. The deck can be accurately set up by the user, but Dolby B and C throw things significantly out of kilter. On a more positive note, the replay response (without Dolby) was spot on through the midrange and well into the treble.

The 10/11kHz intermodulation test threw up high levels of distortion at 0VU (18%), which limits the working dynamic range, but fortunately noise levels were quite good, and the noise spectrogram was fairly clean. Speed stability was not good. Note the highish measured wow and flutter percentages (especially

unweighted), the differences between direction of tape travel, and the fluttergram.

SOUND QUALITY

I'm sorry to report that this cassette deck sounds exactly like — a cassette deck. It was a lack of subtlety and expressiveness with either Dolby B or C active that I liked least. There was a heavy, almost ponderous feel to the low bass, which must take its share of the blame. Concomitant on this was a collapse in stereo imagery, the lateral extremities sounding vague and depth images compressed. But some of the worst effects were ameliorated when recording levels were reduced, and the best of the recordings made on metal tape sounded quite sharp and alive.

Pre-recorded cassettes didn't exactly transcend performance standards elsewhere, and there was a suggestion of a lack of energy at times. But on the whole they didn't lag as far behind as usual.

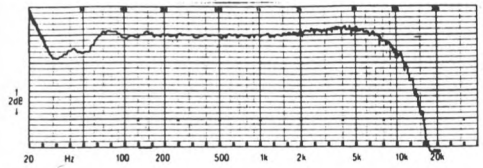
CONCLUSIONS

The problems with this deck are classic high fidelity failings, apparent more or less equally with all three tape groups. Against this must be set a good replay only performance, and worthwhile features.

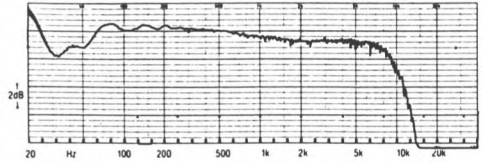
TEST RESULTS

Rec/replay response — 3db ref 1kHz

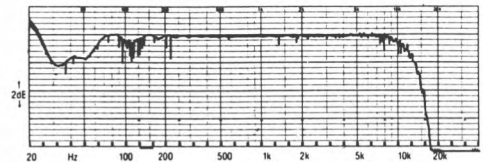
IEC Type I	<20Hz-11kHz
IEC Type II	<20Hz-14.5kHz
IEC Type IV	<20Hz-16kHz
Wow & Flutter — Peak DIN wtd/unweighted side A/side B	-0.11%/0.29%/0.15%/0.34%
Speed error side A/side B	+0.2%/+0.1%
Type I signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	0.5%
Type II signal/noise CCIR/ARM 315Hz	52dB
distortion 0dB	1.0%
Type IV signal/noise CCIR/ARM 315Hz	52.5dB
distortion 0dB	0.75%
Channel separation 0VU/1kHz	48dB
Line input sensitivity/overload	79nV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	675mV/3V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	18%
Azimuth check R-L phase at 8kHz	12 degrees
VU indication at IEC 0dB	+3dB
Dimensions (w×h×d)	42×11×29.5cms
Typical Retail Price	£139.95



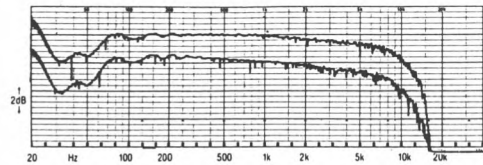
Playback only frequency response (pre-recorded tapes)



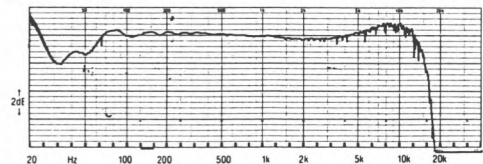
Overall record/replay response. Type I (ferric) tape



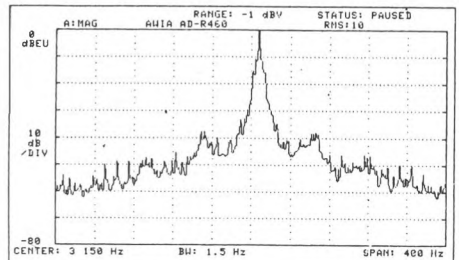
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

AIWA AD-F770B

AIWA UK LTD, DUKES ESTATE, WESTERN AVENUE LONDON W3 0SY.

TEL: 01-993 1672



The AD-F770 has now been available for some years, and has the piano-key ledge presentation that Aiwa have made their own. The horizontal section can act as something of a dust trap, and dictates positioning well below eye level. And it's ugly. But at least it's different.

This is a dual-capstan, three head machine, with off-tape monitoring. Noise reduction is by Dolby B or C, with or without MPX filtering. Dolby HX Pro is also fitted, serving to linearise the record process and reduce HF compression.

A key feature is DATA, an acronym for Digital Automatic Tape Adaption. The microprocessor winds the tape past the leader and then attempts to optimise bias, equalisation and sensitivity by recording and monitoring various sine wave tones at 400Hz and 10kHz and there is a non-volatile memory for the last 3 tape types (one of each kind) so accommodated.

There are many other features too, prominent amongst which are track search, intro-scan, a real-time tape counter (with very approximate time to go readout after the tape length has been programmed in), audible cue/review, counter memory, memory rewind and an output level control which drives the headphone socket as well as the main output. The long record level meters have peak hold LEDs and a moderate

30dB working dynamic range. Microphone sockets are fitted around the back, and there are also add-on remote control options.

The deck is adequately built in a rather plasticky sort of way, and it's a little messy ergonomically. However, the transport section engages quietly and smoothly.

LAB REPORT

Pictured are the IEC test tape record/replay responses optimised by the auto tuning circuits, which gave highly repeatable results from tape to tape and from run to run. Repeatable in this case refers to a characteristic saucer response shape with some broadband boost centred on 100Hz and 12kHz; these become more soup-bowl shaped with Dolby in circuit.

On the other hand the playback only response is ruler flat, though with more accurate azimuth alignment it might have extended still further into the treble. On our sample azimuth error amounted to 40 degrees at 8kHz, with the -3dB point at 12kHz.

Speed stability is very good. There's some complex wow noise at low levels, and some discrete flutter components, notably a -30dB peak at 32Hz. The noise spectrogram also shows good pitch precision and stability, with a well distributed wideband noise floor. But there is significant OVU intermodulation distortion.

SOUND QUALITY

I detected an effect that isn't entirely absent from any of the Aiwas: a kind of heavy 'slowness' to the sound, and a reluctance to let go after a transient has passed. But the 770 is a great deal better than the cheaper Aiwa models tested, and certainly good enough for recommendation.

The 770's best quality is stability in all its forms. Take for example speed stability: there's little of the usual slightly 'seasick' cassette sound. Then there's the stability that comes from intimate tape to head contact: the dual capstan transport seems to have paid dividends here. Finally, stability was also apparent in the stereo sound stage: there was only a slight loss of image localisation or scale compared to the source (records and CD). Set against this, the Aiwa did suffer somewhat from mains hum, at a high enough level to be occasionally distracting.

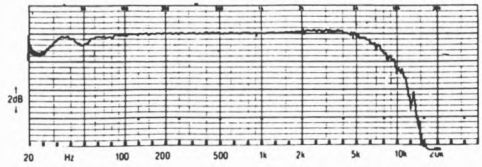
Dolby HX Pro notwithstanding, recordings made on TDK MA (Type IV) were consistently the most alive and open at the top. The Aiwa was capable of making some very impressive metal tapes. It also did a very good job replaying prerecorded material, sounding refined and subtle, with little loss of top end energy.

CONCLUSIONS

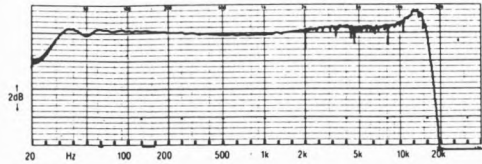
The AD-F770 is clearly recommendable despite the rather gruesome aesthetics, simply because it is capable of making very realistic and potent recordings. It works.

TEST RESULTS

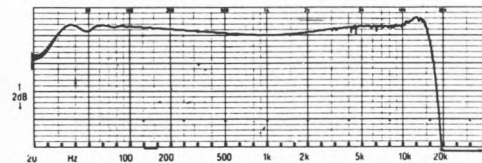
Rec/replay response - 3db ref 1kHz	
IEC Type I	<20Hz-17kHz
IEC Type II	<20Hz-17kHz
IEC Type IV	<20Hz-20kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.08%/0.11%
Speed error	-0.4%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.6%
Type II signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0dB	0.46%
Type IV signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	0.53%
Channel separation 0VU/1kHz	48dB
Line input sensitivity/overload	113mV/>7V
Mic input sensitivity/overload	0.97mV/35mV
Line output for 0dB/maximum	660mV/2.7V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	3%
Azimuth check R-L phase at 8kHz	40 degrees
VU indication at IEC 0dB	5dB
Dimensions (w×h×d)	42×11×28.6cms
Typical Retail Price	£300



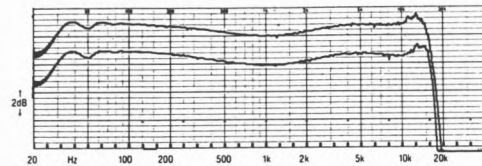
Playback only frequency response (pre-recorded tapes)



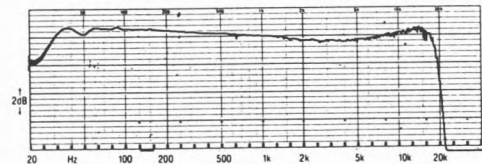
Overall record/replay response. Type I (ferric) tape



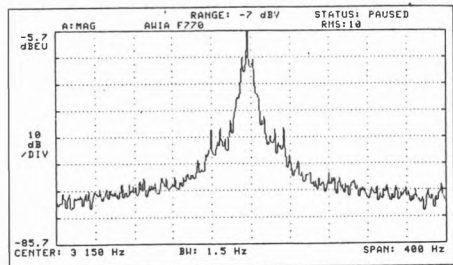
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

AKAIGX-6

AKAI(UK)LTD, 12 HASLEMERE HEATHROW ESTATE, SILVER JUBILEE WAY, HOUNSLOW, MIDDLESEX.
TEL: 01-897 6388



The Akai GX-6 is a very cleanly styled and quite ambitiously designed deck, costing almost exactly £350. The fundamentals include Dolby B and C noise reduction (with independent MPX filtering) and three heads, the record and playback heads being mounted in the same housing, and built according to Akai's proprietary GX glass crystal ferrite design. With off-tape monitoring available whilst recording, tape/source mode switching is handled automatically, but with a manual override facility on tap for instant comparisons. (Incidentally, all such comparisons should be made at the partnering amplifier to get a realistic idea of all the qualitative losses imposed by the recorder.)

The usual three tape types are accepted. Not only does the deck automatically set record bias and equalisation to suit — there's a fine bias adjust knob as well — the record level meters then proceed to show what they consider a suitable working maximum level. The meters have an operating window of no less than 52dB, with red LEDs above 0VU, peak hold — the biz in fact. Sharing the same display area, an electronic tape counter shows number or time, and is (almost) intelligent enough to work out for itself the length of the tape you've inserted. (Insert a CI20, however, and it repeatedly

flashes a warning sign thus: C45-C60-C90-C45 and so on, finally reverting to an incorrect reading based on the C90 algorithm.)

The transport section is very quiet in operation and fully logic controlled, with music search, automatically timed mutes, intro scan and 'record cancel', which reinstates the position just before the last recording began. Finally the eject feature is tied into the machine logic. It closes automatically when play is invoked, and opens when the stop is touched twice. Neat. Double neat.

The display area is particularly attractive, and Akai have clearly gone to some trouble to give the GX-6 a clean 'user interface'. It really is very well designed, made — and, incidentally, finished.

LAB REPORT

As it happens, the only tape type used on test that was not as recommended was the Type I tape, and this was the only one that gave a dead accurate response shape with the bias knob centred. Well, one of the beauties of a bias knob is that it transfers the manufacturer's responsibility for getting things right to you — but at least then you do get results. In this case a bit of extra bias will pull the Type II and IV responses back a bit. The other frequency plots suggest that Dolby mistracking should not be a problem,

and that the replay response is broadly satisfactory, albeit with a degree of premature rolloff due to a 50° azimuth error.

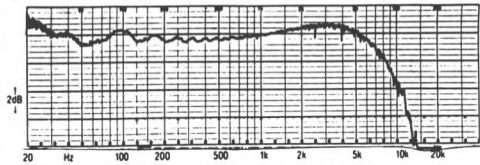
The IM distortion level is low, and as 0VU corresponds to IEC 0dB, the record levels can be allowed to peak a little higher than normal. The transport is a cracker (another of those technical terms, I'm afraid). Absolute (numerical) wow & flutter is very low. The noise modulation plot show a stable, fine centre frequency, with the first sidebands at $\pm 15\text{Hz}$, -27dB , then $\pm 52\text{Hz}$, -36dB , the overall noise level being low. The fluttergram shows that there are some wow components, but at decently low levels, and that the upper part of this frequency spectrum is very well controlled with low noise.

SOUND QUALITY

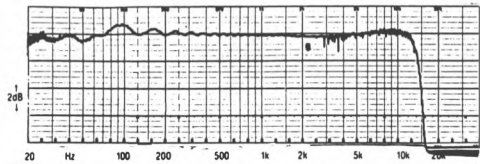
The Akai produced a surprising amount of LF rubbish, *ie* music-unrelated spuri — basically just rumbling noises, which stayed regardless of bias setting, tape type, record level or whether Eastenders was on at the time. There was no really obvious reason why this should have been the case, but it was noticeable that head contour effects reached a long way up into the midband, and peaked around 100Hz. These effects, arising from geometric considerations, have the practical appearance of filter ripples, and what was audible sounded just like filter ringing: a resonant effect, concentrated around one frequency area, but essentially devoid of pitch.

When music of any volume was being recorded, the bass noises were inaudible, but the problem continued as a bloated quality in the region, with a lack of precision and transient attack. This was a pity since the Akai sounded positively wonderful in all other aspects. The midband and top were not unduly upset by the slightly odd LF behaviour, and in fact lent music a sense of luminosity and transparency, of clarity and separation that was well ahead of the normal standard for this price level.

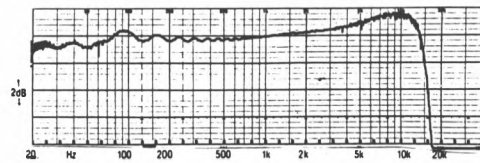
Best results were had with metal Type IV tapes. Dolby B noise reduction offered better midband transparency but a more metallic sounding top than Dolby C, but the difference was not huge. The Dolby-less sound quality was simply too hiss-bound for proper appraisal with most types of music, though where possible it won by sounding much 'faster' with more con-



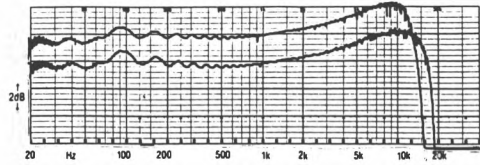
Playback only frequency response (pre-recorded tapes)



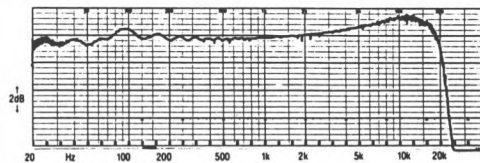
Overall record/replay response. Type I (ferric) tape



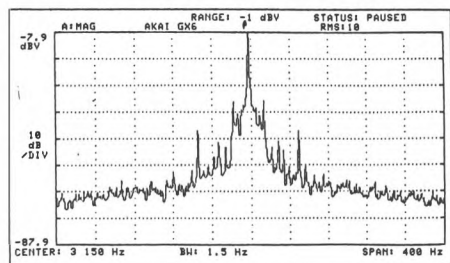
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

sistent stereo.

The lower bias tapes had more 'body' than metal, but an imprecise top end by comparison — Type I ferrics especially. Again though the difference wasn't huge, and the deck did well. Pre-recorded cassettes reproduced almost as well, with plenty of floor-to-ceiling detail and a reasonable degree of refinement (as much as you usually get out of commercially duplicated recordings) — incidentally with a slightly reduced level of the bass problem described above.

CONCLUSIONS

When using the GX-6, there is a strong sense that it is no mere range filler, that someone had really thought this one through, and cared about how it came out. The reality is that it lives up to that indefinable specialness. Had the LF end been properly sorted out, the GX-6 would

probably have merited Best Buy status, despite its highish price.

TEST RESULTS

Rec/replay response — 3db ref 1kHz	
IEC Type I	<20Hz-14.5kHz
IEC Type II	<20Hz-16kHz
IEC Type IV	<20Hz-22kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.065%/0.11%
Speed error	-0.6%
Type I signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	0.65%
Type II signal/noise CCIR/ARM 315Hz	51.5dB
distortion 0dB	0.95%
Type IV signal/noise CCIR/ARM 315Hz	54dB
distortion 0dB	1.3%
Channel separation 0VU/1kHz	44.5dB
Line input sensitivity/overload	107mV/7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	606mV/4.22V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	0.41%
Azimuth check R-L phase at 8kHz	50 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	44×11.1×35.3cms
Typical Retail Price	£350

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Perhaps wisely, the *DR-M07* is as close as Denon come to selling a beer budget cassette deck. It is just the kind of product that will appeal to an audiophile of limited means; it's cheap, has the bare minimum of frills, and decent under-the-skin engineering.

In fact using the Denon is by no means a hair shirt experience, since it does at least have fine bias adjustment, which works on all bar metal (type IV) tapes in the time honoured way. The other facilities consist of input level and balance pots, a headphone socket (fixed level), 3-position rotary tape type and Dolby selectors (B/off/C), and a simple mechanical tape counter.

The only feedback provided the user are power on indicators (the bottom 'minus infinity' LED on the record level meters (!)), and a record mode telltale. The logic controlled transport keys work smoothly and the *DR-M07* conveys an unmistakeable impression of quality. The only slightly tacky touch is the record level meter, which is both plain ugly and has a very limited range (16dB) and coarse resolution (3dB at best).

LAB REPORT

A substantial measured azimuth misalignment led to an early rolloff at high frequencies on pre-recorded tapes — the -3dB point occurs around 6.5kHz. The record/replay responses on the

other hand look a good deal healthier. The fine bias control can take care of the ferric response rolloff, but you are left with what you see in the case of metal, and the only course of action is to choose a metal tape with a duller sound than the IEC type used for these tests — see tape section.

The wow and flutter numbers are impressively low for what after all is a budget price deck, but this is one instance where the real situation isn't revealed by the one figure alone. The flutter spectrum analysis (not shown) is unimpressive due to the quantity and number of wow components and higher frequency noise, at around -42dB between 40Hz — 50Hz. The noise spectrum is also unimpressive.

Unusually, 0VU on the meters also corresponds to IEC 0dB, and harmonic distortion levels are off the scale of the measuring equipment (>3.3%) at this point, so casting the good signal/noise figures in a less favourable light of course. The practical advice is never to let peaks stray into the red. Note also the high level of intermodulation distortion, which means that metal tapes may not be fully exploited.

SOUND QUALITY

Quite frequently, a high fidelity component manages to transcend its measured performance. This is just such a case. Pre-recorded material

works really well, with fine subtlety and an accurately reproduced soundstage — the space and the limits around that space being explicitly reproduced from suitable recordings. Replay speed stability was a strong point too, again despite the numbers. The only real criticism in relation to price was an occasional 'edgy', 'wispy' treble quality.

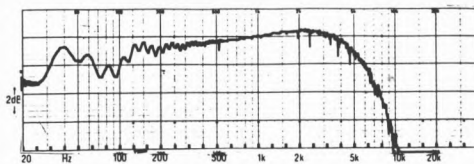
Special attention was paid to source material likely to show up any transport problems, but the Denon consistently scored better than expected here. The only really obvious shortcomings occurred elsewhere — for example, in the loss of transparency the two noise reduction systems brought in their wake, and in significant noise 'pumping' when using Dolby C (which can often be heard clearly with headphones, but much less easily with loudspeakers). Overall, the Denon lacked a degree of incisiveness and 'hear-through' clarity, and on these grounds was best suited by metal Tape IV, followed closely by chrome bias Type II tapes.

CONCLUSIONS

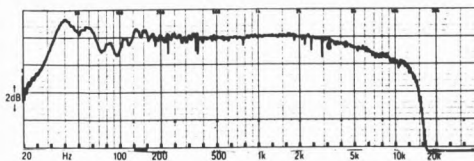
It's not always easy to find out why things work well or badly, but in this case the audio electronics themselves sound decidedly better than usual. There were a number of objective shortcomings ranging from cheapskate metering to a certain amount of transport 'wobbles' — on paper at least. In practice the 'M07 simply sounded marvellous, with good stereo, abundant detail and a welcome lack of artificiality. Obvious Best Buy material.

TEST RESULTS

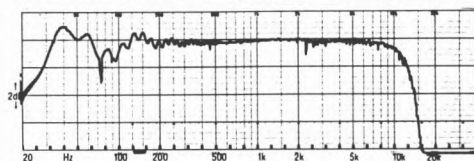
Rec/replay response — 3dB ref 1kHz	
IEC Type I	25Hz-14kHz:
IEC Type II	25Hz-13.5kHz:
IEC Type IV	25Hz-16.5kHz:
Wow & Flutter — Peak DIN wrd/unweighted	0.09%/0.25%
Speed error	+0.2%
Type I signal/noise CCIR/ARM 315Hz:	54dB
distortion 0dB	>3.3%
Type II signal/noise CCIR/ARM 315Hz:	55.5dB
distortion 0dB	>3.3%
Type IV signal/noise CCIR/ARM 315Hz:	57dB
distortion 0dB	>3.3%
Channel separation OVU/1kHz:	43.5dB
Line input sensitivity/overload	110mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	575mV/4.27V
IM distortion 10kHz/1kHz: 0dB peak, 1kHz: product	5.43%
Azimuth check R-L phase at 8kHz:	28 degrees
VU indication at IEC 0dB	0dB
Dimensions (w × h × d)	43.4 × 11 × 23.6cm
Typical Retail Price	£140



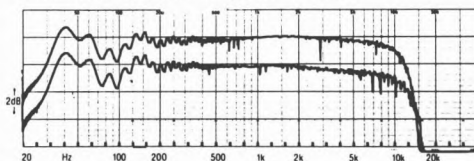
Playback only frequency response (pre-recorded tapes)



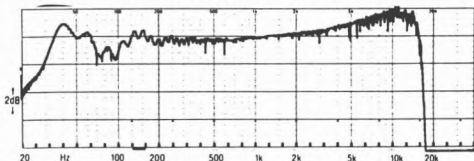
Overall record/replay response. Type I (ferric) tape



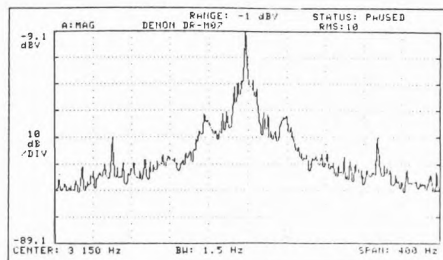
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

COMMENDED

DENON DR-M10

HAYDEN LABORATORIES LTD, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST PETER, BUCKS.
TEL: (0753) 888447



The Denon DR-M10 is a comparative rarity amongst decks around £200. It incorporates only a level of facilities typical of much cheaper machines, the idea being that most of the resources are devoted to ensuring good sound quality instead.

Centrepiece of the deck is a logic controlled, Denon-made transport operating *via* cams instead of the usual solenoids. The obvious advantage is that different drive modes engage with quietness and decorum.

The only vaguely unusual transport modes are track search and automatic record mute which also acts as a record/pause. According to the manufacturer's propaganda it acts as a normal pause control during playback too: it doesn't. The usual three tape types are accepted with automatic switching of bias and equalisation, confirmed by telltales on the front panel. There is a fine bias adjustment pot which works with Type I and II tapes only, and noise reduction is as usual performed by Dolby B and C. Headphones can be connected but not microphones, and the front panel is completed by a simple mechanical tape position counter.

Oh — nearly forgot. There's an output level control wired not only into the headphone feed, but also into the main output. The main output should have been left clean, a minor act of audio

vandalism that loses Denon one brownie point. The clever bits that *earn* brownie points include three motors (capstan, reel and servos, the reel motor being a low cogging type intended to smooth tape tension over the heads), an elaborate power supply section, and DC coupled amplifier stages throughout.

LAB REPORT

There's nothing wrong with the frequency responses, which look like exemplary text-book stuff. There is a slight tilt towards the treble with Type IV tape, but it doesn't amount to much, and the Dolby circuits are well aligned. With pre-recorded tapes there's just a suggestion of an upwards tilt too, but it's a good response shape on the whole, and azimuth error was quite modest.

The wow and flutter figures are less inspiring, but once again it takes spectral analysis to bring the whole picture into perspective, in this case showing more random noise than discrete periodic frequency wow or flutter. There is a component at 6Hz, -33dB, but for much of the range covered the noise floor remains below -40dB.

The noise spectrogram speaks of good pitch stability but some noise modulation at around -27dB from 20Hz out. The 0VU signal/noise figures are quite good, but Type IV metal distortion levels are quite high.

SOUND QUALITY

The DR-M10 upholds the growing reputation of the breed and largely fulfils the promise held out by the sober and well aimed physical design. Even so, the listening notes catalogue a degree of 'heaviness' when reproducing subtle instrumental passages, an inability to 'hear through' the tape, and a slightly 'wavery' quality, more a loss of ultimate pitch precision than any really definable variation in pitch.

For the most part, the DR-M10 is an enjoyable and capable recorder with a wide working dynamic range, a real sense of consistency with level, and good stereo imagery. However, the deck tends to sit hard on the dynamics and cutting qualities of really hard hitting transient material recorded at high levels. The brightness at the top when using Type IV metal tape was innocuous in practice, largely due to satisfactory HF sound quality. Pre-recorded tapes sounded neutral but slightly 'dirty', despite the slightly tilted response.

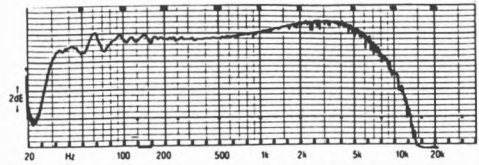
CONCLUSIONS

With one of the simplest and most purposeful sets of controls on the market, the DR-M10 is one of the best decks in its area of the market, representing a very worthwhile step up from budget recorders. Had the electronics been slightly more transparent it would have rated Best Buy, and is nevertheless a near miss.

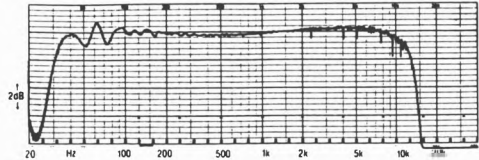
TEST RESULTS

Rec/replay response - 3db ref 1kHz

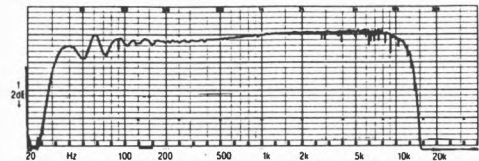
IEC Type I	29Hz-14kHz
IEC Type II	29Hz-14kHz
IEC Type IV	29Hz-17kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.18%/0.46%
Speed error	-0.1%
Type I signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	0.75%
Type II signal/noise CCIR/ARM 315Hz	52dB
distortion 0dB	0.85%
Type IV signal/noise CCIR/ARM 315Hz	52.5dB
distortion 0dB	1.6%
Channel separation 0VU/1kHz	-45.5dB
Line input sensitivity/overload	130mV/>7V
Mic input sensitivity/overload	n/a
Line output for CdB/maximum	848V/3V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	9.3%
Azimuth check R-L phase at 8kHz	12 degrees
VU indication at IEC 0dB	+3dB
Dimensions (w x h x d)	43.4 x 11.5 x 28.6cms
Typical Retail Price	£180



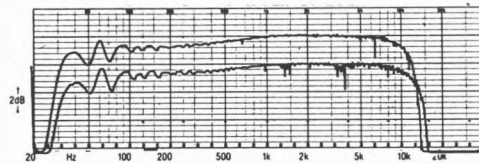
Playback only frequency response (pre-recorded tapes)



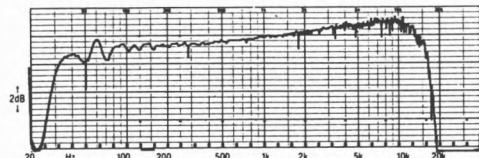
Overall record/replay response. Type I (ferric) tape



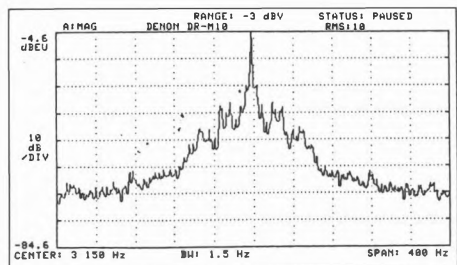
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

DENON DR-M12HX

HAYDEN LABORATORIES LTD, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST PETER, BUCKS.

TEL: (0753) 888447



The DR-M12HX is in many ways a de luxe version of the DR-M10. Though slightly more sophisticated in hardware terms, it follows the same general pattern in emphasising under-the-skin engineering rather than features. There's an alternative DR-M14HX version too, which includes a full infra-red remote control and costs £230.

Facilities are straightforward. Noise reduction is the usual Dolby B and C mix, with separate MPX switching. The transport includes track search and automatic record mute using a control button that obligingly doubles as a record/pause key. Tape type selection is automatic, and record levels are set using impressive fluorescent meters with good range and resolution. The tape counter is electronic and has a memory stop button. Finally, an output level control is wired into both the headphone socket, and also the main amplifier output.

The transport is quite elaborate in design. Power is supplied by no less than three motors, one for the capstan, another for the reel hubs, and the third to operate the cams which replace solenoids in actuating the various transport modes.

Internal features include Dolby HX Pro, which reduces the HF compression that afflicts recordings made on low bias tapes in particular,

a new head profile that extends and smooths bass response, and some quite sophisticated amplifier technology.

LAB REPORT

The broad picture is that the Denon does offer low absolute levels of wow and flutter, as you can see from the numbers. But the noise shoulders are fairly prominent on the spectrum analysis, and some wow components are apparent. The fluttergram shows broad flutter noise at 25-30Hz, and several wow components around the -30dB level in the region 4-10Hz. All distortion products are low too, including intermodulation distortion which other Denons didn't cope with as well. The reason for this last observation, it transpires, is that this deck has a new record/replay amp.

Azimuth is quite accurately set, and the playback only frequency response is fairly accurate, allowing for a small amount of engineered-in brightness. The Type I and II record/replay results shelve up by about a dB above 500Hz-1kHz, but this in itself is not disastrous and Dolby processing does nothing to make matters worse. All bets are off with metal tape, however, whose output rises slowly but considerably with increasing frequency. Naughty, especially as this is the one tape type whose record bias is fixed.

SOUND QUALITY

The combination of Dolby *HX Pro* circuitry with the new record amps that have extra headroom conspire to give this deck a wide working dynamic range, and a more transparent, less obvious kind of sound than usual, especially when the mid to high frequency extremes are stressed.

The net result is that the *DR-M12HX* sounds less like a cassette deck than usual. There is an appealing incisiveness about the sound which can successfully suggest real power combined with a genuine cutting edge, though it can sound rather thin and dry and lacking in ambience. Commercial tapes played on the Denon reproduced broadly along these lines, though even with the best tapes available, the quality of sound was clearly inferior to a good home recording.

Good as it is, it's only fair to note that the review deck suffered from a lack of true pitch constancy, which robbed the music of some of its believability. Sometimes the music could be heard to flutter audibly, and at others it sounded slightly edgy. There was a curious fault too: the channels had been switched internally. It's nice to know that even robots are human!

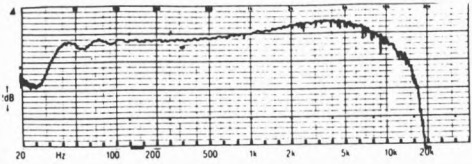
CONCLUSIONS

The *DR-M12HX* is well constructed and unusually pleasant to use. It very nearly sounds superb too; a bit of work on the transport might make that promise a reality.

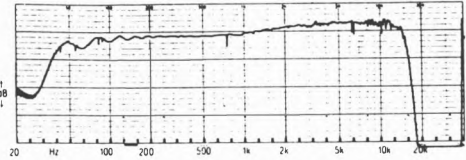
TEST RESULTS

Rec/replay response -3dB ref 1kHz

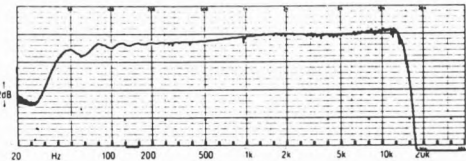
IEC Type I	33Hz-17kHz
IEC Type II	34Hz-16kHz
IEC Type IV	34Hz-20kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.10%/0.23%
Speed error	-0.4%
Type I signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.9%
Type II signal/noise CCIR/ARM 315Hz	51.5dB
distortion 0dB	0.9%
Type IV signal/noise CCIR/ARM 315Hz	53dB
distortion 0dB	1.3%
Channel separation 0VU/1kHz	-47.5dB
Line input sensitivity/overload	80mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	0.32mV/3.8V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	0.58%
Azimuth check R-L phase at 8kHz	8 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	43.4×11.5×28.6cms
Typical Retail Price	£210



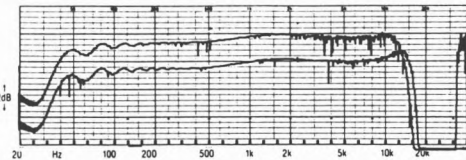
Playback only frequency response (pre-recorded tapes)



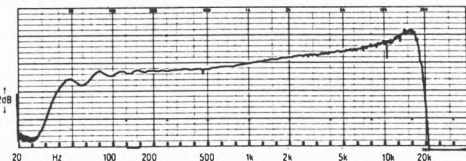
Overall record/replay response. Type I (ferric) tape



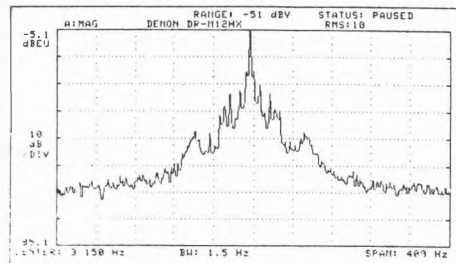
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



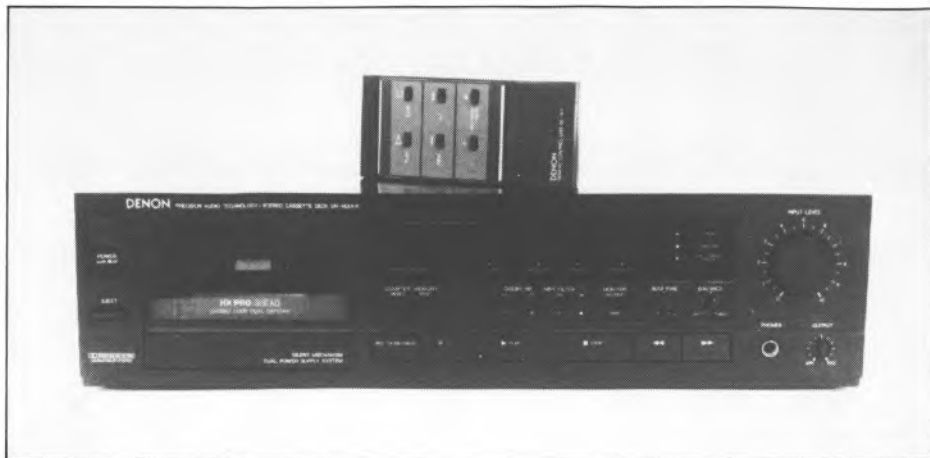
Noise modulation spectrum analysis

RECOMMENDED

DENON DR-M30HX

HAYDEN LABORATORIES LTD, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST PETER, BUCKS.

TEL: (0753) 888447



The £300 DR-M30HX is quite an ambitious product, and the most important selling features are that popular double act — three heads with off-tape monitoring, and a closed-loop, twin-capstan transport. It also joins the very select handful of recorders with infra-red remote control and a further important inclusion is Dolby HX Pro.

In practice the Denon's modus operandi is almost intuitively obvious. About the only criticism is the awkward switching for Dolby B and C. Like some of the other Denon models, the DR-M30 uses near-silent cams to engage transport functions instead of solenoids. The controls themselves stretch out in a long line instructing a logic chip which addresses the transport in a way that avoids strain on the tape.

The other controls are kept to a minimum. Apart from Dolby switching, with an independent MPX filter option, record bias can be adjusted within fine limits, while tape type selection is otherwise automatic. Then you're down to minor points like the headphone socket, the output volume control, a record mute facility and an electronic memory counter. The meters have a 28dB operating range.

The DR-M30HX also comes with a simple infra-red remote control, which addresses all the normal transport modes, plus 'record'.

LAB REPORT

The basic 0.08% wow & flutter figure is more than presentable, but careful analysis uncovered a prominent shoulder in the noise modulation plot at -35dB which stretches from +/- 30Hz to +/- 60Hz. Similarly, rising high frequency 'scrape' noise is evident in the fluttergram.

With the bias control centred, the Type I ferric IEC tape response looked slightly overcooked, though it can be corrected easily by slightly reducing the level of bias. The Type II response was spot on, but Type IV metal was underbiased, leading to a broadband rise peaking at +2.2dB around 16kHz. This is a pity since the electronics are abundantly capable of driving metal tape very hard indeed, yet the response rise is going to make them sound incorrectly set up.

The replay response is curtailed in bandwidth, but flat though the midband. The noise figures turned out to be satisfactory.

SOUND QUALITY

Apart from a suggestion of upper midband congestion — a combination loss of detail and smoothness at the high frequency end of the spectrum — the Denon replays commercially recorded tape with real finesse. This favourable impression was reinforced when making its own recordings, where the prerecorded standard

was easily exceeded.

When used in a system that was really 'on song', the '30HX retained an unmistakable sense of the life and vitality of the original — the subtle qualities that tape normally struggles to capture before ignominiously failing. The Denon didn't take altogether too kindly to very dense, loudly recorded passages: these sounded distinctly congested notwithstanding the good test bench behaviour. This even applied with metal tape, but the fact that the Denon covered a slightly narrower dynamic window really well will be adequate recompense to those who use tape for recording music and not test tones.

In summary then, the deck was highly successful. But it never really sounded right with metal Type IV tape, which had a 'blarey' quality, an almost 'metallic' upper midband and lower treble.

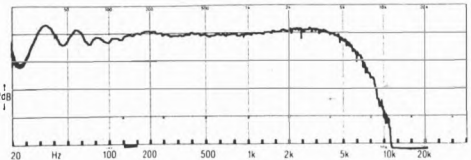
CONCLUSIONS

Though lacking the last ounce of top end life that can come with metal tape on a sympathetically designed deck, the Denon DR-M30 has a range of features that will suit most enthusiasts well, and the way they have been dispersed around the front panel will please their grannies almost as much. Sound quality with Type II tape in particular was surprisingly honest to the source. Recommended.

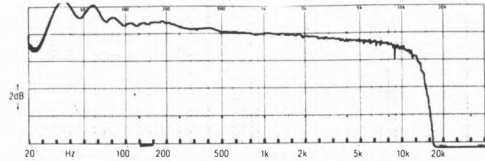
TEST RESULTS

Rec/replay response — 3dB ref 1kHz

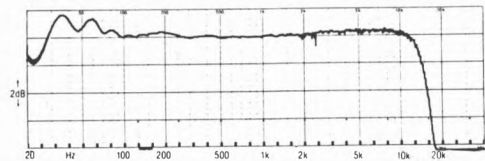
IEC Type I	<20Hz-14kHz
IEC Type II	<20Hz-15kHz
IEC Type IV	<20Hz-21kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.08%/0.10%
Speed error	-0.2%
Type I signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	0.85%
Type II signal/noise CCIR/ARM 315Hz	52dB
distortion 0dB	0.85%
Type IV signal/noise CCIR/ARM 315Hz	53.5dB
distortion 0dB	1.3%
Channel separation 0VU/1kHz	-44dB
Line input sensitivity/overload	120mV/V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	830mV/2.8V
IM distortion 10kHz/11kHz: 0dB peak, 1kHz product	0.09%
Azimuth check R-L phase at 8kHz	3 degrees
VU indication at IEC 0dB	+1dB
Dimensions (w×h×d)	43.4×11.5×28.6cm
Typical Retail Price	£319



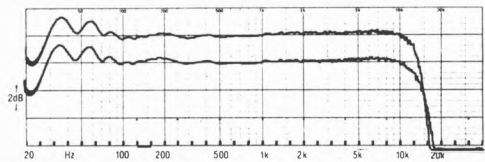
Playback only frequency response (pre-recorded tapes)



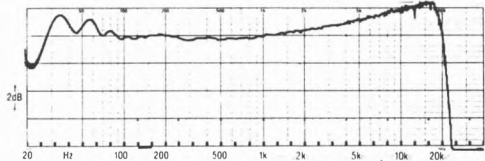
Overall record/replay response. Type I (ferric) tape



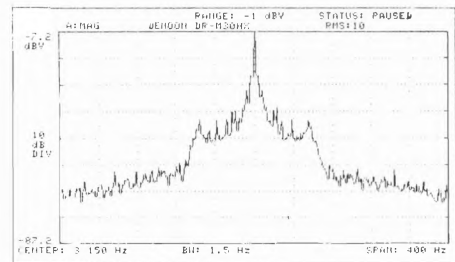
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

DENON DR-M44HX

HAYDEN LABORATORIES LTD, HAYDEN HOUSE, CHILTERN HILL, CHALFONT ST PETER, BUCKS.
TEL: (0753) 888447



Denon's flagship *DR-M44HX* is a three-head (which means off-tape monitoring whilst recording), dual capstan cassette deck with an extremely effective automatic tape set-up system (as distinct from auto tape type recognition, which is also fitted). In addition, Dolby *HX Pro* reduces HF compression and makes the recording process more linear at high levels, especially with low bias tapes.

In common with other recent Denon models, the *DR-M44HX* uses a new cam-operated transport, so tape handling is unusually gentle from the moment a cassette is placed in the back-lit well. This deck is never impolite enough to click and jerk in the way solenoid controlled decks are wont to do as they shift from mode to mode. The transport is made by Denon themselves, who are one of very few who don't buy their transports from an OEM supplier.

The 44 is also blessed with a very full and complex status display. This includes an excellent set of record level meters (28dB range, good resolution, two colours, peak hold LEDs), and an electronic tape counter reading in minutes and seconds, complete with matching memory stop feature. The display area also serves to show the current transport status, tape/source monitoring status, the information concerned with the auto tape tuning system and much more.

Noise reduction is courtesy of the ubiquitous Dolby B and C, with separate MPX filtering. The output level of both headphones and main preamp level output can be adjusted with an output pot: the same criticism applies here as elsewhere; for sonic reasons the level control should not be wired into the critical amplifier feed (sound effect of slapping wrist). A remote control can be added, using an outboard receiver. Even as it stands though, control layout is immaculate, and the deck is a pleasure to use.

LAB REPORT

The *DR-M44HX* has an excellent transport, arguably the single greatest attribute of any cassette deck. The 0.04% weighted wow and flutter figure is low enough in its own right of course, but it's backed up by a flutter spectrogram which shows negligible wow, and other effects well distributed.

The feature that most clearly approximates to a flutter component is at 23Hz, but even this peaks at only -40dB. The pitch centre in the noise modulation graph is also extremely sharp and narrow, which suggests that pitch resolution will be excellent. Modulation noise is low throughout.

The amplitude responses are equally well optimised. The bass end is very well engineered, and deviations from the straight and narrow

amount to no more than can be contained in a 1.5dB envelope (at least when the auto tuning system has been used first, and regardless of the brand and type of tape used). There was no discernible Dolby mistracking.

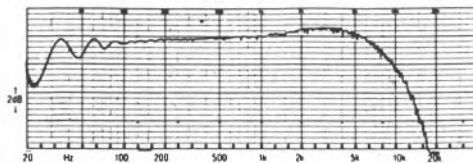
By rights, however, prerecorded tapes should sound a little dull. There's a fairly substantial azimuth error (67 degrees at 8kHz) which should not be present on a deck of the Denon's pretensions. The only other small fly in the ointment is the high level of intermodulation products, which suggests that the record circuit may be running out of headroom at this point, even though the less sensitive harmonic distortion numbers give no confirmation.

SOUND QUALITY

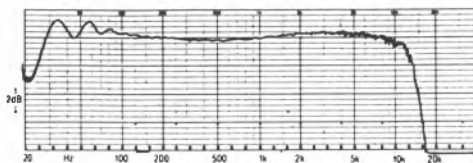
From the first bar of the first recording, it was obvious that here was a deck with real class and an uncommon repertoire of skills. The DR-M44HX has a number of priceless (all right, expensive) facilities. One of these is Dolby HX Professional, which beefs up ferric (Type I) performance standards by reducing compression and improving consistency, especially at high levels. The upshot of this is that a good ferric tape can show most of the capabilities of a good Type II tape, especially in the realm of mid and HF dynamics.

The other is much more important: guaranteed rock steady pitch plus considerable resolution (I believe there is a causal relationship between the two), and without any sense of grain. Best of all, the sound is simply but unmistakably of very high musical quality. This Denon may be used in a truly capable, high resolution 'audiophile' system without betraying itself too obviously as a mere cassette deck, which is no mean accolade given current cassette deck standards!

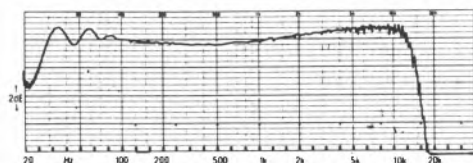
The intermodulation result is reflected in the headroom: high energy HF-rich material tended to splatter and image vaguely around the soundstage with metal tapes in use. Nevertheless, and despite Dolby HX Pro, this deck is a natural for exploiting metal tape. Not because of any half-baked notions of extra HF headroom, but because metal is particularly effective at capturing the subtleties and expressive range of midband information when using a good quality source.



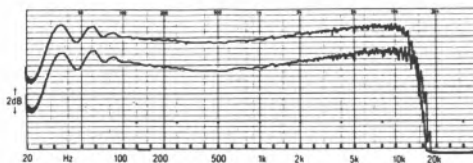
Playback only frequency response (pre-recorded tapes)



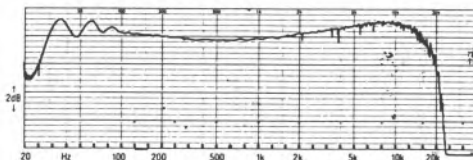
Overall record/replay response, Type I (ferric) tape



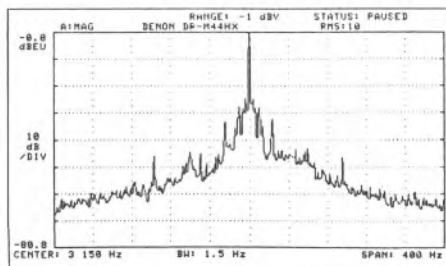
Overall record/replay response, Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response, Type IV (metal) tape



Noise modulation spectrum analysis

Only pre-recorded material disappointed slightly. The quality of music making here was more abrupt, less articulate, and less convincing dynamically. There was also more extreme HF hiss than normal with Dolby B engaged. Dolby B performed quite satisfactorily when recording and playing back, but as usual Dolby C processing messed things up and defocused the sound to a degree.

CONCLUSIONS

The DR-M44HX has certain objective limitations, mostly minor, but is true to the spirit of the music it reproduces, especially with Type IV (metal) tape. A first class transport is the key, but the good range of features, notably auto-tape tuning, does nothing to hinder. Highly recommended.

TEST RESULTS

Rec/replay response - 3db ref 1kHz	
IEC Type I	23Hz-14kHz*
IEC Type II	24Hz-15kHz
IEC Type IV	23Hz-21kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.04%/0.11%
Speed error	-0.4%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.65%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.75%
Type IV signal/noise CCIR/ARM 315Hz	51.5dB
distortion 0dB	0.85%
Channel separation 0VU/1kHz	-45dB
Line input sensitivity/overload	89mV/>7V
Mic input sensitivity/overload	n/A
Line output for 0dB/maximum	826mV/3.4V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	10%
Azimuth check R-L phase at 8kHz	67 degrees
VU indication at IEC 0dB	+1dB
Dimensions (w x h x d)	43.4 x 11.5 x 28.6cms
Typical Retail Price	£399

*after auto-tuning

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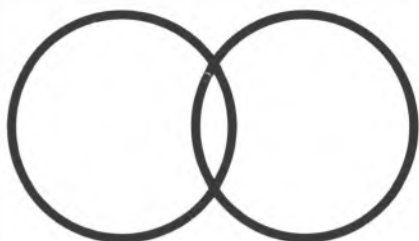
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HARMAN KARDON TD202BL

HARMAN (AUDIO) UK LTD, MILL STREET, SLOUGH, BERKS SL2 5DD.

TEL: (0753) 76911



The designer of the straightforward, no-nonsense, solidly built £249 TD202 obviously wasn't given to frippery. He probably wasn't even a headphone user, which some recordists use extensively, but then he doesn't seem to have been into microphones a whole bunch either. The only connections to the outside world are one set of phono in and outputs and of course the mains lead.

This rather meagre provision seems to have set the pattern for the rest of the machine. What you get is a well designed set of controls to select Dolby B and C, with or without the obligatory MPX filter (obligatory, it seems, because Dolby Labs demand it). You also get an equally well designed set of controls to select the tape type, but at this price such setting should have been automatic. Other facilities are limited to a mechanical non-memory counter, fine bias adjustment, and manual record mute. The short 7-step record level meters have a 26dB dynamic range, which again is a bit mean for a deck you can only buy four of for under £1000.

The transport controls are solenoid actuated, and boast extremely high noise levels on engagement.

LAB REPORT

Each of the tapes tried for the three bias settings

on this recorder gave the dished response shapes shown. The lifted top and bottom end is in effect a 'loudness' contour, which can give the music more 'tangibility' at low levels. Unfortunately it is not accurate.

The HF effect was not excessive in the case of Type IV tapes, or for that matter when playing back pre-recorded material. Type I and II tapes on the other hand recorded over 2dB of top end lift with a 12 o'clock setting of the bias knob, despite using a test signal level 10dB higher than usual (-10dB ref 0VU). Note how Dolby preserves the basic response shapes (which of course it should), whilst mildly reducing the amplitude of the HF peak (which it shouldn't). However, the saving grace is the fine bias adjust feature, which at least allows the HF end to be flattened effectively.

Mechanical behaviour is good. The noise modulation plot indicates a well defined pitch centre (no 'wander'), with noise at an average -45dB at +/- 50Hz, which is fine. The flutter response backs this picture with promisingly low levels of wow and flutter, even though the spectrum is quite complex. Azimuth is close to accurate, and HF saturation levels with metal tape are high. The other numbers are straight down the middle.

SOUND QUALITY

Pre-recorded tapes lacked a little 'air' and sounded both rich and bland. The musical effect was muted and compressed, though it was far from unpleasant in its own distinctive way.

Making its own recordings, the TD202 did well on the whole, but still displayed a degree of richness and a lack of real pace and control in the extreme bass. The most objectionable sounds, however, were those contributed by the Dolby C system, which sapped energy and clarity from the music as though someone had just turned the tap on and run it out. Curiously, Dolby B did considerably less musical damage, and on balance, this is the preferred way of using the deck. Recording at a high enough level to get the non-Dolby tape hiss down to an acceptable level tends to result in audible tape 'squash'.

Metal Type IV tapes had a qualitative edge over the others as usual, but not a massive one. In practice a good Type II tape delivers something like 95% of the deck's potential, though with a mild tendency to blur the music. Ferric tapes could sound quite woolly. Speed stability on the other hand never gave cause for concern, and stereo image quality was good.

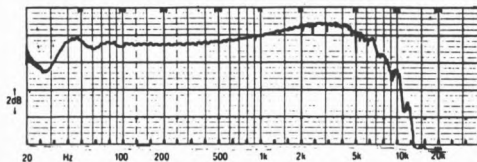
CONCLUSIONS

The TD202 is a competent middle-ranking performer, with good pitch stability and a purposeful appearance. Negative points include some lack of sonic incisiveness, with pre-recorded material especially. On balance, the price is just a little steep.

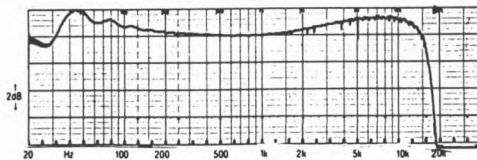
TEST RESULTS

Rec/replay response - 3db ref 1kHz

IEC Type I	<20Hz-17kHz
IEC Type II	<20Hz-17kHz
IEC Type IV	<20Hz-16kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.09%/0.29%
Speed error	+0.2%
Type I signal/noise CCIR/ARM 315Hz	50.5dB
distortion 0dB	1.5%
Type II signal/noise CCIR/ARM 315Hz	52dB
distortion 0dB	2.0%
Type IV signal/noise CCIR/ARM 315Hz	54.5dB
distortion 0dB	1.5%
Channel separation 0VU/1kHz	-48dB
Line input sensitivity/overload	41.3mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	385mV/3.3V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	1.06%
Azimuth check R-L phase at 8kHz	14 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	44.3×12.2×26.4cms
Typical Retail Price	£249



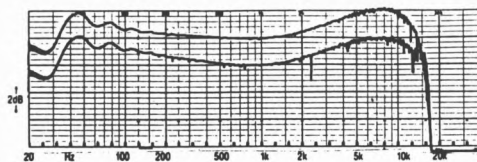
Playback only frequency response (pre-recorded tapes)



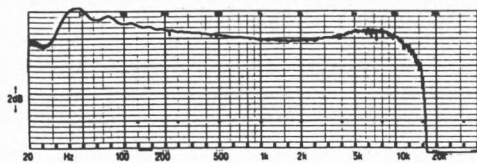
Overall record/replay response. Type I (ferric) tape



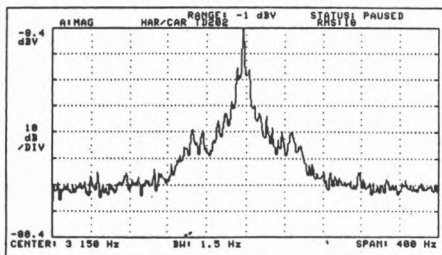
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

HARMAN KARDON CD491

HARMAN (AUDIO) UK LTD, MILL STREET, SLOUGH, BERKS SL2 5DD.

TEL: (0753) 76911



The antiquity of this design can be gauged by a model name which is hardly appropriate in the CD era. Old though it is, the Dolby HX Pro-equipped, 3-head, dual capstan CD491 remains the flagship of the range. I should add that if leadership potential is based on the number of bells and whistles, the CD491 will retain its present position well into the next century.

There is some attempt at grouping the controls by function. One such group clubs together the left and right input level controls, the stereo master fader (the most prominent control of the lot), mike input level and output voltage level, plus the record mute and autospace.

We could go on like this for the rest of the night, so briefly . . . The main control group covers tape type selection, Dolby B/C/MPX switching, and includes bias and sensitivity adjustment (for Dolby tracking) using built-in oscillators and the record level meters.

The record level meters have a 40dB range and best case 1dB resolution with optional peak hold and selectable weighting. Transport facilities include 'punch-in' recording, a counter memory and/or auto rewind (VCR style), plus track search in either direction. The transport changes modes like the well oiled machine it is, and the abiding impression is of a superbly

built deck that is designed to last. But it isn't granny proof, by any stretch of the imagination.

LAB REPORT

Allowing for just a hint of rise at extreme HF, the amplitude responses are very well engineered with all tape types, with or without Dolby — even Dolby C. The playback response is equally well optimised, although for reasons presently undetermined tape-to-head contact was 'iffy', and the pen of the chart recorder just couldn't keep still. Note also the substantial 8kHz azimuth error.

Wow and flutter levels measured superbly by any standards. The noise modulation spectrogram shows a razor sharp centreline, but there's some smearing from 20-50Hz either side, at about -40dB average. The noise floor of the 50Hz fluttergram averages -40dB, but there is some quite complex peakiness.

Noise and distortion levels referred to 0VU are satisfactory, though not exactly state of the art. The only problem that was noticed was that intermodulation levels rose steeply at high levels, and this will certainly prejudice the ability to take metal tapes to the outside of their performance envelopes before the recorder's electronics (or record head) start to protest.

SOUND QUALITY

The HK fared well on pre-recorded material. The frequency extremes were in correct proportion and clean, but there was some loss of body and the more structural qualities of the music. The deck sounded slightly (though not seriously) flat.

When assigned the task of recording as well as playing back, the 491 does particularly well, achieving a final ranking only one rung below the best and delivering an excellent sound with all three tape types.

This was partly the responsibility of the Dolby HX Pro circuitry which gives ferric tapes in particular a bit of a leg up. HX Pro cannot play any part in pre-recorded material of course (except where the system was used by the duplicator), which might account for the extra freedom from the dynamic smear and loss of top end resolution that prevails with commercially available tapes. The other factor responsible for the 491's good showing is the superb transport stability.

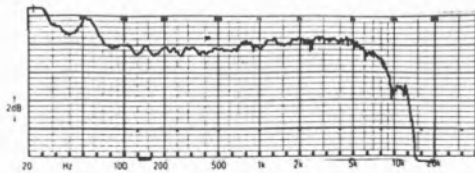
The only snags were that metal tapes clearly didn't offer quite their usual dynamic range, and that the Dolby circuitry put a bit of a damper on perceived quality.

CONCLUSIONS

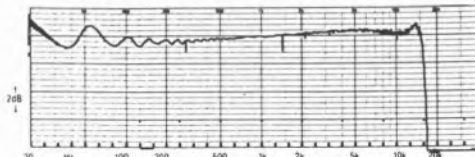
Two factors combine to assure this machine a special place. One is the excellent under-the-skin audio engineering. The other is the tremendous degree of flexibility that make this an audiophile cassette deck *par excellence*.

TEST RESULTS

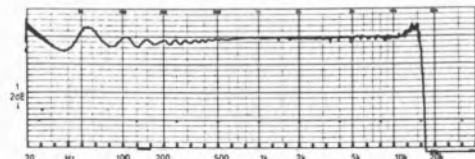
Rec/replay response - 3db ref 1kHz	
IEC Type I	<20Hz-16kHz
IEC Type II	<20Hz-16kHz
IEC Type IV	<20Hz-16kHz
Wow & Flutter - Peak DIN wrd/unweighted	0.048%/0.11%
Speed error	+0.3%
Type I signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	1.0%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0db	1.1%
Type IV signal/noise CCIR/ARM 315Hz	51dB
distortion 0db	1.1%
Channel separation 0VU/1kHz	-42dB
Line input sensitivity/overload	37mV/>7V
Mic input sensitivity/overload	0.258mV/28.4mV
Line output for 0db/maximum	182mV/2.3V
IM distortion 10kHz/11kHz: 0dB peak, 1kHz product	19.7%
Azimuth check R-L phase at 8kHz	42 degrees
VU indication at IEC 0db	+2dB
Dimensions (w x h x d)	44.3 x 12.2 x 34.3cms
Typical Retail Price	£599



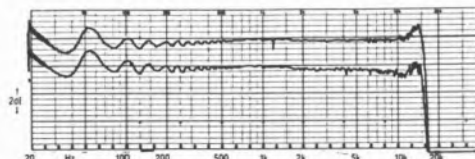
Playback only frequency response (pre-recorded tapes)



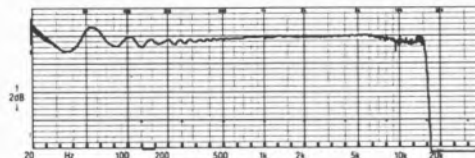
Overall record/replay response, Type I (ferric) tape



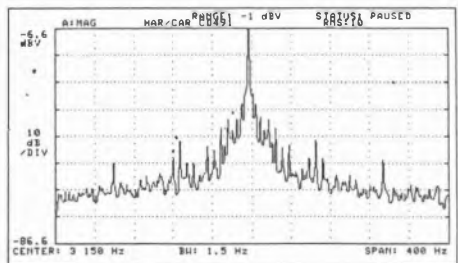
Overall record/replay response, Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response, Type IV (metal) tape



Noise modulation spectrum analysis

HITACHI D-007

HITACHI SALES (UK) LTD, HITACHI HOUSE, STATION ROAD, HAYES, MI DDX, UB3 4DR.

TEL: 01-848 8787



The Hitachi D00-7 is one of the relatively few twin 'dubbing' cassette decks aimed at the serious hi-fi end of the market, rather than at the traditional rack system patch that has proved so profitable for the breed to date.

Both transports offer a full auto-reverse capability, but as usual only one of them is capable of recording. Each has its own set of neatly laid out transport controls that address the works *via* a logic chip, and then on to a clickity-clack set of solenoids.

A mode switch selects unidirectional, auto-reverse at end of side, and full blown continuous auto-reverse, the latter of course for playback only. Dolby B and C perform the usual honours, and the deck is configured for dubbing at normal or 2X speed, and also for continuous sequential play, which plays one tape and then the other.

The D00-7 has a number of peripheral functions loosely based on the track search principle. They include intro scan and the facility to program up to 15 tracks in any order into a memory. The record level meters, set into the cassette compartment cover of the record/replay deck, have a restricted 16dB range over 5 steps and are far too bright. Build is lightweight, and styling is House of Tack, though making due allowances for the amount of hardware involved, ergonomics are pretty, er, sound.

LAB REPORT

The mechanics are surprisingly good, given the rather iffy performance standards of twin deck models generally. 0.9% DIN weighted wow & flutter is not to be sniffed at. Assessed using spectrum analysis, all flutter components were -40dB or better, which is good. In fact there are a fair number of peaks in the plot, but they're pretty well controlled. The noise modulation plot was equally encouraging, with some sidebands but generally low levels. The centre frequency looks stable, and the noise 'shoulders' narrow. The only fly in the ointment is that performance deteriorates significantly when using reverse drive.

The Hitachi is not capable of laying very high levels of HF onto metal tapes, as the intermodulation result makes clear. Harmonic distortion on the other hand is satisfactory when set against the signal/noise achievement. The deck doesn't have the top to bottom working dynamic range of the best single transport decks at the price, but it is reasonable nonetheless.

However, the frequency response shapes were mixed. The playback only response was excellent, but record/replay on each of the three tape types gave slightly erratic plots, though these were containable within broadly acceptable envelopes. However, low frequencies are very curtailed, and Dolby processing served to compress

the top end quite severely. The high speed dub plot (not shown) was plain embarrassing.

SOUND QUALITY

High speed dubs predictably sounded very compressed and messy — 'very' being the operative word. Lateral image locations tended to shift alarmingly according to the energy content of the two channels, and the whole effect was rather fairground ride-like: not exactly comfortable, certainly.

Sound quality in normal use with Dolby B or C switched in was also suspect. Even with metal tapes, the basic quality was soft and vague, with a woolly bass, a lack of transient impact, and image locations that tended to spread. Lower bias tapes fared worst, and even without Dolby the sound had something of the qualities outlined above. However, pre-recorded material sounded quite respectable under the circumstances.

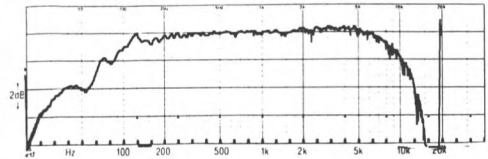
CONCLUSIONS

The D-007 is not an outstanding success. The well sorted controls and unexpectedly good transport were offset by a very murky underlying sound quality, which deteriorated further with Dolby noise reduction in use.

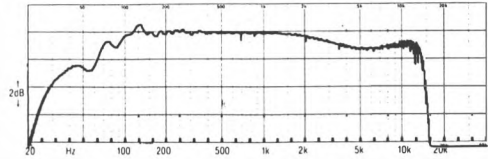
TEST RESULTS

Rec/replay response — 3db ref 1kHz

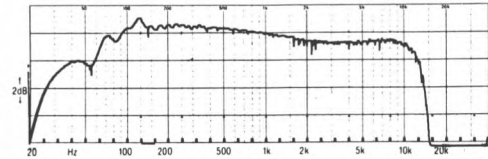
IEC Type I	34Hz-14.5kHz
IEC Type II	31Hz-13kHz
IEC Type IV	32Hz-16kHz
Wow & Flutter — Peak DIN wrd/unweighted:	Side 1: 0.09%/0.36%
	Side 2: 0.18/0.42%
Speed error	+0.8%
Type I signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	0.8%
Type II signal/noise CCIR/ARM 315Hz	53.5dB
distortion 0db	1.3%
Type IV signal/noise CCIR/ARM 315Hz	53dB
distortion 0db	1.2%
Channel separation 0VU/1kHz	46dB
Line input sensitivity/overload	92mV/V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	692mV/3.24V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	14.2%
Azimuth check R-L phase at 8kHz	20 degrees
VU indication at IEC 0db	+3dB
Dimensions (w×h×d)	370 (400*)×12.9×27.6cms
Typical Retail Price	£300



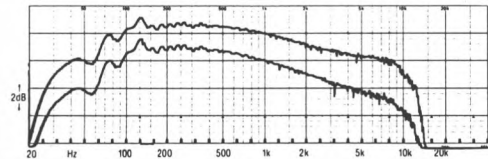
Playback only frequency response (pre-recorded tapes)



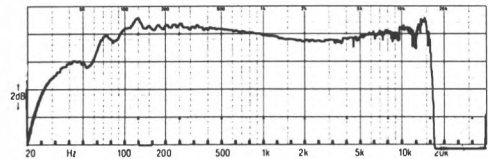
Overall record/replay response. Type I (ferric) tape



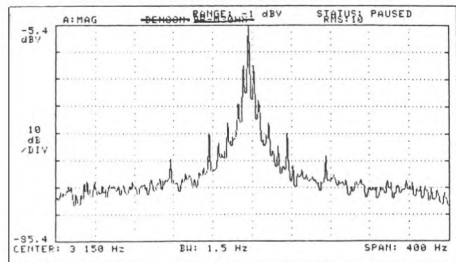
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

HITACHI D-707II

HITACHI SALES (UK) LTD, HITACHI HOUSE, STATION ROAD, HAYES, MIDDX, UB3 4DR.

TEL: 01-848 8787



One of Hitachi's more ambitious cassette decks, the *D-707II* is a full three-head dual-capstan model, with off-tape monitoring and a 'half way house' manual bias and sensitivity calibration system which is quite easy to use in practice. The 707 is also equipped with a near impenetrable range of other features, some quite difficult to use, mostly based around variations on the track search theme . . .

The first thing you notice is that the deck is surprisingly heavy. A massive transformer helps account for some of the weight, and so does an unusual transport with two large motors and heavy flywheels, plus a zinc diecast, rubber-filled thing Hitachi call a headbase, which is probably a base for the heads.

Some of the features are rather surprising. Quite why the deck couldn't include automatic tape type switching isn't clear — especially given the plethora of other automated features. It's even less clear why the Dolby B and C switching has to be done using permutations of just two incredibly fiddly little control buttons. On balance, the guy who did the human engineering for this deck ought to be sent back home to Ganymede.

Quality of manufacture is mildly suspect too. The front panel is designed to look as though

it has been made from one extrusion, with a horizontal channel giving some shape to the deck. It's quite stylish in it's own low key way, but the fascia doesn't line up visually, and laying a straight edge along the front confirms that it has been assembled a couple of millimetres out of true. Secondly, the display area provides quite a lot of information, even down to neat little touches like the spelt-out sign 'end' as the tape runs out. But the display elements themselves are of poor quality and harsh on the eye.

However, there's little wrong with the performance of the meters, which are two colour affairs with a 50dB range and 'peak hold' LEDs. Other neat features include a real time tape counter that measures time remaining. It's even possible to get the machine to seek out a blank section of tape, and go into record standby after laying down a four second gap, whilst the display reads out how much time remains on the tape. You don't even need to programme the tape length, though the system doesn't cope with C120s.

This last kind of ability is really the Hitachi's forte. It will perform any number of similar tricks, including old favourites like music search, intro-scan, and others more common with CD players like the 15-track programme memory.

Getting down to more mundane gadgetry, the output level control is wired into both the output amplifier and headphone feeds (the main

output should have been left unadulterated). A rear panel socket accommodates an optional remote control.

LAB REPORT

The *TD-707II* suffers a peculiar lack of output uniformity in the lower few octaves up to 2kHz, the actual shape repeating itself from one response run to the next which proves that we're not dealing with a random effect. This apart, the record/replay traces were generally satisfactory. However, the playback only response was not well extended into the treble, despite the measured zero azimuth error.

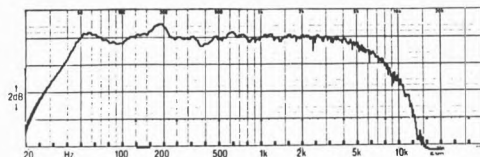
The rest of the story is that the *TD-707* is a low distortion deck which is perfectly capable of driving metal tape very hard indeed. The noise modulation spectrogram suggests good pitch resolution and little audible 'muck' to worry about over a wide bandwidth. Other tests uncovered a moderate level of wow below about 4Hz, which matches the shape of the DIN weighting curve — that is, it rises just as the DIN weighting starts downgrading its contribution to the result. Nevertheless, the performance achieved is satisfactory. The final weighted wow and flutter figure is an extremely fine 0.044%.

SOUND QUALITY

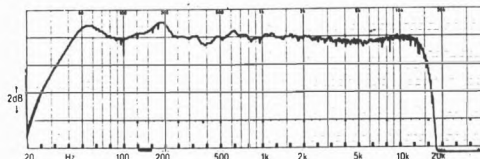
the *D-707II* was disappointing on audition, and the deck's amplifier circuits were partly responsible. They had a distinctive character of their own, an almost opulent richness, apparently due to an over-prominent upper bass with a balancing boost somewhere just short of the treble proper — almost like a loudness contour.

Subjectively the deck lost quite a lot of HF resolution, and this was not a subtle effect. The tape itself sounded 'off' even before starting to record proper music signals. Significant hum was injected onto tape at all settings of the input gain control, and the expected background hiss had a curiously heavy, dull quality.

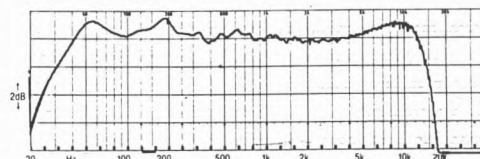
When dealing with music, the Hitachi tended to emphasise the more prominent detail, which became even more pointed as a result. At the same time there was a clear net loss of information, and the outcome, inevitably, was a crude presentation of music — at times amounting almost to caricature.



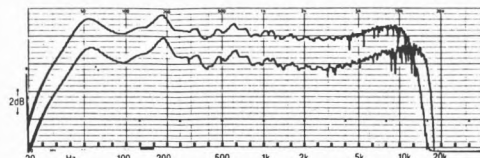
Playback only frequency response (pre-recorded tapes)



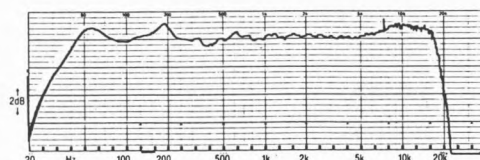
Overall record/replay response. Type I (ferric) tape



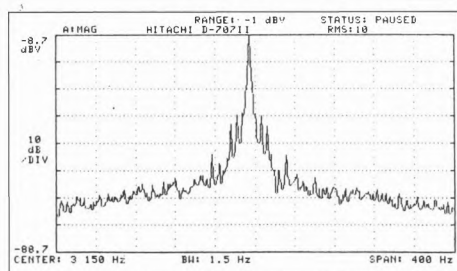
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

Metal tapes sounded less at home than lower bias tapes. Although the measured distortion levels were perfectly satisfactory, there were audible signs of strain. The deck was at its best with Type II tape stock and Dolby C noise reduction, the lack of hiss enabling the deck to sound smoother without additional loss of resolution.

Pre-recorded cassettes suffered a little from the measured loss of top, leading to a poorly differentiated, 'sat-upon' quality.

CONCLUSIONS

Sonically nondescript, the D-707 has some distinctive failings including ergonomics that beggar description, and an all-but hidden set of features spun off from the basic track search idea. The promising transport and many worthwhile features are insufficient to compensate for

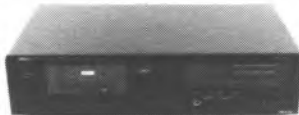
the highish price.

TEST RESULTS

Rec/replay response - 3db ref 1kHz	
IEC Type I	23Hz-16kHz
IEC Type II	27Hz-15kHz
IEC Type IV	28Hz-19kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.044%/0.95%
Speed error	+0.02%
Type I signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	1.6%
Type II signal/noise CCIR/ARM 315Hz	52.5dB
distortion 0dB	1.3%
Type IV signal/noise CCIR/ARM 315Hz	54.0dB
distortion 0dB	1.7%
Channel separation 0VU/1kHz	41.5dB
Line input sensitivity/overload	96.5mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	306mV/3V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.28%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0dB	+1dB
Dimensions (w x h x d)	43.5 x 11.5 x 27.9cms
Typical Retail Price	£350



DENON DR-M07



YAMAHA KX-200



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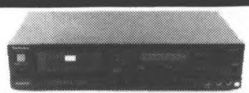
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JVC TD-X202

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TEL: 01-450 3282



The TD-X202 is a typical low-to-mid price 2-motor, 2-head cassette deck, with a fairly standard range of facilities. In some ways it's a little old-fashioned — the manual tape type setting switches being a good example. On the other hand, some old-fashioned attributes serve the JVC well: this is one of a rapidly shrinking number of cassette decks into which you can plug microphones.

The range of facilities and displays is utilitarian. Two three-position level switches select Dolby B and C, and the three main tape types. Input levels are set using a slider and the pair of meters has just 5 steps between -10 and $+6$ dB which really isn't sufficient, (the spec sheet says 6 LEDs per channel but one acts only as 'power on' indicator). Surprisingly, there is no way to alter the gain of one channel with respect to the other.

There are very few status indicators either, just power on, tape run (which blinks to show tape movement) and record mode. The transport controls are well disposed, smooth engaging and employ full logic interfacing. But fast wind is desperately slow: it took a full 2 mins 22 seconds to wind a C90 through from end to end. The JVC will automatically record a short blank passage (auto record mute). Finally, it can be linked to the auto source selection feature of

JVC systems fitted with Compulink socketry.

LAB REPORT

All record/replay frequency responses bar metal (Type IV) (which is an unacceptably bright $+2.2$ dB at 14kHz due to underbiasing), are flat within quite tight limits. The playback response is flat too through the midrange, before rolling off a little early in the treble.

IEC 0dB is set at $+3$ dB on the deck meters, and with this in mind the 0VU distortion figures look low, with the noise figures about average. Unfortunately, this slightly better than expected result is offset by the 2.5% 10/11kHz intermodulation measured at the same 0VU, which implies that the recording process is becoming non-linear at these levels. The noise modulation plot isn't bad, showing as it should a quite clearly defined centre frequency, but with clear flutter sidebands at ± 40 Hz.

The fluttergram shows complex wow components at -31 dB over the range 0-15Hz, which includes the most audible type of wow extending up to about 4Hz. (Above 4Hz or so wow tends to be heard as a 'roughening' of recorded textures.) Note also the total wow and flutter figure (0.12% wtd), which is distinctly high.

SOUND QUALITY

The 202 has strictly defined limits. It is not at

its best with metal tapes, which tend to sound a little edgy. It's not that wonderful with piano music either, which stresses the limits of pitch stability: the JVC produces audible wow under such circumstances, and a piano that sounds a bit like a Wurlitzer is disconcerting.

Very dense loud passages tend to opaqueness, while prerecorded tapes simply sounded flattened, with much of the distinctiveness and energy in the sound dissipated. A bit of extra setting up back at the mill would cure this of course.

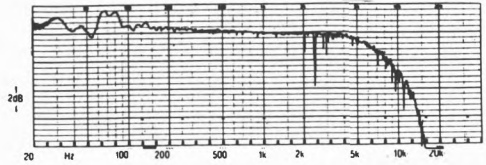
At other times, the deck made some quite pleasing recordings. It does have a fine, open midband and good stereo resolution, albeit with some all too typical (of the cassette deck world) bass end waffle. It was at its best with Type II tapes, TDK SA working extremely well, for example.

CONCLUSIONS

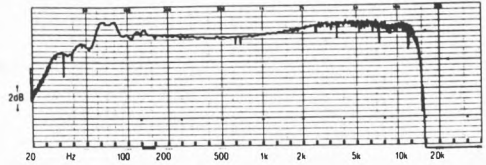
The restricted range of the meters, the necessity to set the tape type by hand, the fact that the record mute switch is adjacent to the record control and that the two look identical, the idiotic flashing tape run indicator — all these things combine to give the wrong message. The TD-X202 is well built, but poorly equipped in those features that help make life easy. And merely because it sounds OK sometimes isn't quite enough to make the TD-X202 into a recommendable proposition. It is overall a bit too much of a mixed bag.

TEST RESULTS

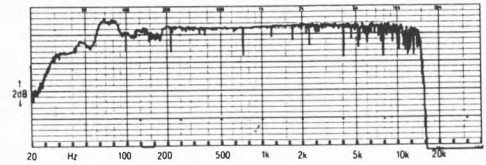
Rec/replay response — 3db ref 1kHz		
IEC Type I	_____	25Hz-15kHz
IEC Type II	_____	26Hz-15kHz
IEC Type IV	_____	25Hz-16kHz
Wow & Flutter — Peak DIN wtd/unweighted	_____	0.12%/0.26%
Speed error	_____	-0.2%
Type I signal/noise CCIR/ARM 315Hz	_____	50dB
distortion 0dB	_____	0.46%
Type II signal/noise CCIR/ARM 315Hz	_____	51dB
distortion 0dB	_____	0.42%
Type IV signal/noise CCIR/ARM 315Hz	_____	51dB
distortion 0dB	_____	0.55%
Channel separation 0VU/1kHz	_____	-46dB
Line input sensitivity/overload	_____	121mV/>7V
Mic input sensitivity/overload	_____	0.55mV/1.1mV
Line output for 0dB/maximum	_____	485mV/1.9V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	_____	2.5%
Azimuth check R-L phase at 8kHz	_____	18 degrees
VU indication at IEC 0dB	_____	+ 3dB
Dimensions (w×h×d)	_____	43.5×10.9×22.8cms
Typical Retail Price	_____	£130



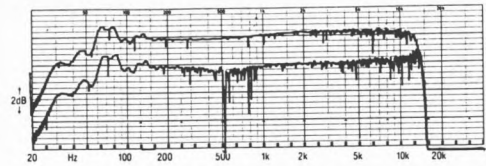
Playback only frequency response (pre-recorded tapes)



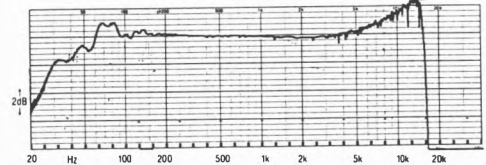
Overall record/replay response. Type I (ferric) tape



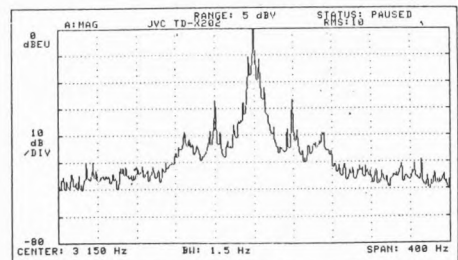
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

JVC TD-X502

JVC(UK)LTD, ELDONWALL TRADING ESTATE, PRIESTLEY WAY, STAPLES CORNER, LONDON NW2.

TEL: 01-450 3282



Here is a middle range deck which reflects modern trends in a number of ways, particularly those concerned with metering and the various search functions available. The basics, however are fairly conventional, this being a two-head deck with a fully logic controlled transport powered by separate reel and capstan motors. Dolby B and C noise reductions are fitted but without independent MPX filtering. The TD-X502 continues JVC's evident disdain for automatic tape selection, and this must be set manually using a three position level switch.

JVC use a technique familiar to Sinclair (and, in fairness, other) computer users to reduce the control count. The main transport function keys have been given additional functions which are accessed by pressing a key marked shift at the same time. These are the search functions mentioned above: index scan (*aka* intro scan), blank skip, and rewind auto play, whose purposes are self-explanatory.

The record level meters are excellent functionally, if a little gaudy in appearance. They have good resolution and a 27dB dynamic range, and incorporate peak-hold LEDs. There's even a digital readout of the peak reading, but this should not be confused with the variation of the same idea found in the TD-V66 (which stores the

highest peak, updating as required, to be recalled at a later time, after running through a programme to be recorded for example). In this instance the readout does nothing that the peak hold LED doesn't do just as well.

Other features include an electronic tape counter (no memory), record mute and microphone inputs.

LAB REPORT

Our TD-X502 has a serious problem of too many low rate speed variations: wow components are only 26dB down at 4Hz, which is about the frequency where the ear's sensitivity is at its greatest. The noise spectrogram is interesting in that it shows a degree of uncertainty in the pitch centre, and a great deal of energy nearby — witness the -35dB sidebands at +/-80Hz.

The levels of noise and distortion were both satisfactory. Similarly satisfactory are the Type I and II record/replay frequency responses. Introducing Dolby B has little effect on the amplitude response, but Dolby C does — the plot shown suggests misalignment leading to mistracking, plus some modification of response shape in the important 80Hz — 400 Hz region. The metal Type IV response is also adrift, in this case probably due to underbiasing, with a consequent 2.8dB peak at 15kHz which should be noticeable as a touch of 'edginess'. The play-

back only response, which is what you're concerned with when playing prerecorded cassettes, is flat through the midband, but dies quite early in the treble, despite only a modest azimuth error.

SOUND QUALITY

Prerecorded cassettes sounded dull and boring; metal tape recordings *did* sound slightly edgy; Dolby C introduced some odd timbral changes; and the bass acquired an air of opulence and diffuseness definitely not part of the real thing. However, the least tolerable aspect of the deck was pitch inconstancy, but as usual with this particular performance parameter the problem was intermittently disturbing, depending largely on programme content.

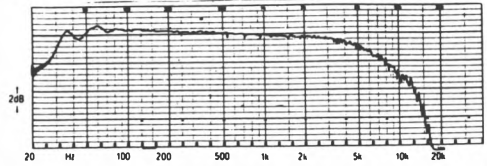
When things were going the JVC's way (and this tended to be when recording orchestral music onto TDK SA or other Type II tape with Dolby B), there were signs of considerable under-the-skin talent. The basic sound off-tape, and of the monitoring electronics, was surprisingly transparent, refined and spacious in stereo terms. If only the ingredients had had a more consistent flavour.

CONCLUSIONS

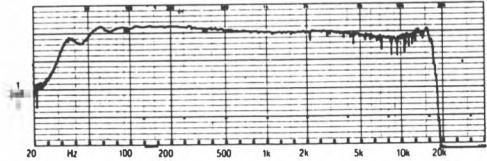
From the user's point of view, the TD-X502 hasn't been properly thought through. Stir in the rotten speed stability which makes a mess of many recordings, Dolby C circuitry that doesn't track properly, and metal that isn't properly catered for, and what do you get? All together now . . .

TEST RESULTS

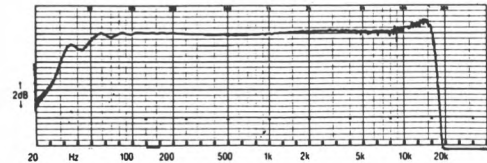
Rec/replay response -3dB ref 1kHz	
IEC Type I	26Hz-18kHz
IEC Type II	28Hz-18kHz
IEC Type IV	28Hz-19kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.18%/0.42%
Speed error	-0.25%
Type I signal/noise CCIR/ARM 315Hz	47dB
distortion 0dB	0.65%
Type II signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0dB	0.85%
Type IV signal/noise CCIR/ARM 315Hz	50.5dB
distortion 0dB	0.6%
Channel separation 0VU/1kHz	43dB
Line input sensitivity/overload	114mV/>7V
Mic input sensitivity/overload	0.55mV/5.25mV
Line output for 0dB/maximum	466mV/4.4V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.31%
Azimuth check R-L phase at 8kHz	5 degrees
VU indication at IEC 0dB	4dB
Dimensions (w×h×d)	43.5×10.9×22.9cms
Typical Retail Price	£250



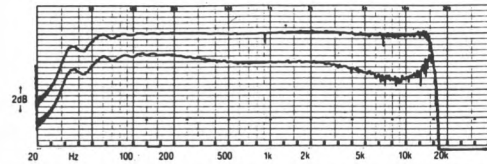
Playback only frequency response (pre-recorded tapes)



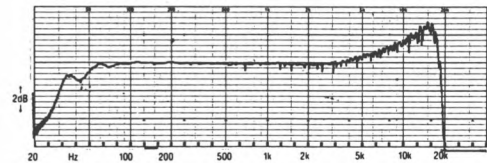
Overall record/replay response. Type I (ferric) tape



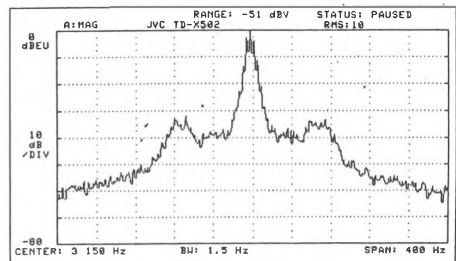
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

JVC TD-V66

JVC (UK) LTD, ELDONWALL, TRADING ESTATE, PRIESTLEY WAY, STAPLES CORNER, LONDON NW2.

TEL: 01-450 3282



Here is another face of JVC, that of a technologically proud company who can provide a taste of real sophistication at a still reasonable price. This deck has everything short of auto-reverse. Well almost: it has discrete record (Sen-Alloy) and playback heads and off-tape monitoring; the transport has separate capstan and reel motors; and the transport controls are driven by a logic chip.

Some of the minor switching is a little jumbled, but for the most part the TD-V66 can be learned quickly and used intuitively thereafter. Although the basic styling is pretty ordinary, the quality of finish and attention to detail is something else entirely. That quality is what distinguishes the deck internally too: there is an unusual (for a cassette deck) shunt-regulator controlled power supply, and a lot of attention (says the manufacturer) has been paid to areas like the audio quality of the amplifier circuits and the physical support of the heads — even gold plating on the audio connectors.

The record level meters have a 29dB range with good resolution, peak hold LED, plus a separate numerical indicator which reads out peaks above 0VU continuously, recalling the previous highest setting at the press of a button. The patient has therefore the option to play through a record or CD prior to making a re-

ording to check maximum levels. Add to this the auto mute function and the ability to work with other JVC components to produce automatically sequenced recordings — with convenient 4 second gaps between tracks for the auto track locate function to use afterwards — and you have a cassette deck that the record industry certainly won't approve of.

There are also a host of minor and not so minor facilities, of the kind that mid-market cassette decks are increasingly looking undressed without. These include automatic tape type selection (unusual for JVC), intro ('index') scan, track search (forwards or back), an illuminated cassette well, a silly redundant tape running indicator, an electronic numerical/time counter with memory, and various repeat options. An attractive R-70E wired (not infra-red) remote control is available at extra cost.

Criticisms? The Dolby B and C switching, which includes the facility to bypass the 19kHz MPX filter, is inconveniently designed. Also, the headphone socket and main rear panel output are fed via a front panel volume control: for sonic reasons it would have been better had the pot been used for the headphones only, leaving the main output as electrically clean as possible. Annoyingly, the cover on the cassette well requires full dismantling for cleaning and demagnetising access. Finally, and this is more of an

observation than a criticism, there are no microphone inputs.

'Full logic, silent mechanism' brags the sign on the cassette cover. I pressed play, not noticing that the tape had run through, and watched open mouthed as the drive squealed and the hubs strained to turn, whilst the tape running monitor LEDs tried to convince me the tape was actually on the march! This lasted for several seconds before the auto stop finally twigged what was up and put an end to the charade. Overall I found the sound effects realistic enough; fortunately the only thing missing was the apocryphal plume of smoke . . .

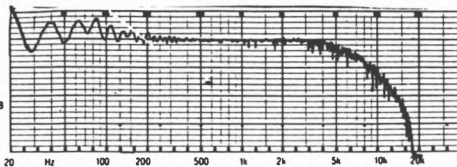
LAB REPORT

The first point to note is the amount of dropout. The first response plots (not reproduced here) were eloquent testimony to poor tape to head contact, perhaps a byproduct of low or erratic tape tensioning, or (and this is less likely) tape path geometry.

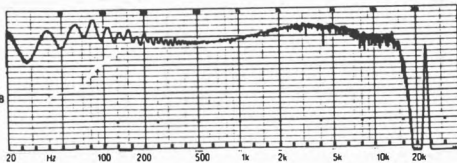
The response curves themselves — important partly because the TD-V66 provides no ready means of adjusting bias or any of the other preset characteristics — are pretty good. Like all the JVCs tested for this issue, however, metal Type IV tapes showed a mild but significant rise into the treble. The consistency with which this happens with all models, despite using recommended tape varieties, suggests that it is deliberately inspired to add a touch of pizzazz to the sound. It is not, however, good audio engineering practice; the copying machine should not be allowed to second guess the original.

Intriguingly, there is an overall response rise at the normally neutrally recorded low frequency extreme, even taking head contour effects into account. This characteristic adds a little output in the 50-100Hz, 'warmth' region, but the amount is not excessive. The Dolby traces show excellent correspondence with the non-Dolby response through the mid and top, so noise reduction mistracking shouldn't be a problem here. However, the story was different in the bass, the Dolby circuits adding noticeably to the curve's curvature.

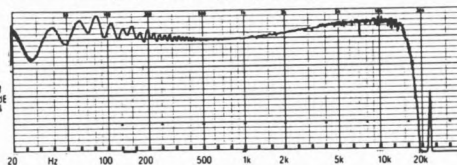
Noise, both in level and in quality, is not a problem with this machine, but speed stability is a different matter. 0.12% weighted is the kind



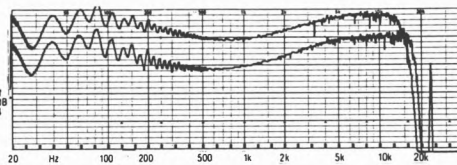
Playback only frequency response (pre-recorded tapes)



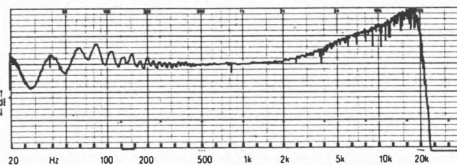
Overall record/replay response. Type I (ferric) tape



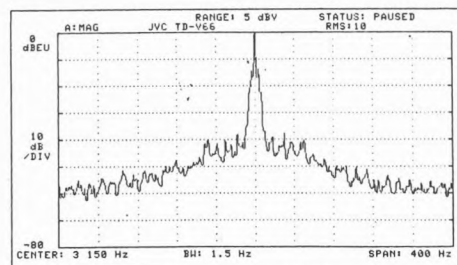
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

Continued over the page

JVCTD-V66

Continued from previous page

of figure you'd expect from a budget player, or a mid-price auto-reverse deck perhaps — but not an up-market unidirectional cassette deck with an audiophile bent. The unweighted figure is even worse, and appears to be accounted for by some quite complex low frequency wow, extending up to about 10Hz. There is also some 40Hz flutter at -28dB. Programme wow was audible on occasions.

Note the higher than usual 0dB maximum output, which can be reduced as required using the output level control, as explained earlier. The +5dB IEC 0VU figure suggests that recordings can be allowed to peak well into the red in order to minimise noise.

SOUND QUALITY

There's a certain opaqueness to the sound of the record electronics as monitored direct, in other words without putting music onto tape. This is quite a common finding, but an important one, and incidentally is one of the reasons why it can be difficult to tell the source sound from the sound off-tape with many 3-head decks.

That wasn't the problem here. The differences were all too apparent. Metal recordings lacked body and punch, whilst other tape formulations simply sounded soft and vague. There was obvious compression with these tape types, and the bass acquired a 'bloated' directionless quality. Pitch information was under-characterised and the whole sound picture seemed 'lazy'. There were also intermittent signs of pitch variability and dropout too. Pre-recorded material sounded vaguely 'sat upon' and lacking in airiness.

What was never really in evidence was the coherent impression of a soundstage with the constituent elements pasted firmly into position: where each instrument leads a viable and independent life, and where the deck is master of the dynamics and temporal clues it is trying

to reproduce. The best the TD-V66 could manage was to sound smooth and inoffensive. What did transpire in the end, however, was that the sound sharpened up considerably if the deck was used with the noise reduction circuits switched off. There were still problems even in this mode but at least the music sounded more focused and alive, and under such conditions it became easier to forgive minor tonal and other aberrations.

CONCLUSIONS

The TD-V66 saw some intensive use during the preparation for this test, by the end of which I was getting to dislike the tape running indicator intensely. But this was one of the very few annoyances in what was otherwise a particularly sensible and rewarding package to get to grips with — at least from the equipment and user-interface point of view.

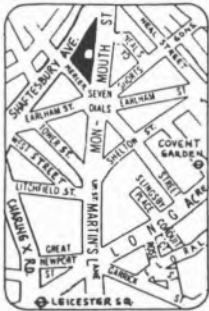
More's the pity then that the electronics — the noise reduction circuits especially — did so much to compress and generally over-sanitise the sound. The grandeur of fortissimo piano playing was diminished and vivid orchestral recordings sounded smeared. Speed stability was only marginal too. The clincher was that the deck was also dropout-prone.

TEST RESULTS

Rec/replay response - 3db ref 1kHz	
IEC Type I	<20Hz-17kHz
IEC Type II	<20Hz-17kHz
IEC Type IV	<20Hz - 21kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.12%/0.50%
Speed error	-0.1%
Type I signal/noise CCIR/ARM 315Hz	47dB
distortion 0dB	0.9%
Type II signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0dB	1.1%
Type IV signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0dB	1.1%
Channel separation 0VU/1kHz	48.5dB
Line input sensitivity/overload	141mV/7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	818mV/2.3V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.1%
Azimuth check R-L phase at 8kHz	80 degrees
VU indication at IEC 0db	5dB
Dimensions (w×h×d)	43.5×11×28.2cms
Typical Retail Price	£350

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KENWOOD KX550HX

TRIO KENWOOD, 17 BRISTOL ROAD, THE METROPOLITAN CENTRE, GREENFORD, MIDDX UB6 8UP.

TEL: 01-575 6030



Rather than trying to be all things to all men, Kenwood's design brief for this deck was to produce a relatively simple and stylish £150 machine which would include everything important whilst concentrating on good, sound engineering and simple, Europeanised aesthetics. The headlines read Dolby B and C, auto tape type selection, and the increasingly popular Dolby *HX Pro* headroom extension system.

The KX-550 is a two head deck, with separate reel and capstan motors and conventional single capstan drive. Instead of the usual level plus balance, individual channel controls are used to adjust relative balance, alongside a much larger ganged master control. Alongside, the very fetching vertical bar-graph meters have 2dB resolution around 0VU, a 32dB dynamic range, and red LEDs above 0VU.

The KX-550 also has microphone and headphone sockets, and a bias adjustment facility. There's even a handy feature to seek out and play any track up to 16 away from the current position, according to the number of times the button is pressed. In normal day to day use the deck feels very workmanlike, and finish is to a high standard.

LAB REPORT

Pitch resolution is well defined in the spectrogram. The next most prominent feature are the 'shoulders' at -43dB , $\pm 100\text{Hz}$ — hum ripple modulation perhaps? Flutter distribution is rather complex, but pretty good in view of the moderate amplitudes involved (0.085% wtd).

The various responses were mostly satisfactory, but two of them deserve comment. The Type IV record/replay response shelves down in the treble, which should result in a rather damped sound quality. Otherwise, this deck certainly has the wherewithal to make good use of metal tape. Finally, although response integrity is maintained with Dolby B, this isn't the case with Dolby C, where some mistracking — or at least a modified tonal balance — is inevitable.

SOUND QUALITY

Pre-recorded cassettes sounded a little thin, with a vaguely unstable quality on top, which appeared to be related to a degree of dropout rather than wow or flutter. There was also some low frequency noise, rather like the vinyl roar you thought had gone out of fashion with the IP (no, I know it hasn't really!).

Information losses were noticeable in a number of ways. As an example, the effect on

a particular solo Steinway recording that was used throughout this project was heard as muting of transients, a loss of 'richness' and a lack of the characteristic bell-like qualities which are especially apparent in the notes in the couple of octaves below middle C. The end result seemed quite clear and certainly stable in its own way, but ultimately also a little 'wooden' and mechanical.

Dolby HX Pro did its stuff well, so that much of the best of this deck was available with all species of tape, not just the high bias ones. The noise reduction systems on the other hand did less than wonderful things to the music. As anticipated from the measurements, Dolby C did put a particularly insidious barrier between the recording and the listener — and incredibly didn't appear to reduce hiss by as much as usual. The system put a damper on things, and is best avoided.

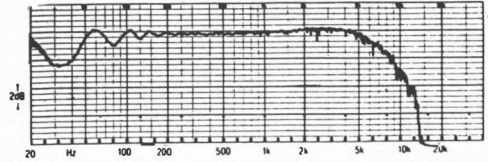
CONCLUSIONS

This is a good cassette deck, but ultimately lacks the edge to stand out in a competitive field. I don't think anyone owning one would reasonably be less than delighted, but the conception outweighs the quality of the execution when assessed for its musical qualities. Nevertheless, the *KX-550HX* is well laid out and attractive from the user's point of view, and comes within a whisker of being a fine sounding deck.

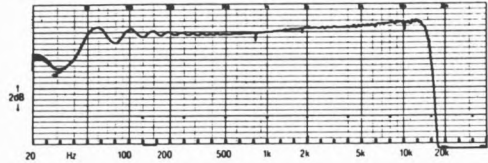
TEST RESULTS

Rec/replay response — 3dB ref 1kHz

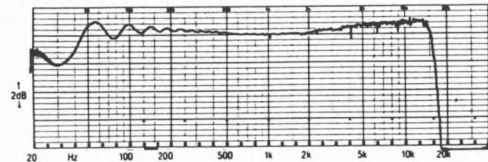
IEC Type I	<20Hz-16kHz
IEC Type II	<20Hz-16kHz
IEC Type IV	<20Hz-17kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.085%/0.32%
Speed error	-0.4%
Type I signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	0.9%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.95%
Type IV signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	0.95%
Channel separation 0VU/1kHz	-47.5dB
Line input sensitivity/overload	112mV/>7V
Mic input sensitivity/overload	0.53mV/28.6V
Line output for 0dB/maximum	536mV/2.6V
FM distortion 10kHz/11kHz 0dB peak, 1kHz product	2.0%
Azimuth check R-L phase at 8kHz	10 degrees
VU indication at IEC 0dB	4dB
Dimensions (w×h×d)	420×113×32.6cms
Typical Retail Price	£149



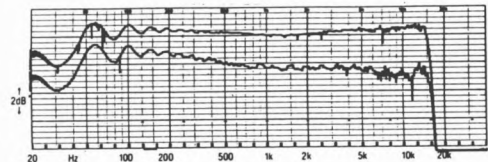
Playback only frequency response (pre-recorded tapes)



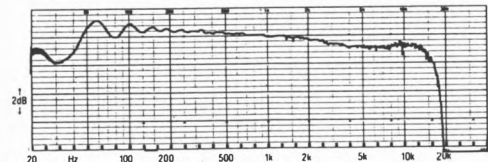
Overall record/replay response. Type I (ferric) tape



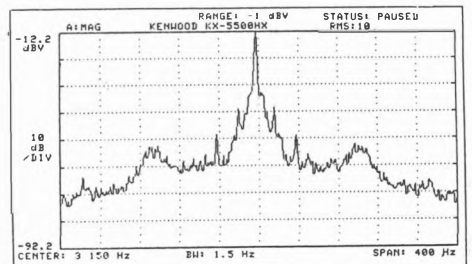
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

LUXMAN K-100

HW INTERNATIONAL LTD, 3-5 EDEN GROVE, LONDON N7 8EQ.

TEL: 01-607 2717



The Lux Corporation, now a subsidiary of Alps (Alpine) in Japan, have a well established if low key presence in this country. The products themselves are mostly relatively up-market, but the *K-100* represents one of their infrequent forays into more affordable territory. It has few obvious distinguishing qualities from its peers except for the easily overlooked ability to interface with either one of two external units.

The first of these is the *U-100*, which controls a complete Luxman system using a supplied comprehensive infra-red remote control handset. The other is the *F-105*, whose main task is to perform as the heart of an A/V surround sound system. Amongst the other things, the *F-105* is a Dolby surround sound decoder.

Unfortunately there are some distinct ergonomics failings, quite apart from the 'bare bones' record level meters (16dB over 5 steps) which are bettered on some models at half the price. In no particular order they include the two-button Dolby B/C selectors, the manual tape type selectors (why not automatic?), and two tiny rotary record level controls which make accurately matched fades improbable at best. Finally, the solenoids that operate the transport are so amazingly noisy they must be in danger of setting some kind of record.

These things apart, the deck feels solid and well screwed together. Although noisy, the

transport control section is well laid out, and will prove a revelation to anyone graduating from an older, cheaper design. There are status tell-tales for play, pause and record modes, and the deck is rounded off with both headphone and microphone socketry.

LAB REPORT

Lab tests confirmed that the *K-100* has a good electrical performance on most counts, but the mechanics are borderline. The measured wow & flutter figure is not all that high at 0.12% peak DIN weighted, but spectrum analysis shows a high level of wow at ± 8 Hz, with noise shoulders a little further out at ± 50 Hz, -38 dB. The flutter analysis similarly shows a concentration of spectral 'lines' at the 'wow' end of the spectrum.

All responses rise into the treble, even the pre-recorded playback one (which succumbs to azimuth-induced rolloff early enough to disguise the worst effects). Happily, Dolby processing doesn't spoil the picture too severely especially (and this is a novelty) Dolby C.

To help signal/noise along, it's possible to peak a few dB into the red, though the limited resolution of the meters makes accuracy difficult. Note also the intermodulation test result, which calls into question the ability of the deck to drive metal tapes hard when the music is HF rich.

SOUND QUALITY

Commerically recorded cassettes sounded exactly as the lab test results suggested. The frequency balance was a little brightly lit, yet the sound could be heard to shut down prematurely at higher frequencies. The giveaway observation here was a rather 'cramped' sound, lacking the real top-end differentiation you only get when the whole harmonic structure is reproduced in correct proportions. The deck also suffered a degree of residual mains hum which could be heard when monitoring on headphones.

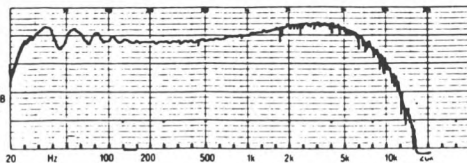
However, the K-100 made good recordings, even though it didn't sound especially close to the source using the IEC reference tapes. What it did sound like was very lively and informative, with an almost 'crystalline' purity at HF (with metal tape especially) that wasn't expected from its other attributes. There was plenty of differentiation (in contrast to the replay only findings), plenty of 'life', and a notably three dimensional stereo image. The Luxman definitely added a touch of brilliance, using Dolby B, C or moonshine for that matter, that wasn't there on the original. But it did so in such a natural unforced way, and with such panache and grace, it was difficult to object.

CONCLUSIONS

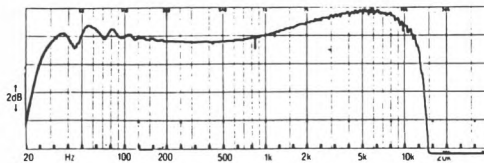
This surprising deck escaped from the hands-on test rather better than it perhaps deserved, in the sense that a lack of absolute fidelity was compensated by musical attributes. This still doesn't excuse the controls and displays entirely.

TEST RESULTS

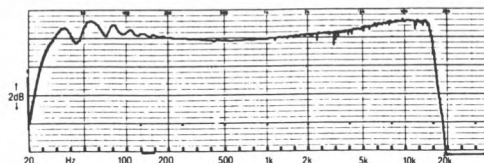
Rec/replay response - 3db ref 1kHz	
IEC Type I	24Hz-13.5kHz
IEC Type II	23Hz-17kHz
IEC Type IV	23Hz-18kHz
Wow & Flutter - Peak DIN wd/unweighted	0.12%/0.27%
Speed error	+0.1%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0db	0.7%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0db	0.75%
Type IV signal/noise CCIR/ARM 315Hz	50dB
distortion 0db	1.2%
Channel separation 0VU/1kHz	44dB
Line input sensitivity/overload	110mV/7V
Mic input sensitivity/overload	1mV/5.6V
Line output for 0dB/maximum	664mV/3V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	5.24%
Azimuth check R-L phase at 8kHz	.6 degrees
VU indication at IEC 0db	+3dB
Dimensions (w x h x d)	43.8 x 11 x 26.7cms
Typical Retail Price	£199



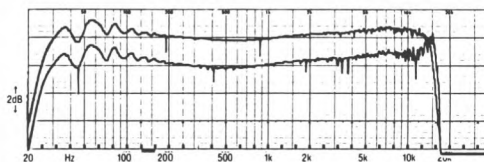
Playback only frequency response (pre-recorded tapes)



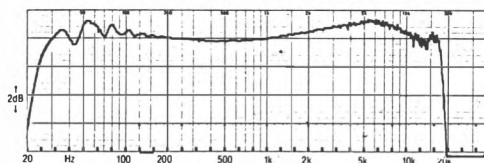
Overall record/replay response. Type I (ferric) tape



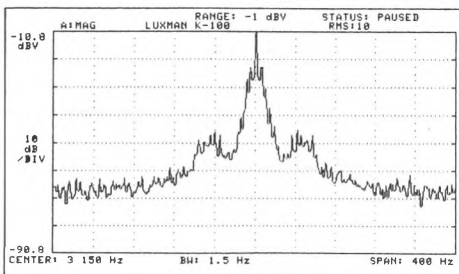
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

LUXMAN K-105

HW INTERNATIONAL LTD, 3-5 EDEN GROVE, LONDON N7 8EQ.

TEL: 01-607 2717



The K-105 is an up-market auto-reverse cassette deck, with a dual-capstan, three-motor transport which differs from the sheep in swapping between modes more quietly than usual. Auto-reverse operation is triggered mechanically at the end of the tape, so there are no fast turnarounds here. Naturally, noise reduction is courtesy of a set of Dolby B and C processors. The K-105 can be driven by infra-red remote control, if used in a Luxman system alongside their U-100 remote control receiver. There is also an A/V surround sound control system that integrates with this deck, and others in the Lux range.

Ergonomics are an odd mixture of the good, the bad and the indifferent. One petty aggravation is the separation of the two record level displays. Physically short (under 4cm each), and measuring only 7 discrete steps over their 26dB span, their presentation is difficult to read singly and impractical for establishing relative gain between channels.

On the other hand the rotary Dolby B/C selector is easily the best switching arrangement yet devised, and tape type selection is automatic, praise be! The track search facility has its own dedicated controls, and mode selection (unidirectional/both sides/continuous play) uses another sensible rotary.

The K-105 has a fair number of special features generically related to the track search, and Luxman has sensibly rationalised them in a single group alongside the track search keys. They include record mute/auto space, auto record pause, blank search, blank skip and intro scan. Nearby, a direction selector conveniently remembers the last mode selected when power is restored. The deck includes a host of tell-tales, making it pleasant to use as well as merely well equipped. The only important feature missing is a memory stop to complement the mechanical tape counter.

LAB REPORT

All frequency responses were tilted down a little in the treble, Type II clearly providing the best results. Pitch stability measured well by auto-reverse standards, with the spectrogram noise shoulders at -28dB , $\pm 50\text{Hz}$, and absolute pitch good. However, the flutter analysis showed quite a few wow components bunched together, the overall level in this region being around -25dB or only slightly better, which is poor. Noise also rises at higher frequencies.

Azimuth errors were absent, a fact that ties in with the quite good playback response shape. IM distortion was very high, however, and the deck therefore won't make the most of the headroom available with metal tape.

SOUND QUALITY

Sound quality is a little more sophisticated than with its cheaper cousin the *K-100*. That is, it sounds worse....

In fact the situation is a little more complicated than that. The *K-105* sounds smoother and more refined, with a cooler, denser midband and obviously greater control at the frequency extremes. The results were altogether more palatable when playing commercially recorded material, but were a mixed blessing on its own recordings. These did sound pretty good, but ultimately were also a little sterile.

Pitch and image stability were surprisingly unproblematical, given that this is an auto-reverse deck, though cyclic wow was just audible on some recordings. On set-up grounds the *K-105* is best suited to Type II tapes, though the top end rolloff didn't hurt recordings made with ferric or metal tapes as much as might have been expected. Image stability was a strong feature of a sound which on the whole was smooth and easy on the ear.

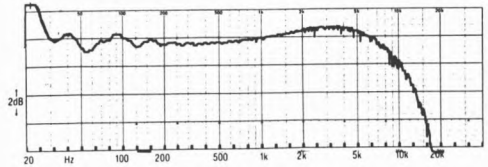
CONCLUSIONS

This cool, sophisticated-sounding player is essentially good, if not especially engaging to listen to. Don't interpret this remark as damnation with faint praise; this is definitely one of the best of the auto-reverse decks now doing the rounds. There are a number of useful track search features, and the 'user interface' is on the whole good. The quality of metering, however, is not commensurate with the price.

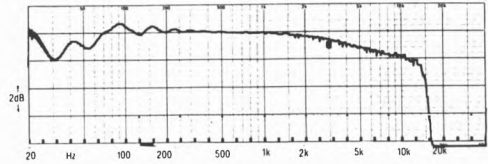
TEST RESULTS

Rec/replay response - 3dB ref 1kHz

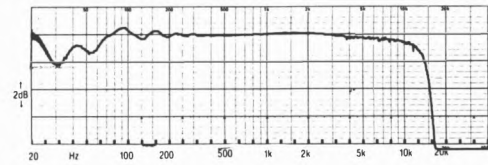
IEC Type I	<20Hz-14kHz
IEC Type II	<20Hz-15kHz
IEC Type IV	<20Hz-13kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.12%/0.23%
Speed error	-0.1%
Type I signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	0.6%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.6%
Type IV signal/noise CCIR/ARM 315Hz	51.5dB
distortion 0dB	0.8%
Channel separation 0VU/1kHz	-48dB
Line input sensitivity/overload	155mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	645mV/2.6V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	16.6%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0dB	+3dB
Dimensions (w×h×d)	43.8×11×30.7cms
Typical Retail Price	£349



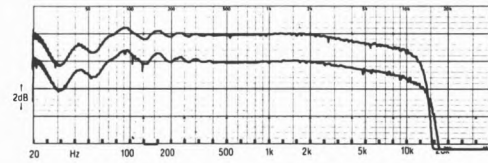
Playback only frequency response (pre-recorded tapes)



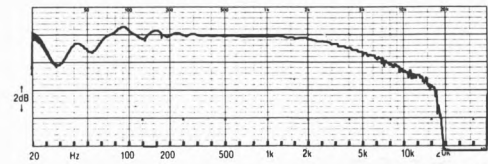
Overall record/replay response. Type I (ferric) tape



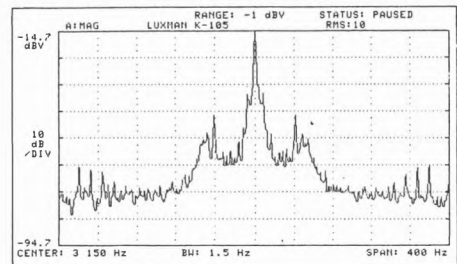
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape

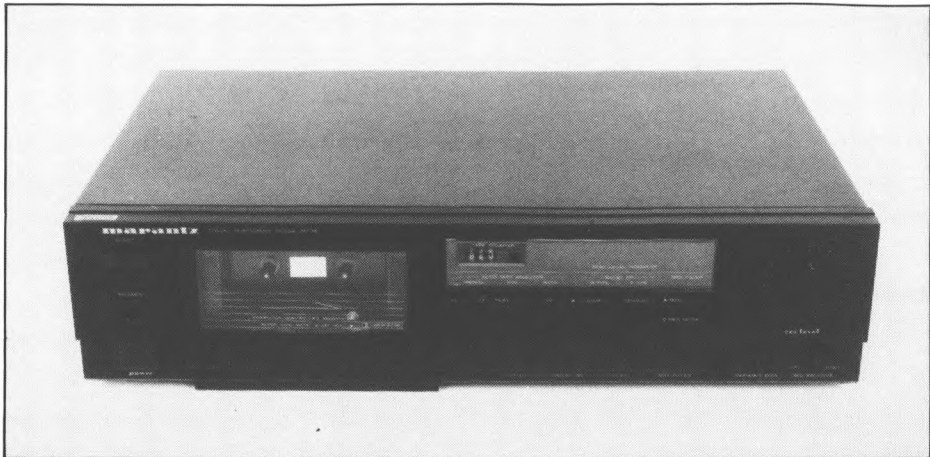


Noise modulation spectrum analysis

BEST BUY

MARANTZ SD-35

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE,
HARMONDSWORTH, MIDDX UB7 0LW. TEL: 01-897 6633



Marantz have made quite a splash (for want of a better term) in the budget esoteric market, largely through the efforts of designer Ken Ishiwata and product manager Steve Harris, both of whom are keen audiophiles.

Applying audiophile criteria to cassette decks, especially low cost cassette decks, might be regarded as novel, if not in danger of being revolutionary. This one is actually subtitled as an 'audiophile deck', a label it earns by, for example, incorporating a number of audio grade components in sensitive circuit areas. The quality theme is continued externally with a smooth and attractive three dimensional gold on satin black fascia, and a reassuringly solid and expensive feel.

Annoyingly, single finger record/pause starts are not allowed, and as a matter of personal preference I missed a memory stop feature, which is about the most rudimentary way there is of finding your way around a tape. However, the SD-35 will find the start point of a recording that has just been made if rewind is selected direct from record mode.

The other facilities are straightforward, and neatly executed, and the deck is blessed with a transport that fairly glides about its business, with little of the clankiness or lack of feel of

many rivals. Tape selection is automatic, and noise reduction is by Dolby B and C, with an independent MPX filter.

The usual transport modes include a one touch four second mute feature. Record bias is adjustable for all but metal tapes (the usual exclusion), and record levels are set on a pleasingly designed rotary input level control, using an even more pleasingly designed but perhaps rather brightly lit pair of record levels meters with reasonably wide range and resolution.

LAB REPORT

The numbers suggest that the SD-35 should reproduce timbre and pitch accurately, and the noise spectrogram is extremely clean, with all residuals -40dB or better. The spectrogram does show some complex noise modulation, with a number of small but clearly defined sidebands. However, the pitch centre is sharply defined, and sidebands are adequately controlled.

The record/playback responses are quite satisfactory, allowing for a mild tendency to brightness especially with metal and Dolby C. The effect is smooth and far from severe though, and curable (if it seems like a problem) by choosing tapes with a falling top end response (see tape section). Other test results are at worst unremarkable — so no remarks.

SOUND QUALITY

Headphone listening was spoiled a little by random variations in output caused by slightly 'iffy' tape-to-head contact. This, and a rather bright replay only response (applicable to pre-recorded material) were perhaps the only obvious snags with this machine.

The SD-35 is a remarkably successful recorder, with much of the credit due to the rock steady transport. The consistent measured performance between tapes was reflected in relatively consistent sound, though predictably Type I ferric tapes often sounded rather flattened when pushed hard.

Sound quality was best without noise reduction, where it was characterised by excellent resolution, a tidy and tuneful bass, and well resolved stereo imagery. With Dolby the sound stayed very good on the whole. But there was some mild Dolby mistracking, along with quite severe noise pumping with transient material (piano etc) which was more distracting than the steadier hiss that results when Dolby isn't being used.

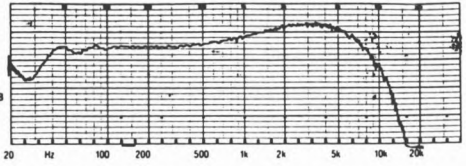
Commercial pre-recorded material sounded fine, the added brightness being perfectly tolerable due to the precision and cleanliness of high frequency reproduction.

CONCLUSIONS

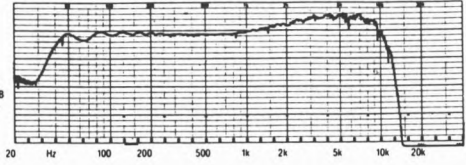
Good quality, properly aligned electronics combine with an excellent tape transport and good ergonomics to make the SD-35 an obvious Best Buy.

TEST RESULTS

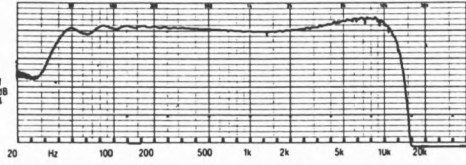
Rec/replay response - 3db ref 1kHz	
IEC Type I _____	32Hz-13kHz
IEC Type II _____	30Hz-14kHz
IEC Type IV _____	29Hz-19kHz
Wow & Flutter - Peak DIN wtd/unweighted _____	0.07%/0.19%
Speed error _____	+0.25%
Type I signal/noise CCIR/ARM 315Hz _____	50dB
distortion 0dB _____	0.6%
Type II signal/noise CCIR/ARM 315Hz _____	52dB
distortion 0dB _____	0.95%
Type IV signal/noise CCIR/ARM 315Hz _____	53dB
distortion 0dB _____	1.5%
Channel separation OVU/1kHz _____	-49.5dB
Line input sensitivity/overload _____	98mV/>7V
Mic input sensitivity/overload _____	n/a
Line output for 0dB/maximum _____	507mV/2.9V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product _____	1.26%
Azimuth check R-L phase at 8kHz _____	16 degrees
VU indication at IEC 0db _____	0db
Dimensions (w x h x d) _____	42 x 10 x 26cms
Typical Retail Price _____	£160



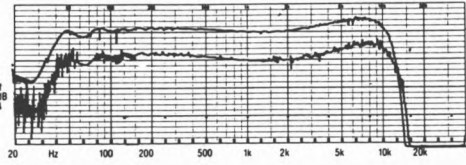
Playback only frequency response (pre-recorded tapes)



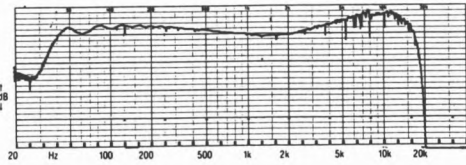
Overall record/replay response. Type I (ferric) tape



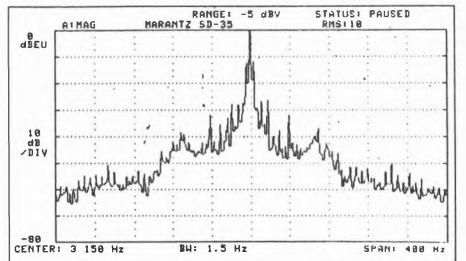
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

MARANTZ SD-45II

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE,
HARMONDSWORTH, MIDDX UB7 0LW. TEL: 01-897 6633



This two head, two motor, £200 Mk II model fits slap bang in the middle of the UK market. Best described as of simple functional design, it has circuitry specifically developed to meet the expectations of the less wealthy audiophile. To this end, it uses ceramic damped Cerafin capacitors around the Dolby block and power supply section, and has what Marantz describe as a separate high slew rate op-amp playback amplifier rather than the rather nasty single IC chips often used.

Build is solid and heavy, whilst fit and finish are in the 7 out of 10 category. Ergonomics are good on the whole, except that the transport uses feel-less keys, artlessly jumbled together.

Small but very well calibrated record level meters have a more than handsome 37dB operating span, with peak hold LEDs. The deck also includes such handy gadgetry as an autotape type selector, variable bias (Type I and II only, as usual), Dolby B and C and a separate MPX filter.

Naturally, the *SD-45II* has an automatic record mute function, but illogically there's no direct way of taking advantage of this as there is no track search feature (propaganda sheet notwithstanding). However, the deck will seek out the beginning of recordings if 'rewind' is selected direct from 'record' without passing

through 'stop', the pause key flashing when it has done so.

The *SD-45II* has an electronic tape counter and memory stop feature. There is one itsy-bitsy oversight, however: the memory has no status indicator, so you'll have to remember whether it's been selected for yourself.

LAB REPORT

The lab test programme was passed with ease and style — with just the odd caveat for the bright pre-recorded replay response (this isn't the only Marantz so affected). The ferric (Type I) graph had a similar characteristic, which tends to make recordings sound very incisive but rather thin and hissy. The other responses were almost perfectly flat with or without Dolby (and still hissy by normal standards!). The record chain has plenty of headroom, and signal/noise ratios are good verging on excellent, whilst distortion levels are unusually low.

And the good news continues . . . the raw wow & flutter figures are good. The noise spectrogram indicates good pitch resolution and sidebands at $\pm 60\text{Hz}$ with a peak amplitude at -36dB . In English, that means good. The energy content of the flutter analysis is also low (that means good too). The worst flutter component is at 30Hz , -35dB , and wow is low, with few discrete components. However, the *SD-45*

is rather adept at picking up and amplifying stray magnetic fields, so siting should be done with special care.

SOUND QUALITY

Pre-recorded material often sounded hissy, particularly at high frequencies, but as a recorder the SD-45II proved remarkably successful in comparison to its peers, though here too high frequency tape hiss was a little more obvious than usual. However, Dolby mistracking was not too apparent and sound quality with Dolby in was not prejudiced.

Recognisably of the same parentage as the SD-35, the 45 has much the same very high level of detail and absence of 'fluff'. Bar an occasional touch of 'acidity', this is a deck that really sings, with a more articulate, more pitch specific and generally classier sound than most of the direct competition. The sound has a good working dynamic range, and the result was very firm and stable in character. Speed stability was also subjectively good, if not totally secure pitch-wise. The sound had real projection and power in the midband and above, but the bass seemed mildly flattened in character.

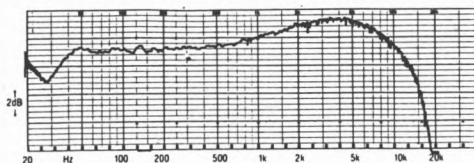
CONCLUSIONS

On balance, this is an excellent sounding deck, which extracts more information off tape with less dynamic squash than experience with its competitors will lead you to expect. Only a marginal lack of absolute pitch security counts against it at the price.

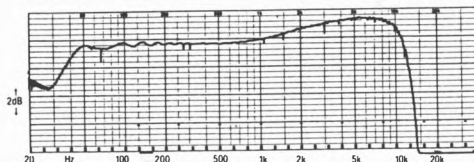
TEST RESULTS

Rec/replay response - 3dB ref 1kHz

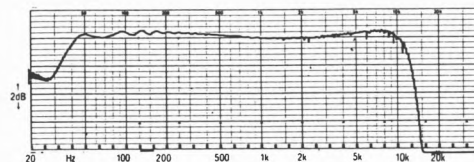
IEC Type I	32Hz-13kHz
IEC Type II	28Hz-13kHz
IEC Type IV	<20Hz-18kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.10%/0.24%
Speed error	+0.1%
Type I signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.65%
Type II signal/noise CCIR/ARM 315Hz	52.5dB
distortion 0dB	0.9%
Type IV signal/noise CCIR/ARM 315Hz	53dB
distortion 0dB	1.3%
Channel separation 0VU/1kHz	-49dB
Line input sensitivity/overload	98mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	520mV/3V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.44%
Azimuth check R-L phase at 8kHz	5 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	42×10×26cms
Typical Retail Price	£200



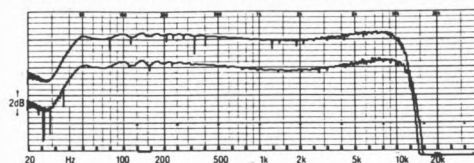
Playback only frequency response (pre-recorded tapes)



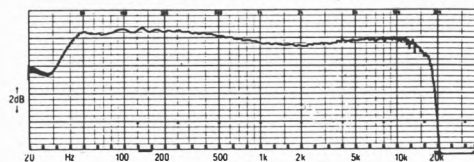
Overall record/replay response, Type I (ferric) tape



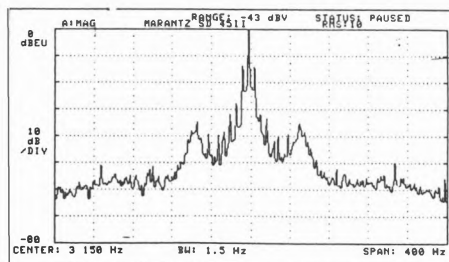
Overall record/replay response, Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response, Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

MARANTZ CP230

MARANTZ AUDIO (UK) LTD, 15-16 SAXON WAY INDUSTRIAL ESTATE, MOOR LANE,
HARMONDSWORTH, MIDDX UB7 0LW. TEL: 01-897 6633



Here is a welcome and extremely practical oddity: a true portable cassette deck, extremely well thought through and comprehensively equipped, for less than £200. But if after you've read what follows you decide you want even more, there is a similarly packaged companion model with three heads, off-tape monitoring, *dbx* noise reduction and slightly higher rated specs (before *dbx*), the £250 CP430.

The deck itself is scarcely larger than a chunky paperback — the vital statistics are just 226×50×167mm, and less than 1.3kg for the raw unit. The deck is either powered by three MN1300 batteries (always use alkalines — the Marantz is a heavy drinker), an outboard mains power unit (supplied), or a rechargeable power pack unit (extra). Also supplied is a working case that allows access to everything that counts on the move, a shoulder strap, and a small case that fastens to the strap to hold microphones and a tape or two — and perhaps a very thin sandwich.

Every kind of portable recording need is catered for, and the deck will attract some domestic users too. The mechanical transport controls are well laid out and allow audible cueing. Tape movement can be logged on the tape counter and stopped at the counter zero

reading using a memory switch, though the review deck was a bit erratic here. Record levels are set manually using a small dual-concentric control, recessed to avoid accidental changes. In addition, a limiter is fitted which can act as an auto level control if required, and is useful for live 'actuality' recording. Levels are monitored on good quality (optionally illuminated) moving coil meters (which also monitor battery condition), backed up by a peak reading LED.

The CP230 plugs into a hi-fi system using standard DIN and phono socketry, and accepts headphones and microphones (mono or stereo), the latter supplemented by -15dB and -30dB attenuators for some of the higher output electrets or to handle high input volumes. The deck also has a single built-in loudspeaker for monitoring purposes, switchable to reproduce either left or right hand channel or a mono sum. Other features include variable bias for all three tape types, variable pitch (playback only), and Dolby B switching with or without MPX filtering.

The Marantz may sound over the top on paper, and it's difficult to credit the sheer profusion of controls, sockets and other paraphernalia. They confront you every time you look round another edge or peer into another cranny. Yet miraculously, so well is the grouping

and organisation of controls contrived, the deck is anything but confusing to use, and a little practice makes the machine almost intuitively obvious. It is robustly constructed from metal and plastic structural parts, and in every sense is eminently practical. The only thing missed out on my wish list was a built-in mono microphone for emergency convenient low-fi use.

LAB REPORT

The CP230 cannot claim to be of domestic hi-fi standard all round, though in certain respects the sound belies the measurements. The wow and flutter is a relatively poor 0.20% weighted, but the unweighted figure is a more acceptable 0.29% and the flutter spectrogram shows why. The wow end of the spectrum is quite good, but there's a strong energy bias around 50Hz, perhaps because the capstan flywheel is too small. This is certain to add some roughness to the sound and result in a loss of resolution. The noise spectrogram also shows severe modulation outside the DIN weighting curve.

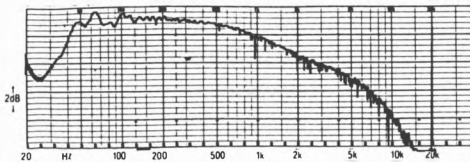
The Marantz runs perilously close to clipping at 0VU, as the intermodulation test shows. Simple harmonic distortion levels and signal/noise figures are perfectly satisfactory at this level on all three tape types, but complex high level, high frequency material will not be recorded cleanly.

The response shape is good in each case too, the ferric Type I plot promising the snappiest performance. Dolby noise reduction only mis-tracks to a marginal extent. However, the replay only response is very poor, and declines at a rate of knots from well below 1kHz, resulting in an effective (perceived) bandwidth worse than AM radio.

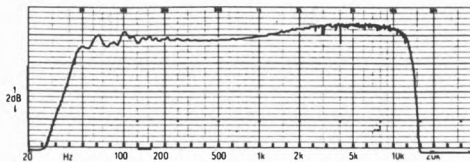
Note that IEC 0dB corresponds to +5dB on the meters, and that although they read transients quite well, they do tend to under-read peaks a little compared to LED meters. The peak reading LED responds faster and therefore acts as a useful safety net.

SOUND QUALITY

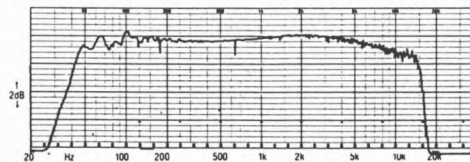
You'll not be surprised to hear that prerecorded material replayed with a very dull and rather stodgy, monochromatic sound, with the harmonic overtone structure severely curtailed. It



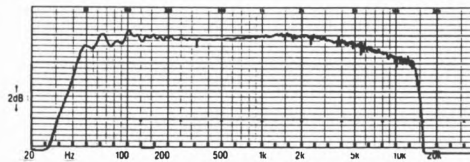
Playback only frequency response (pre-recorded tapes)



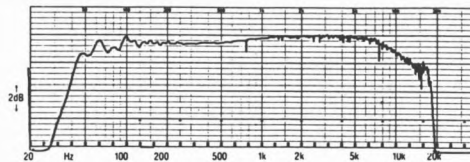
Overall record/replay response. Type I (ferric) tape



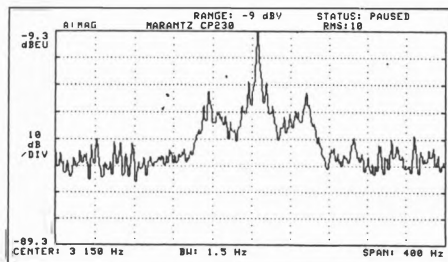
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

Continued over the page

Marantz CP230

Continued from previous page

was, to use the correct technical phrase, a washout.

When recording, the CP230 caused a loss of body and richness, which was also apparent when the electronics were assessed on their own. In addition to this, it sounded a little cluttered and coarse, and some HF unevenness and 'splash' was intermittently apparent. These shortcomings were reduced with the higher energy formulations, however.

On the whole the Marantz coped quite well with complex, wide ranging material, and almost as well with very simple recordings of chamber and recital material for instance, where the problems are always most clearly exposed.

Top end squash was quite easy to avoid without running into noise problems caused by excessively low record levels, because the deck has quite a wide inherent dynamic range. Even so, the ability of this deck to produce listenable tapes when not using noise reduction is questionable in most situations. Happily, the degradation caused by the additional signal processing circuits wasn't serious in context, though it was audible.

Logically, Type II chrome-bias tapes should suit the CP230 best, and certainly the Marantz proved incapable of extracting the best that metal can offer. Nevertheless, metal on the Marantz offered a particularly attractive blend

of shape and stability in the midband that was well worth having.

CONCLUSIONS

As a pro or semi-pro recorder which can be taken on an assignment, the Marantz has several virtues, including versatility, practicality and toughness.

As a domestic hi-fi recorder, the case is nothing like as clearly in the Marantz's favour, and the review sample wouldn't adequately serve for commercially recorded software at all. When used to play back its own tapes, however, the situation was much better, and this is clearly a recommendable package. By any standards, it's also extremely well priced.

TEST RESULTS

Rec/replay response - 3db ref 1kHz	
IEC Type I	40Hz-14kHz
IEC Type II	40Hz-16kHz
IEC Type IV	40Hz-18kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.20%/0.29%
Speed error	+0.15%
Type I signal/noise CCIR/ARM 315Hz	-49dB
distortion 0dB	0.7%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.9%
Type IV signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	0.85%
Channel separation OVU/1kHz	47dB
Line input sensitivity/overload	88mV/73V
Mic input sensitivity/overload	0.48mV/110mV*
Line output for 0dB/maximum	645mV/1.29V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	6.6%
Azimuth check R-L phase at 8kHz	30 degrees
VU indication at IEC 0dB	+5dB
Dimensions (w x h x d)	22.6 x 5 x 16.7cms
Typical Retail Price	£250
*mic attenuator at 0dB	

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WEST SUSSEX. TEL: (0903) 750750



The BX-125E is a 'budget' Nakamichi deck (the word budget used in a relative rather than absolute sense), with two heads plus Dolby B and C noise reduction. What sets the BX-125E apart is what sets most Nakamichis apart: engineering integrity. The impression of a solid and stable build quality is unmistakable, reinforced by a cam-operated transport which has a well-oiled slickness that would credit a deck several times the price.

Operating logic is just about perfect too. The touch of a single finger invokes record/pause, another starts record mode proper. The record level meters have adequate resolution and a near 40dB operating dynamic range. Twin record level sliders make ganged fading easy and facilitate balance adjustment. The tape counter is mechanical, but does have memory stop and repeat, the latter cycling between counter zero and the end of the tape, or simply between the two tape extremities. Microphones are not accommodated, but a headphone socket is adjustable via a front panel pot which also feeds the main output. (Naughty!)

The usual Nakamichi quirks are here too, notably the separate bias and equalisation switching for the various tape types, confusingly labelled with IEC type numbers and Nakamichi's own tape designations. Dolby switching

is confusing too.

Automatically controlled fades can be accomplished with the Master Fader rocker control, and the deck can be coupled to a timer. As with all Nakamichi models, the cassette well cover is readily removable if access is required to the heads and guides for cleaning and demagnetisation. The transport as always is a peach, with no less than three motors, one each for the tape hubs and the single capstan.

LAB REPORT

The noise spectrogram has an excellent pitch centre, with virtually no noise or sidebands out to $\pm 40\text{Hz}$, and a low overall level of noise. Wow and flutter is well controlled in absolute terms (0.065% wtd, 0.14% unwtd), but analysis shows a cluster of wow components below 10Hz, measuring -33dB at 5Hz. At 40Hz there is a strong -30dB flutter component, indicative perhaps of a resonant mode of some description.

Peak level intermodulation is low enough to suggest adequate headroom for metal tape, but without overgenerous margins. Head azimuth is only modestly in error, but the replay response is flat only up to about 2kHz, after which it rolls off rapidly, with -3dB coming up around 7.5kHz. The record/replay response shapes are mostly pretty good barring some HF effects, the most disturbing of which is quite significant

Dolby mistracking, especially with Dolby C. The noise vs harmonic distortion tests threw up quite good results.

Note that this deck must be positioned carefully to avoid hum pickup.

SOUND QUALITY

Allowing for some rough edges, the BX-125 lived up to its reputation, except when using pre-recorded material. Although the Nakamichi sounded only mildly dulled with such tapes, it did sound messy and the various instruments and voices in representative recordings sounded poorly separated, with a curiously muddy bass and slightly higher than expected hiss levels.

Recordings made on the machine itself could not have presented a stronger contrast. The BX-125 does have an upper midband colouration of the kind associated with (for example) certain capacitor types when fitted to suitably transparent sounding amplifiers. Underpinning this, however, is truly excellent resolution, a taut, tuneful but again rather coloured bass, and a sweet treble which speaks volumes for transport stability and circuit design generally. This Nakamichi doesn't swamp inherent differences in tapes, and whilst the three tape groups all worked well, Type IV metals offered more lucid and articulate midrange, and firmer bass.

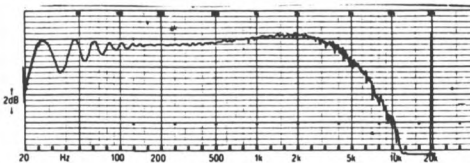
CONCLUSIONS

There is a certain messiness to the sound of this deck, but the fundamentals are very, very right. Dynamics, pitch integrity and clarity come together in a very convincing form. But pre-recorded cassettes remain the poor relation.

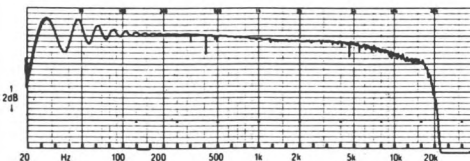
TEST RESULTS

Rec/replay response - 3dB ref 1kHz

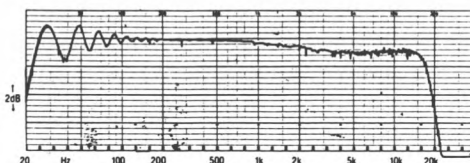
IEC Type I	20Hz-19kHz
IEC Type II	21Hz-19kHz
IEC Type IV	20Hz-22kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.065%/0.14%
Speed error	+0.4%
Type I signal/noise CCIR/ARM 315Hz	48.5dB
distortion 0dB	0.95%
Type II signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	1.0%
Type IV signal/noise CCIR/ARM 315Hz	50.5dB
distortion 0dB	1.5%
Channel separation 0VU/1kHz	47dB
Line input sensitivity/overload	75mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	666mV/3.19V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	1.58%
Azimuth check R-L phase at 8kHz	13 degrees
VU indication at IEC 0dB	+4dB
Dimensions (w×h×d)	43×10×25cms
Typical Retail Price	£395



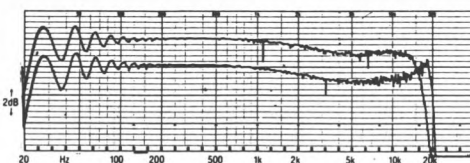
Playback only frequency response (pre-recorded tapes)



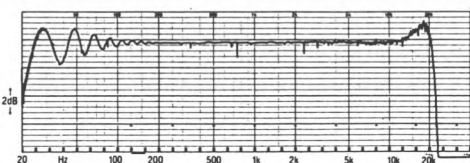
Overall record/replay response. Type I (ferric) tape



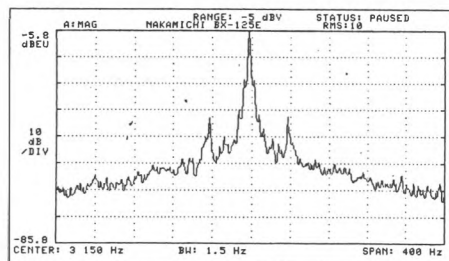
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

NAKAMICHI BX300E

NAKAMICHI B&W (UK) LTD, MARLBOROUGH ROAD, CHURCHILL INDUSTRIAL ESTATE,
—LANCING, WEST SUSSEX. TEL: (0903) 750750—



Nakamichi is still the first name in audiophile cassette decks. The BX-300E may not be at the top of the Nakamichi hierarchy, but it still embodies a quality of engineering quite beyond that achieved by the majority of Nakamichi's peers.

This is a standard width unidirectional player equipped with three heads, which allows off-tape monitoring. Noise reduction is the usual Dolby B and C, with separate multiplex filtering. Playback pitch is adjustable over a narrow range, and bias can be tweaked by a small amount too. Output voltage is adjustable via an output level control, which is also ganged with the head-phone feed: far better than the amplifier feed had been at a fixed level.

A large number of controls cover a multiplicity of functions, including a (two speed) master fader control for use when recording, auto repeat (whole side or from counter zero), and memory on the electronic counter. Around the back there is a socket for an optional wired remote control. The record level controls take the form of twin sliders which can be operated quite naturally in unison. Record level meters are long and clearly calibrated, but with no colour change or peak hold facility above 0VU.

The mechanical design of the BX-300E is quite sophisticated. It has twin capstans, uses

Nakamichi's 'diffused resonance' construction, and is operated by slick and quietly engaging transport controls. From almost every point of view, this is an impressive piece of machinery.

However, it is not a deck for the casual user. In some ways it seems almost deliberately obstructive. Where the majority of modern cassette decks have automatic tape type recognition, the 300 is saddled with manual bias settings, using three switches marked with the Nakamichi tape type and the IEC type number in brackets (*viz*: ZX[IV]), plus a separate equalisation switch. Unhelpfully these are press buttons, and like others fitted to this machine they don't give a clear indication of their status at a glance. In mitigation, the engineering quality of Nakamichi's controls (as for most of the rest of the deck) is such that it's almost a pleasure to be so inconvenienced....

LAB REPORT

It would have been a major surprise had speed stability not been up to scratch in all respects. There were no surprises. 0.04% measured wow and flutter weighted (0.10% unweighted) are excellent numbers even for a deck costing twice the price. Analysis of the various spectrograms shows that there is some hash at the lowest (wow) frequencies, but very little that is correlated into specific frequency bands except for

one peak (structural resonance?) at 34Hz, -38dB.

The noise modulation spectrogram confirms some of the same information. Note the fine definition of the centre frequency, which means excellent speed stability, and the low modulation noise overall.

Surprisingly, there was more than just a touch of replay head azimuth error (22 degrees at 8kHz), and the replay response was well below par, as seen in the downwards slope in the playback response up to 5kHz, and the quick death thereafter. The plot disappears through the floor (-8dB) only a little above 10kHz.

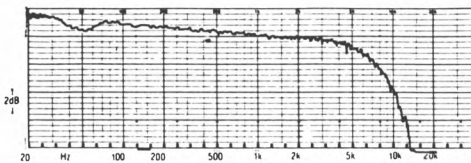
The record/replay responses dip about 1dB at the HF end with Type I and II tapes, but are amenable to adjustment with the fine bias control (set to the central position for this test with the IEC test tapes). The plots show how this error is exaggerated by Dolby C processing, with a worst case -2dB around 14kHz for Type II with Dolby C.

Because IEC 0VU is set at no less than +5dB on the deck's own meters, the reason for the slightly better signal/noise and poorer than normal distortion becomes clear. In fact performance on both counts is very good, and backed by ultra-low intermodulation which promises more than adequate HF headroom especially with Type IV tapes. Just make sure to peak recordings a little higher than normal on the record level meters.

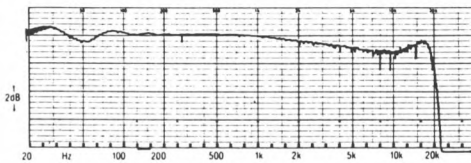
SOUND QUALITY

The Nakamichi's electronics are responsible for noticeable degradation on their own accord, injecting a certain 'heaviness' and slurred quality into the music. Nevertheless, although not top ranking the deck's electronics have good detail and do less to 'process' the sound than most. It's a sad but true fact that no cassette deck (known to the author at least) has even the basic electronics sound quality of a top flight pre-amplifier, which functionally they resemble.

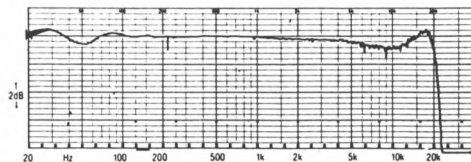
Off-tape, where greater losses are to be expected, the BX-300E proved extraordinarily lucid and stable. There was nothing in the sound that could indicate less than immaculate speed stability: the deck had a sense of image and pitch precision that knows few better, and none whatsoever at the price. Imagery was explicit



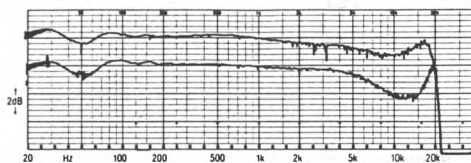
Playback only frequency response (pre-recorded tapes)



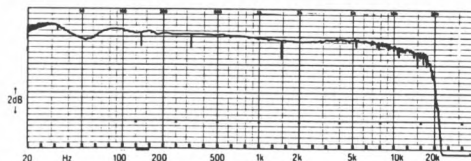
Overall record/replay response. Type I (ferric) tape



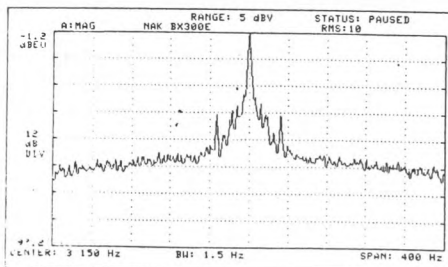
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

in lateral and depth planes, and instrumental (plus vocal) separation (as in distinctiveness) was well above average. The Nakamichi simply didn't sound much like a cassette deck — a rare accolade.

The BX-300E was particularly successful with metal Type IV tapes, and very nearly as good with Type II tapes (ferric Type I tapes generally sounded softer and easier). But there was noticeable degradation with Dolby on board, with Dolby B sounding better than Dolby C as the numbers imply. The working dynamic range of the BX-300E is such that it is often feasible to record without Dolby at all, and sound quality definitely benefits as a result.

Pre-recorded cassettes, however, were bad news. The wobbly response curve was very audible indeed as a kind of muddy, dulled sound, with Dolby mis-tracking taking its toll of image integrity and dynamics. This was probably an individual aberration judging by normal Nakamichi standards, but as it stands the review sample certainly wouldn't make an acceptable tool for playing commercially recorded tapes.

CONCLUSIONS

As a low-end audiophile cassette deck, the

BX-300E looks an excellent proposition, with many of the best attributes of more expensive Nakamichis, and sacrifices mostly where they don't matter very much. Nakamichi still have something to learn about human engineering, but few can teach them how to make tape machines work. A little more care over setting up (which can be readily accomplished by the better Nakamichi dealers anyway) would make it unassailable at the price.

TEST RESULTS

Rec/replay response — 3db ref 1kHz	
IEC Type I _____	<20Hz-20kHz
IEC Type II _____	<20Hz-22kHz
IEC Type IV _____	<20Hz — 20kHz
Wow & Flutter — Peak DIN wtd/unweighted _____	0.04%/0.10%
Speed error _____	0%
Type I signal/noise CCIR/ARM 315Hz _____	48dB
distortion 0dB _____	0.65%
Type II signal/noise CCIR/ARM 315Hz _____	49.5dB
distortion 0dB _____	0.65%
Type IV signal/noise CCIR/ARM 315Hz _____	51dB
distortion 0dB _____	0.46%
Channel separation OVU/1kHz _____	-48dB
Line input sensitivity/overload _____	100mV/>7V
Mic input sensitivity/overload _____	n/a
Line output for 0dB/maximum _____	1.56mV/6.5V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product _____	0.14%
Azimuth check R-L phase at 8kHz _____	+ 22 degrees
VU indication at IEC 0dB _____	+ 5dB
Dimensions (w×h×d) _____	43×10×25cms
Typical Retail Price _____	£645



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NAKAMICHI CR-7E

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Although a full £250 cheaper than the *Dragon*, the Dolby B/C CR-7E is not downmarket of that model. It simply offers an alternative and in certain ways more domesticated set of specifications, with a roughly equivalent standard of engineering. Naturally this is in the Mercedes class.

Proof of its friendlier packaging is the auto tape type sensing feature, the first time this has been seen on Nakamichi (though a manual facility is retained as an option). There is also a version of the playback head azimuth adjustment facility first seen in the *Dragon*, and an auto tape tuning facility for the first time with this marque.

Naturally the CR-7E has three discrete heads, offering better physical and electrical independence than the siamesed variety (claim Nakamichi). The transport uses an elaborate dual capstan system with all components made in such a way that the various inevitable structural resonances don't excite each other. One feature missing from the CR-7E, however is the *Dragon's* auto-reverse.

The auto tape alignment works similarly to the manual *Dragon* system in adjusting sensitivity and bias but not record equalisation. However, the CR-7 also includes playback head azimuth adjustment as the first step in the pro-

cess (necessary because the playback head can be re-oriented with respect to the record one, which is not the case elsewhere). The whole alignment procedure takes about 15 seconds. To cope with the playback situation, the CR-7E has a *manual* azimuth alignment control, with a graphic display which is of no help at all — it's purely cosmetic: the technique is simply to tune for maximum treble.

Another example of the new user-friendly Nakamichi image takes the shape of a neat infrared remote control handset. With just eight control buttons, it enables the user to start recording or access any of the other important transport modes, and to tweak the azimuth setting.

The record level meters have a 50dB dynamic range and peak hold LEDs. There is even an intelligent tape counter, which gives numerical and time counts, with a choice of elapsed or time to go. You program in the tape length first (C45, C60 & C90, but not C120) and the machine does the rest within a few seconds, even if the tape is inserted halfway through. Needless to say, there are any number of other convenience features; things like a counter memory, auto fades at the end of a tape (yes, switchable), or invoked manually at any other time, auto repeat, subsonic and MPX filtering, and an output level control.

LAB REPORT

The CR-7E has an excellent transport by normal standards, but on the showing of this sample at least it's inferior to that of the *Dragon*. Overlaying either of the spectrograms shows the extra energy contained under the CR-7 trace. Taking the noise modulation plot, the CR-7 has a fairly narrow main component, but with observable wow sidebands. At wider bandwidths, noise levels are low. The differences were more marked with the fluttergram, which should have been better. 6Hz wow was at -24dB , and there were other significant components at 12Hz, 18Hz and at other multiples of 6Hz. All of which helps explain the 0.13% peak DIN weighted wow & flutter figure, which on past form is not typical for this model.

As with other Nakamichis, the record/replay frequency responses — measured after auto-calibration — have supremely accurate midbands, which barely deteriorate at the frequency extremes. IEC Type I ferric tape had a barely perceptible rolloff in the extreme HF, whilst Type II and IV tapes were simply flat up to nearly 20kHz. Both types of Dolby processing had a small but perhaps significant effect on the intrinsic response shape.

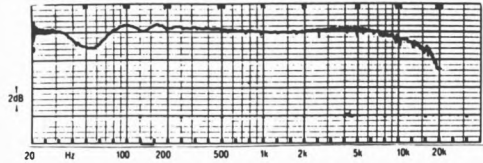
The playback only response, is textbook stuff, akin to that of the *Dragon*. Out of interest, this response was run twice, once with the azimuth control centred, and once with the setting corrected by ear. The former gave a measured 60 degree phase lag at 8kHz, and a -3dB point at just over 8kHz. Properly optimised, the -3dB point was at just over 20kHz!

Taking the achieved harmonic distortion levels into account, the CR-7E has an amazingly good noise performance, with Type II stock in particular (Type I ferrics measured similarly). This deck has a genuinely wide working dynamic range, on a par with the best currently achievable with the compact cassette medium.

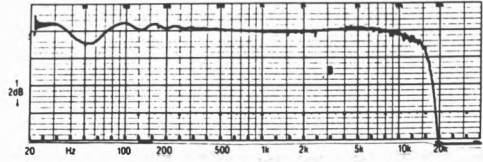
SOUND QUALITY

Given the inferior measurements in crucial areas, notably wow & flutter, the CR-7 was expected to audition a little worse than the *Dragon*. Instead it sounded better — clearly better.

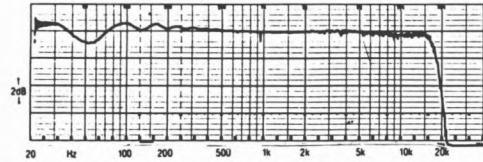
However the main sonic features were shared between the two. One of the points that was



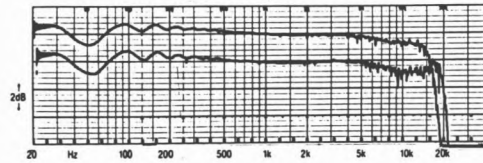
Playback only frequency response (pre-recorded tapes)



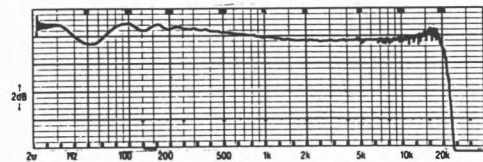
Overall record/replay response. Type I (ferric) tape



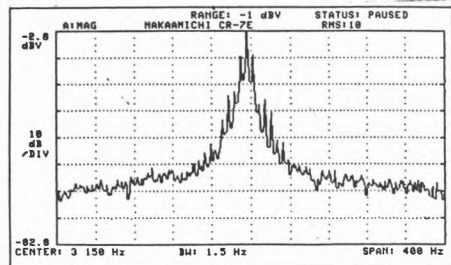
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

noticed first was the comparative absence of 'waffle' in the bass. The CR-7 shares with the *Dragon* a very powerful, deeply extended bass that has a superb sense of pitch and a real ability to start and stop quickly, adding stature and tonal variety to the music as a whole. The other remarkable feature of the sound of both top Nakamichis is the combination of lucidity and transparency in the midband.

Where the CR-7 scores over the *Dragon* and any other cassette deck known to the author is in the quality of its electronics. Where the *Dragon* tended to sound a little hard and constrained, the CR-7 was sweetness and light itself. It sounded as though the circuit is what it probably isn't — simple. With a minimal effect on music signals passing through, this deck had an unrivalled ability to preserve subtle soundstage information and the almost subliminal ambient cues that can make an involving musical experience from a quality sound that is merely good.

The CR-7 preserved much of these almost intangible qualities through the tape chain, and ended up providing a standard of music making that was nothing if it wasn't just that — tangible. Inevitably there were some losses of some of the more subtle information, and on a couple of tapes there was a suggestion of 'shimmering' on high piano notes, presumed to be wow.

For most of the time, however, pitch and image stability were not materially worse than the *Dragon*, numbers notwithstanding. But again it was necessary to switch the Dolby circuits off to extract the last ounce of vitality and resolution. With some types of music this is simply impractical, but the CR-7 can drive tape very hard indeed before obvious compression sets in.

Adjustable azimuth once again means that pre-recorded cassettes can be exploited for all they're worth. The CR-7 was capable of extract-

ing a great deal from a wide range of tapes, but it cannot be overlooked that these still tended to sound a little threadbare compared to other sources of pre-recorded music, including cassette's senior partner and oldest foe, the 12-inch vinyl LP.

The CR-7 was an open book to the tapes that were used in it. Metal Type IV tapes gave the clearest and best separated sound; Type I and II tapes were generally slightly softer in *extremis*, but almost equally capable. The sheer quality of sound that can be extracted from this £1500 machine playing £1.50's worth of ferric oxide, binder and plastic is quite an eye-opener.

CONCLUSIONS

As well as offering a more extensive range of user features than cheaper Nakamichis, the CR-7 also sounds better, thus justifying its extremely high price. It demonstrates clearly what is possible with the cassette medium, in a rather more user-friendly form than previous top decks from this manufacturer.

TEST RESULTS

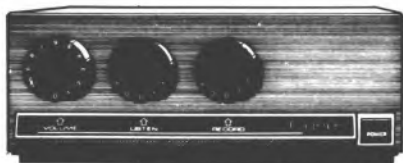
Rec/replay response — 3db ref 1kHz	
IEC Type I _____	<20Hz-17kHz
IEC Type II _____	<20Hz-19kHz
IEC Type IV _____	<20Hz — 23kHz
Wow & Flutter — Peak DIN wtd/unweighted _____	— .13%/0.20%
Speed error _____	— 0.1%
Type I signal/noise CCIR/ARM 315Hz: _____	50dB
distortion 0dB _____	0.7%
Type II signal/noise CCIR/ARM 315Hz: _____	52dB
distortion 0db _____	0.8%
Type IV signal/noise CCIR/ARM 315HZ: _____	52.5dB
distortion 0db _____	0.6%
Channel separation 0VU/1kHz: _____	48dB
Line input sensitivity/overload _____	74mV/>7V
Mic input sensitivity/overload _____	n/a
Line output for 0dB/maximum _____	1.4CV/7.4V
I-M distortion 10kHz/11kHz: 0dB peak, 1kHz: product _____	— 0.75%
Azimuth check R-L phase at 8kHz _____	adjustable *
VU indication at IEC 0db _____	+ 3dB
Dimensions (w × h × d) _____	43.5 × 13.5 × 30.6cms
Typical Retail Price _____	£1500
* see text	

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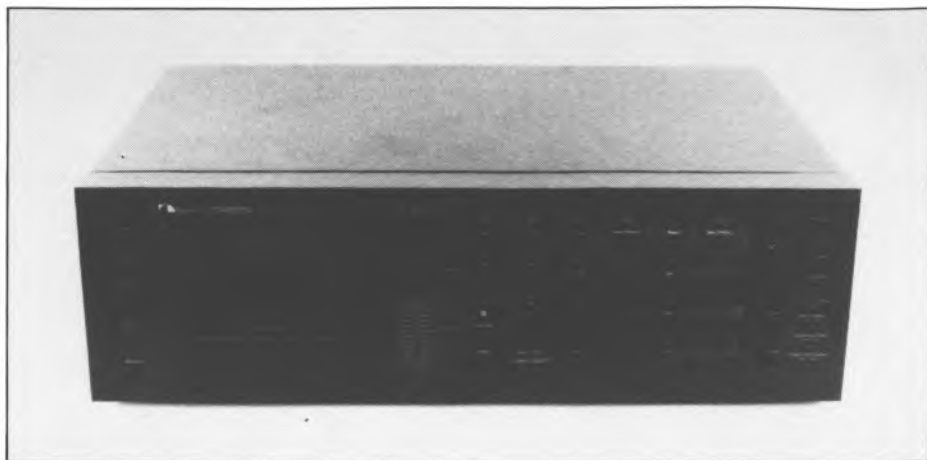


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Until the CR-7E arrived, this was the cassette deck against which all others were judged. The *Dragon's* claim to fame is twofold. First, it is almost unequalled in the sheer quality and integrity of its construction, which has all the hallmarks of a professional piece of kit. It has a truly sophisticated transport mechanism using two separate quartz-referenced non-cogging direct drive motors, one for each of the two capstans, plus a separate reel motor. The trailing capstan must run slightly slower than the leading one to maintain tension across the heads, and although this is established practice with unidirectional decks, it's hairy stuff with auto-reverse models.

Secondly, the *Dragon* is uncompromisingly directed at extracting the optimum playback quality from any tape, no matter what its origins. In this case, no compromise means exactly what it says. Allowing for some typical Nakamichi quirks, the *Dragon* is as functional and straightforward as the nature of the design allows. But the nature of the design dictates that each of the three tape types be kitted out with its own set of bias and sensitivity controls, for each of the two separate channels.

Bias adjustment varies the amplitude/frequency response, especially at HF, whilst the sensitivity adjustment facilitates correct Dolby

tracking integrity. The Nakamichi design enables any tape to be tuned in by way of the three tape slots independently. The adjustments are performed manually using built-in 400Hz and 15kHz oscillators.

The other unique *Dragon* feature is the automatically adjusting replay head azimuth. The playback head gap for one channel only is divided along its length (equivalent to track width on the tape) into two sub-units, each with its own windings, and circuitry looks for phase differences between them. This difference signal then feeds a servo motor which corrects the azimuth of the head to match that of the original recording. This happens transparently to the user, and of course does not happen when recording.

These are the items you won't find on the *Dragon*: there is no automatic tape type selection. Bias and equalisation are set separately using controls labelled obscurely with the Nakamichi tape types (ZX, SX etc). You won't find Dolby HX Pro or dbx, nor auto-reverse record, even though the deck can reverse automatically at the tape end in play mode. The reverse action is triggered mechanically, and is therefore slower-acting than optical detector systems.

You will of course find Dolby B and C, with independent MPX filtering and using an awk-

ward juxtaposition of controls. Other features include subsonic filtering (useful with some record decks), auto record pause, separate channel and ganged master input controls, and an output level control (for the main output and headphone socket alike), a counter memory, 50dB meters, 2-speed auto fade — and the rest is all in the fine print.

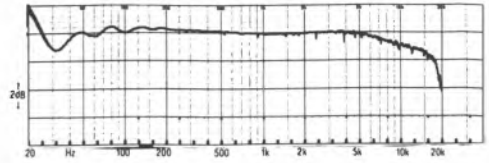
The inescapable irony with the *Dragon* is that a great deal of the expense and complication is directed at a task that shouldn't be necessary if other manufacturers did their jobs right by sticking to the relevant standards — correcting the incompatibilities that arise from recorder to recorder and from tape to tape. You should consider how far such incompatibilities affect you before choosing this machine over, say, certain of the *Dragon's* stablemates.

LAB REPORT

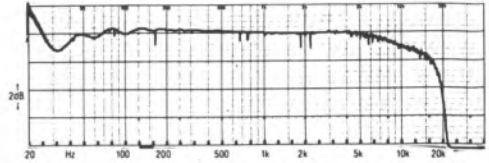
Pitch stability is of an impressively high order, as demonstrated by the noise modulation spectrogram for example, with ultra-low noise levels from ± 20 Hz out. The fluttergram told a similar story — all discrete peaks were at -40 dB or better! And those that were there were well dispersed, which of course is the primary design aim of the diffused resonance transport construction. 0.027% peak DIN weighted wow & flutter is a fine result by any standard, and combined with the two spectrum analysis plots, speaks volumes for the *Dragon's* engineering.

As expected, very little measured inter-modulation distortion means the *Dragon* is one deck that is perfectly capable of driving metal tape hard. The signal/noise and harmonic distortion figures are referred to the 0VU point on the Nakamichi meters, which corresponds to 3dB below IEC 0dB. Taking this into account, the noise levels are good, especially with Type II and IV tapes. The distortion figures are also low, so most program material can be recorded a few decibels into the red. The *Dragon* has a wide working dynamic range.

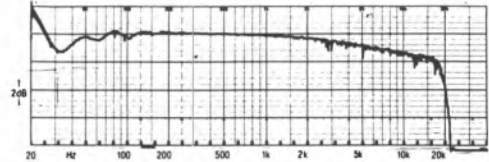
The playback plot displayed here speaks for itself. Likewise most of the record/playback responses. The bias and sensitivity settings used were the standard ones (all adjustments points centred) and can in fact be flattened at the HF end to a high degree of accuracy with almost



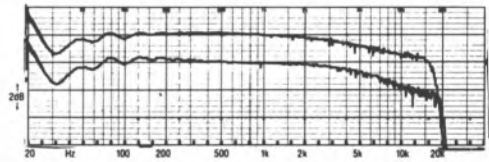
Playback only frequency response (pre-recorded tapes)



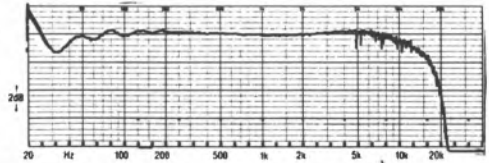
Overall record/replay response. Type I (ferric) tape



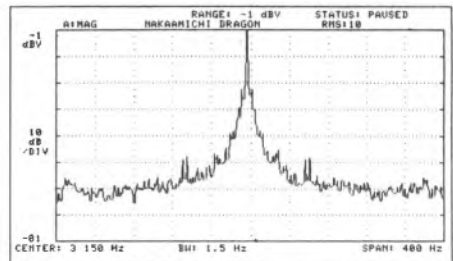
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

any tape type. Dolby processing had essentially no effect whatever on the intrinsic responses. The LF end is well tailored, with a bare minimum of head contour effects.

SOUND QUALITY

There's no doubting the audio quality of this elaborate cassette deck. By any standards, it's special. As a tape processor — ignoring its record and playback amplifiers for a moment — it is all but inaudible. With a good tape on board, especially a metal (Type IV) the quality of sound produced from the tapes was essentially the same as the sound monitored via the deck's electronics, but with certain caveats.

Caveat number one concerns Dolby processing. A common theme running through this whole project is the loss of resolution imposed by Dolby circuits. Often these losses can be laid at the door of low grade chips (Dolby processors like other components are available in various grades), or incorrect tracking, which can occur if almost any of the many interrelated adjustments that are made on the production line should change. With the *Dragon*, however, we hoped to find a deck where Dolby simply reduced noise, without significant side effects.

Sadly it was not to be. Selecting either flavour of noise reduction added a hardness and constrictor to the music that could not be mistaken. It wasn't severe, and with some program material couldn't even be heard, but there was no doubt at all that when quality was of the essence, recording without Dolby led to a freer, airier and sweeter sound. Happily, the Nakamichi is one deck that has a sufficiently wide dynamic range for practical use without noise reduction.

The only other slight bottleneck with the *Dragon* was the electronics, which also imposed a distinctive sonic signature on the sound. Using the *Dragon* wired into the tape monitor loop of a high grade preamplifier introduced further slight hardening and loss of stereo depth and separation. But the effect was mild.

Auto azimuth control means that the best will be extracted from all pre-recorded cassettes, and these sounded magnificent in nearly all respects. The extraordinary amount of detail the *Dragon*

pulled off tapes I had almost given up on was the biggest and best surprise.

There was never any suggestion through the tests that speed constancy was anything less than absolute, and tape to head contact was also very stable, as evidenced by the low dropout level. On tape choice, high bias tapes perform optimally in this deck; they outperform others with most types of music. But the *Dragon* specialises in making the most of the tape you have, and as long as it is a reliable brand, it should make fine music.

CONCLUSIONS

Never was a cassette deck more appropriately named. The *Dragon* is a genuine fire-breathing monster, an anachronism of the first order. No amount of self-deception can make an easy-to-use cassette deck from this confused and confusing mass of controls.

Prior to the introduction of the *CR-7E*, the *Dragon* was very simply the finest domestic cassette recorder money could buy. However, the *CR-7* has placed it in a slightly different perspective. Take away some of the shiny finish, attach rack mounting handles and balanced 600ohm socketry, and what it *really* is would be revealed: a refugee from the studio world, a machine to test and calibrate tape and machine, or a hack for monitoring output quality of blank or pre-recorded tape stock.

TEST RESULTS

Rec/replay response — 3db ref 1kHz

IEC Type I	<20Hz-18kHz
IEC Type II	<20Hz-19kHz
IEC Type IV	<20Hz-18kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.027%/0.065%
Speed error	-0.2%
Type I signal/noise CCIR/ARM 315Hz	48.5dB
distortion @1B	0.65%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion @1B	0.5%
Type IV signal/noise CCIR/ARM 315Hz	51dB
distortion @1B	0.44%
Channel separation @VU/1kHz	-47dB
Line input sensitivity/overload	80mV/>7V
Mic input sensitivity/overload	n/a
Line output for @1B/maximum	1.36mV/6.5V
IM distortion 10kHz/11kHz @3dB p.p.s.k. 1kHz p.p.s.d.c.c.	0.2%
Azimuth check R-L phase at 8kHz	5 degrees
VU indication at IEC @1B	+3dB
Dimensions (w×h×d)	45×13.5×30cm
Typical Retail Price	£1750

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At the time of writing, Onkyo is getting underway with a new distributor. This may give what so far has been a range with a good reputation but a laid back image a bit more exposure and pizzazz. The TA-2130 shows that the company has the basic mettle to succeed though some of its design points are nevertheless questionable.

Conventional in external design and layout, the TA-2130 is solidly built and quite slick in a low-key way if you turn a blind ear to the usual deafening solenoid clicks. It's a two-motor, two-head deck, with Dolby B and C, auto tape recognition, and variable bias ('Accubias') (for Types I and II tapes only). The record level meters have a best case 3dB resolution and a 26dB dynamic range, which is adequate. Strangely, the almost inevitable track search facility is only available as an intro-scan feature, to play a few seconds from each track, though of course play can be continued manually at any time. The machine will also repeat individual tracks or tape sides up to five times.

This is one of the few moderate price cassette decks left fitted with microphone inputs (come to think of it, I keep writing the same thing...). Unusually, the mike inputs have their own input level controls separate from the line level controls, which provides a simple

built-in mixing facility, perhaps for making compilations with voice overs, or adding music to whatever is being recorded.

The cassette loading drawer is obstructively designed: unless the tape is inserted at precisely the right angle, the thing jams up and refuses to take it at all. A trivial redesign would cue this. And whilst they are about it, how about a little friction coupling between the split halves of the input level controls? Ta very much.

LAB REPORT

On the whole, the Onkyo emerges from the bench tests without too many blots on its copy-book. The spectrogram shows good centre frequency definition, clean (uncorrelated) noise out to $\pm 20\text{Hz}$ at -25dB , and quite good broadband noise modulation. The major flutter component is at 5Hz, -23dB which is a little high for comfort, but the spectrum at higher frequencies is quite clean — low noise and low flutter.

IM distortion is disappointingly high at 10.9% (measured in the usual way), and the record electronics don't have much headroom to spare. (Metal tape Barbara Striesand freaks or percussion enthusiasts might be better off looking elsewhere.) However, all response runs were clean and accurate with especially neutral midbands, and Dolby processing caused little

change. The replay only response, of particular interest to those who listen to pre-recorded material, is very wonderful: the midband area is essentially flat, and the -3dB points falls at 13kHz .

SOUND QUALITY

Commercially recorded tapes sounded pretty fair, apart from an occasional attack of the 'wobbles' and a smidgen of HF grain and noise. Tonally the deck sounded neutral, and musically the sound had a nice, cohesive quality with adequate detail — nothing too ambitious mind.

And it makes good recordings too, though the tiny non-coupled twin input pots are a right royal pain in the butt. The Onkyo offers a degree of consistency amongst the various tape species, and on balance Type II tapes like TDK SA offer about the optimum compromise between performance and price. Metal tape is hardly worth the premium here. The overall characteristics were a handy mixture of clarity, stability and — best of all — a consistency with changing levels and frequencies that helped make the deck satisfactorily unobtrusive in practice.

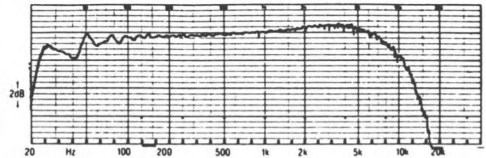
CONCLUSIONS

Not a complicated deck this, the particular blend of gadgetry appears to have been arrived at without the benefit of a hands-on by someone who uses cassette decks on a day to day basis. Sound quality and engineering, however, are a little better than average and the price is reasonable. Recommended.

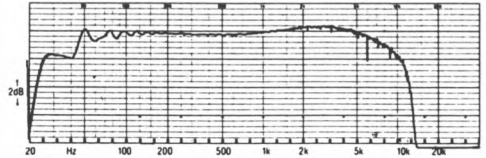
TEST RESULTS

Rec/replay response -3dB ref 1kHz	
IEC Type I	24Hz-12kHz*
IEC Type II	24Hz-14.5kHz*
IEC Type IV	24Hz-16kHz*
Wow & Flutter — Peak DIN wtd/unweighted	0.13%/0.30%
Speed error	-0.5%
Type I signal/noise CCIR/ARM 315Hz	52dB
distortion 0dB	0.6%
Type II signal/noise CCIR/ARM 315Hz	54.5dB
distortion 0dB	2.6%
Type IV signal/noise CCIR/ARM 315Hz	55dB
distortion 0dB	2.0%
Channel separation 0VU/1kHz	-46.5dB
Line input sensitivity/overload	72mV/ $>7\text{V}$
Mic input sensitivity/overload	0.57mV/23.8mV
Line output for 0dB/maximum	536mV/2.7V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	10.9%
Azimuth check R-L phase at 8kHz	8 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	43.5×11.2×26.2cms
Typical Retail Price	£140

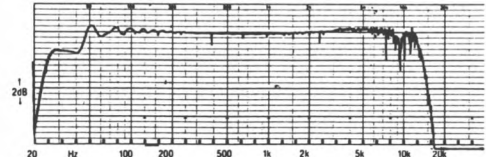
* bias set per manufacturers recommendations for TDK tapes



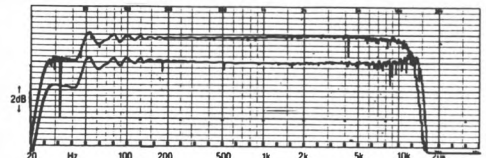
Playback only frequency response (pre-recorded tapes)



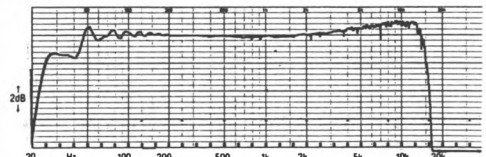
Overall record/replay response. Type I (ferric) tape



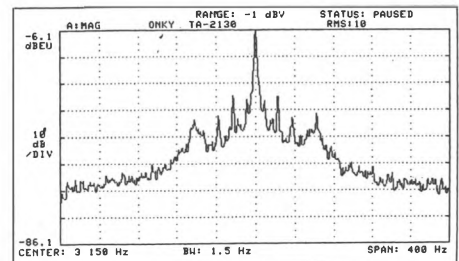
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

PIONEER D-1000

PIONEER HIGH FIDELITY GB LTD, FIELD WAY, GREENFORD, MIDDX UB6 8UZ.

TEL: 01-575 5757



At the time of writing (end June 1987) no DAT recorder was on sale in the UK or anywhere else outside Japan, nor have launch dates been publicly set. This applies to the subject of this review of course, which is a Japanese home market sample wired for 100 volt working. Some of the issues surrounding DAT are discussed in the Introductions, but inevitably much of this review is of a general nature.

Rather than assemble and include reviews of a number of products you can't actually buy, we thought it sensible to choose just one representative DAT recorder to show where the main differences and similarities to the traditional compact cassette lay. The Pioneer was chosen to make the case for DAT, as it is more obviously aimed at the audiophile market than some of its peers.

The Pioneer D-1000 is an impressively large and heavy machine, superbly finished according to the mores of the Japanese home market in satin black with gold graphics, with wooden end-cheeks and a gold feature line to set it off. Internal construction is even more impressive, with extensive use of audio grade capacitors, a very sophisticated power supply, separate 16 bit, 4x oversampled ADCs and DACs with digital filtering for each channel, extensive use of OFC

cables for the loose wiring and inside the transformer, and full internal copper screening around sensitive circuit areas.

The tapes load into a fully enclosed holder which opens out from the bowels of the machine on command. The holder acts as a cassette stabiliser, and the drawer can be left open whilst playing. The machine is essentially impervious to jolts (in contrast to compact disc), though it is not proof against microphony, and I found some advantage in siting it on a light, stiff platform.

Appearance is a little less daunting than most early DAT machines, but that's scant consolation when the control system is so complex. In essence, however, the complement of bells and whistles is very similar to a typical modern up-market cassette deck or CD player, with a few extras to take care of indexing functions.

The main transport section on the right has the same controls you'll find on any cassette deck, plus cue and review (with audible output) and a numeric keypad to select track numbers. The deck can be programmed to play tracks in a random running order much like a CD player, but it will accept more programming steps (a grand total of 50) to match the longer playing time, and registers track and access times that are very much longer than you'd expect on a CD player. DAT struggles and ultimately fails

to behave like a true random access system, but this doesn't make such features unusable. Far from it.

The really unfamiliar controls are those just below the status window which carry legends like 'ID Mode' and 'Renumber'. DAT has so-called subcode or control tracks alongside to the main data tracks, and these can be used to store a CD style compendium of time and track number information, including of course track start points. Track index (access) points can be recorded automatically, when the machine 'hears' a gap between selections. Alternatively, the tracks can be programmed manually, or the automatically entered subcodes can be edited after the recording has been made.

The Pioneer is also equipped with an output level control and headphone socket. Record level is monitored by superb 60dB meters backed by numerical readout of the maximum reading encountered so far.

Tape handling takes its cue from the video world, and in the initial stages at least is a lot longer-winded than the familiar compact cassette where you simply open a flap, drop in a tape and press 'play'. With the Pioneer, from the time of asking the drawer to open to the point where the music is heard takes about 10 seconds — it takes about 4 seconds to eject the tape, which is mostly unlacing time (the loader opens simultaneously). Once the tape has been inserted and laced around the heads, response to commands is immediate — then you're down to the speed at which the tape can be shunted around whilst the deck continues to read time code.

'Next' and 'last' track commands are usually fulfilled within three or four seconds, but long distance hauls can take up to about 35 seconds, which compares to typical 3-4 seconds for CD, or 1 second for the best of the breed. And of course with CD you always start from the beginning — with DAT you may well need to rewind before the tape can be used.

In this as in many other areas (not forgetting the fact that DAT is anything but a no-wear system), DAT comes off second best to CD. Even maximum uninterrupted playing times may only be about 90 minutes when (and if) pre-recorded material becomes available, because the thinnest pure metal tapes don't yet work in the pro-

jected high speed duplication process.

Compared to the cassette, however, DAT looks like a rocket on sleds — at least after the initial lacing and prior to the final unlacing. Track-to-track times are much faster than any cassette deck can manage, and the subcode track makes it possible to encode absolute track numbers as on CD without having to rewind back to the start point. Uninterrupted recording times (as distinct from playback times with duplicated material) are 120 minutes, which makes feasible long classical works without interruption (C90 cassettes are notorious for running out just minutes before the end).

The Pioneer is capable of remote control, though no handset was supplied with the review sample (probably wisely!).

LAB REPORT

The *D-1000* will record at 16-bit with 48kHz quantisation, giving a bandwidth a semitone or so up on compact disc, and identical theoretical resolution. The deck will also replay tapes made externally using the familiar 44.1kHz sampling frequency (the future standard for pre-recorded material). HF pre-emphasis is switchable manually when recording to reduce HF noise, which can sometimes be heard, at the expense of headroom. Playback de-emphasis is always selected automatically.

The measurement programme followed the general lines of the cassette deck tests to a degree, but of course this would tend to play into DAT's hands, since we know it does best just what the compact cassette does worst — the very things that get measured.

Thus the noise modulation spectrogram was textbook stuff: there was negligible wow and flutter, and no noise modulation. Likewise the fluttergram gave only instrument noise at around -60dB. Harmonic distortion was within a few decibels of the -100dB CCIR/ARM weighted noise floor, and speed stability is certainly of the same high order.

The ability of the deck to reproduce a -80dB sinewave (a standard compact disc test) was good. There is some evidence of noise, and some triangulation of the signal, but on the whole the waveform integrity compares favourably with a good CD player. This is an even better result than it sounds, since the Pioneer is recording



the signal, not just playing it back. Overall record/playback resolution — a relatively crude measure of the ability of a digital system to reproduce a low level waveform intact — is estimated at 16 bits. Filter ringing shows an excellent, quickly damped output.

SOUND QUALITY

The Pioneer produced a degree of mechanical noise, but at a much lower level than a typical video recorder. Response to control commands was immaculate, but in the absence of English instructions I guess many people (author included) would have difficulty editing the sub-code track. Leaving this to the automatics can lead to the kinds of errors that afflict any track search system, so there may be no alternative to getting the instruction book down and getting stuck in . . .

There were no other operational problems. Recording level adjustment is assisted by the numerical peak indicator, and nobody could reasonably complain about the main bar graphs, which also have peak hold LEDs.

Although equipped with optical and electrical

digital datastream sockets for input and output purposes, internal logic prevents any direct digital copy from CD. You have to go through the analogue phono sockets, and there were clear losses of euphony and clarity when this was done, though sound quality remained reasonably close to the original. The deck also proved quite successful at recording from a high grade turntable, which is an area where cassette decks often get into trouble.

However, at the end of a fairly short period of use, the author admits to feeling somewhat equivocal. In back-to-back comparison with the very best that compact cassette can offer (a Nakamichi CR-7 was used for this enterprise) the indicators were pointing in both directions. The Pioneer sounds initially more detailed — or at least more explicit in the way it reproduces detail — and the soundstage is also well resolved, in common with the best CD players. Music has an open, spacious quality, and instrumental positioning is very precise. The CR-7 came close to matching the Pioneer — closer probably than most others could manage — but there was an indefinable cloudiness at LF especially that detracted from the assertiveness with which

images were set. The Pioneer was also more or less noise free, which contrasts with the Nakamichi when used optimally without noise reduction at all.

Where the Nakamichi did score consistently, however, was in its supreme lack of artificiality, and real, under-the-skin resolving power. Whether the Pioneer was auditioned off-tape or *via* the partnering amplifier's tape monitor circuits (the ADC and DAC are wired back to back in this mode), it sounded perceptibly synthetic. The effect was of a kind of hardening and constriction through the midband, with high frequencies sounding very positive and articulate, but again rather grainy and unsubtle. The Pioneer has a wonderful way of projecting sound into the listening room, but it does not sound entirely natural whilst so doing.

There were some indications that a loss of data may result when a tape is replayed repeatedly, presumably as a result of physical wear of the tape. (Of course the same thing happens with compact cassettes, where the outcome is a loss of HF and the likelihood of additional dropout.) My short test didn't cause audible dropout, but sound quality did deteriorate after I ran one track 30 times, comparing it 'before' and 'after' to a CD original. Tape brands and recorders alike will probably vary in their sensitivity to this phenomenon.

CONCLUSIONS

The problems with DAT are obvious if you think about it. The system is new and essentially unproven, even by the manufacturers themselves. Nobody knows how the tapes will age as a result of pulling against the end stops, environmental hazards like heat and vibration and other ageing processes. There is just as much uncertainty surrounding the various political issues involved, which will determine if and when we'll be able to buy pre-recorded material in the format, and exactly what DAT can and cannot be used for.

What we can say, however, is that DAT does not presently enjoy the universality of the compact cassette. There are no DAT players for cars, and no Walkman DAT. Prototypes have

been shown, but neither type is ready yet, and when they are they may be bulky, heavy, expensive and delicate — hardly the recipe for an overnight takeover from an entrenched, well supported and highly successful medium like the compact cassette.

But for the first time the hegemony of the cassette is challenged by a new system which extends CD-style digital processing into the home taping environment. It won't take over in the next five years, it may not even do so in 10 or 20: too many questions remain unanswered. But the carriage end of the trade should begin to feel the winds of change in very short order.

From the general to the specific, it is difficult to make a reasoned final verdict on this machine in a knowledge vacuum. Until we know if it will go on sale in its present form, and the price and the nature of the competition, judgement must be suspended.

One thing we can say for sure is that the D-1000 is a technological *tour de force*, performing like clockwork (not literally of course) and feeling like a million dollars. Sound quality is partly politically determined, in the sense that direct digital dubs from the only digital source available to the public — compact discs — are disallowed.

On pure sound quality, doing the kind of job that cassette decks can do — for example copying records and CDs in the analogue domain — the Pioneer is cosmetically the best there is, due to the absence of analogue tape related problems. But in musical terms the best analogue cassette decks still have its measure.

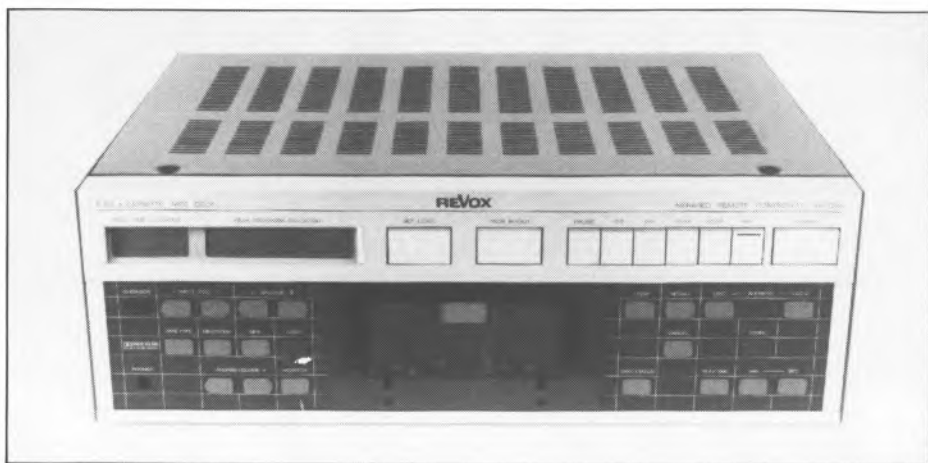
TEST RESULTS

Rec/replay response - 3dB ref 1kHz	
IEC Type I	20Hz-20kHz
Wow & Flutter - Peak DIN wtd/unweighted	<0.001%
Speed error	n/a
Signal/noise CCIR/ARM 315Hz	-100dB
distortion 0dB	-74dB
Channel separation 0VU/1kHz	dB
Line input sensitivity/overload	<7.00mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	2V/>7V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.001%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0dB	n/a
Dimensions (w×h×d)	45.8×11×39.5cms
Typical Retail Price	n/a

REVOX B215

FWO BAUCH LTD, 49 THEOBALD ST, BOREHAMWOOD, HERTS WD6 4RZ.

TEL: 01-953 0091



Not many cassette decks command the best part of £1,500, but this exquisitely engineered West German model is an exception. The transport section is elaborate to put it mildly, with twin capstans, each driven by its own direct drive motor, and two further reel motors for spooling and tape tensioning during play and record modes. A by-product of this sophistication is an extremely rapid fast wind, accomplished without significant tape scatter on the takeup reel.

Eliminating the cassette loading slot is a two-edge sword. Though it probably leads to a more stable, less resonant platform for the crucial tape to head interface, the heads and guides are unprotected from the environment unless a positive action is taken (*viz*: to replace the plastic cover). And there is more mechanical noise than usual when playing tapes, even if the plastic cover is used and despite inherently quiet internal workings from the SFX dept.

Naturally, the B215 is a three-head deck. Normal monitoring is off tape when recording, but the source may be selected manually for checking record quality, rather than using the tape monitor switch on the partnering amplifier.

The electronics are as elaborate as the mechanics. All displays take the form of very high contrast side-lit LCD panels. The fine record

level meters have a 38dB dynamic range, and 1dB resolution within a 12dB envelope around 0VU. In addition to other status indications, Revox have fitted a real time tape counter. Having set the tape length, this gives a continuous elapsed time reading during fast wind as well as play — and even on the fly when a part wound tape is inserted. Fast auto fades and punch-in recording (press 'record' whilst holding 'play') are both facilitated.

A rather awkwardly implemented automatic tape type alignment circuit is fitted. The procedure takes about 20 seconds and is extremely comprehensive, setting sensitivity, bias and equalisation using three rather than the usual two reference frequencies (400Hz, 4kHz and 17kHz). Two Type I, three Type II and one Type IV settings can then be stored in non-volatile memory. The results it produces are consistent, but consistently wrong unfortunately (see later).

Hiss control is by Dolby B and C as usual. In addition, the B215 joins the select group of decks fitted with Dolby HX Pro which maintains static bias regardless of the music HF content contribution, and which thereby linearises the record process.

In addition to these major facilities, the housekeeping microprocessor has enough spare capacity to provide a host of well thought through extras, each of which performs gen

uinely useful functions. Automatic once-only setting of the record level control is available as a utility option (you have to find your own loudest section of the material to be recorded first), along with automatic tape type recognition with manual override. The software includes the option of two independently addressable (by time, or by spooling the tape to the required points) index points for memory stop and repeat purposes, and the existing status can be memorised for recall at any time, for example on activation by a timer. (Students of technology will note that old-fashioned mechanical decks have built in 'memories' and inherent 'status indications'. Electronic decks like the Revox are just beginning to catch up!)

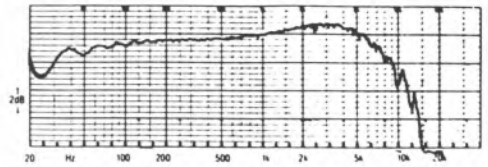
None of these things do much to tackle the inherent messiness of the complex control system. In fairness, some messiness was almost inevitable, but the design engineers haven't helped by adopting a rather unimaginative and utilitarian approach, resulting in a fascia plastered with a matrix of identikit buttons. Nobody will complain about the finish and general engineering quality though, which is amongst the top hand — no, armful — regardless of price.

The B215 can be operated using any Revox system remote handset, or plumbed in *via* a wire link to Revox systems. Output from the deck is at fixed line level, or *via* a resistive ladder volume control to headphones. Sound quality is slightly but unmistakably improved when the fixed level output is used. Perhaps surprisingly in this instance, microphones cannot be connected directly.

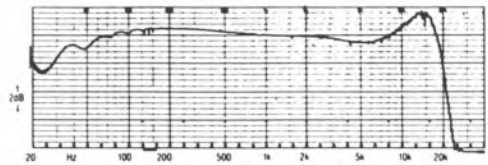
LAB REPORT

None of the record/replay responses, optimised by the deck's computerised little helper, is anything to write home about. They all suggest mild underbiasing, and uniformly so with each of the three tape groups. However, Dolby tracking integrity is first rate, and the playback response shape is also sound (no pun), with reasonable HF despite a 36 degree azimuth error at 8kHz. Ah well...

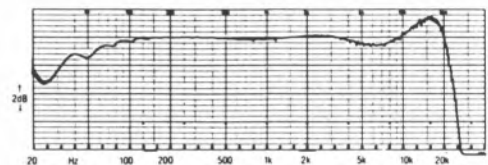
IM distortion is negligibly small, and the record amplifiers are well equipped to cope with all the headroom modern high energy tapes can stand. The noise modulation plot demonstrates



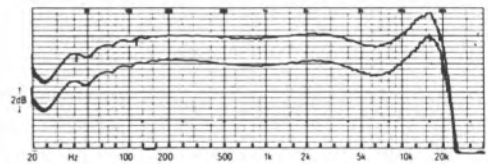
Playback only frequency response (pre-recorded tapes)



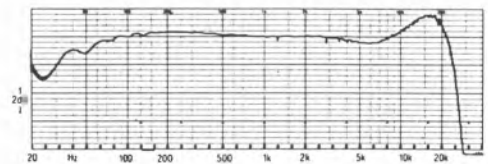
Overall record/replay response. Type I (ferri) tape



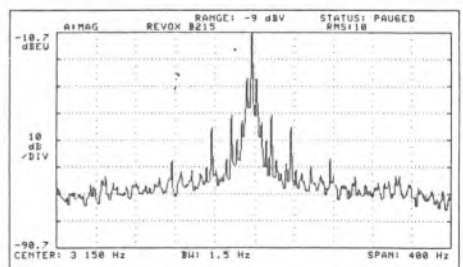
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

very good shaping of the noise envelope, with main sidebands at 40Hz, -33dB down. The fluttergram shows a number of discrete flutter components, also mostly around -33dB. However, the more audible wow components are very well controlled, and backed up by some impressive wow and flutter numbers. These numbers help reinforce the picture of the Revox as a finely crafted cassette playing engine.

SOUND QUALITY

Given the superb engineering and very high cost of this product, I felt justified in expecting something special on audition, so the following comments were arrived at using unusually strict criteria of judgement. The Revox is a fine cassette deck by any standards, but there were some important constraints on its music making potential, and at times it sounded just the stereotypical cassette deck: a bit soft and muddy in the bass and unwilling to image or focus properly in the midband area.

Things started off on the wrong foot with pre-recorded cassettes, which sounded rather 'woolly' at LF and nonedescript higher up. The HF level was there — in fact the deck often sounded rather bright in this mode — but resolution, and the simple quality of the original were missing. The shortfall was of a kind that I have drawn attention to elsewhere in this project: the sound had all the characteristics of a far from top ranking amplifier. There was a tightness, a coolness and an inability to breathe and relax of the kind that makes some people hanker — for quite the wrong reasons in my view — for valve powered amplifiers.

Altogether, Type I ferric recordings sounded less immediate and rank well behind, Dolby HX Pro notwithstanding, encouragingly, when recording on metal or chrome type tapes, switching between sources and monitor on the cassette deck produced what at times were imperceptible differences. Even where differences were apparent, it was not always clear which was better, the slight top end rise adding a touch of incisiveness and superficial clarity to the off-tape sound that often counted in its favour.

But switching between source and tape at the amplifier tape monitor switch gave a slightly different perspective (having of course made due allowances by first auditioning the tape monitor circuit with a loop of wire). Now the Revox could be heard to compress and constrain the sound in the manner described earlier. There was also some loss of image stability of the kind often associated with low level transport problems, along with some blurring of LF information. At the same time, the Revox has a characteristically smooth, almost elegant and obviously low distortion sound that was very easy on the ear.

The B215 is one of the most attractive and least obtrusive sounding cassette decks in this issue. Despite the critical standards adopted because of the high price, this is a top ranking deck, convincingly outperformed by very few others in this project.

CONCLUSIONS

The Revox is a superb piece of engineering by any standards, but the edge is taken off its musical performance by a simple lack of the unobtrusive, hear-through qualities that characterise the best hi-fi equipment. Good, yes, but the B215 could so clearly have also been better still.

TEST RESULTS

Rec/replay response -3db ref 1kHz	
IEC Type I	<20Hz-22kHz
IEC Type II	28Hz-23kHz
IEC Type IV	24Hz-24kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.075%/0.17%
Speed error	-0.1%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0db	0.9%
Type II signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0db	1.0%
Type IV signal/noise CCIR/ARM 315Hz	50dB
distortion 0db	1.1%
Channel separation 0VU/1kHz	52dB
Line input sensitivity/overload	70mV/2.86V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	1V/4.7V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.07%
Azimuth check R-L phase at 8kHz	+36 degrees
VU indication at IEC 0db	+3dB
Dimensions (w×h×d)	45×15.5×33.5cms
Typical Retail Price	£1,462

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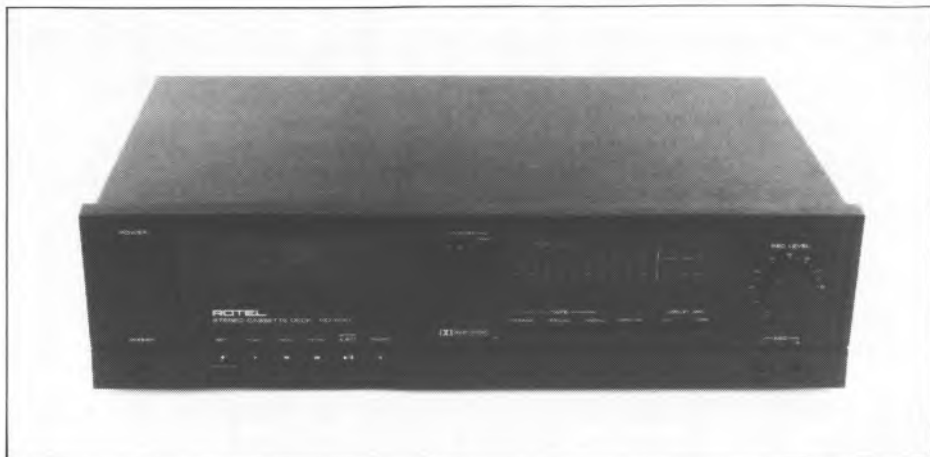
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ROTEL RD-830

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Long in the tooth is a pretty fair description of this venerable machine. Geriatric is a word that has been used by some, and it's perfectly true that the RD-830 isn't the most dazzling example of late 1980's technology. But it is very purposeful and practical nonetheless, with exactly the facilities needed for normal purposes — no more and no less. It is due to be replaced within the next year by a Dolby HX Pro equipped model called the RD-870, which will sell for around double the price of this model. For now, the RD-830 continues as the only pre-RA-820 series Rotel product, and sells at a bargain basement price of £99.

There is no fancy gadgetry. Tape type selection is manual using three buttons quaintly labelled Normal, Special (!) and Metal. Noise reduction is Dolby B, and the MPX filter can be removed from circuit — a good point in such a low cost deck. A simple status display area includes very basic metering (two rows of 5 LEDs, triggered at -10, -5, 0, +3 and +6dB), plus Dolby and record mode tell-tales. Record levels are set on a single, ganged rotary control — with no means of altering channel balance. There are inputs for microphones and an output for headphones, plus a set of solenoid assisted mechanically latching transport controls, and an even more purist mechanical tape counter.

The rear panel has low grade captive phono flying leads and the mains wire.

The deck was designed in Japan and is built in Taiwan with some UK design involvement. Build quality is acceptable, but you understand that for £99 you can't always be cooking with gas . . .

LAB REPORT

The Rotel's frequency responses are similar for all three tape types. At the low frequency extreme, the output is rolled away severely below 100Hz, and all but vanishes below 60Hz. The playback response shape shows that this happens during recording rather than when playing back. Above about 500Hz, the output starts to rise, peaking eventually at around +3dB between 10 — 15kHz, depending on tape type. Adding Dolby B into the equation didn't change things noticeably, so Dolby mistracking shouldn't be a problem (it wasn't). The replay only response was lacking in HF energy, largely because of head azimuth misalignment (see test results).

Noise and harmonic distortion findings are quite satisfactory, but as they were run at 315kHz they understate subjectively apparent hiss levels to a degree. However, intermodulation distortion — often heard as a muddling effect — was very high. The noise modulation spectrogram was unimpressive, showing a substantial amount of

energy within the noise 'shoulders' positioned $\pm 80\text{Hz}$ from the centre frequency. The percentage measurement for stability is higher than normal, and quite a lot of flutter components are clumped around 40Hz , but wow components are reasonably well suppressed.

SOUND QUALITY

There is something attractive in the bright, incisive and sometimes almost 'tactile' quality of recordings made on this deck, but it soon becomes painfully apparent that there is little of substance underpinning the sound. The lack of bass and the bright tonal colours combined to produce a small scale stereo image, some disruption of tonal colours, and a thin, edgy quality that emphasised transients. There was little body or weight to the sound, and very little depth imagery. Pre-recorded cassettes in contrast lacked 'air', sounding rather uneven and messy.

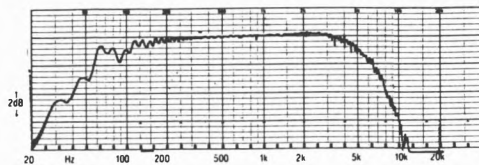
On the positive side, pitch stability was subjectively a little better than the numbers suggested, and the Dolby processing was effectively transparent: it simply reduced noise.

CONCLUSIONS

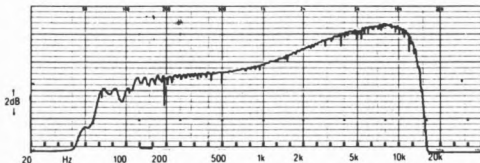
Though this deck might have performed a little better with tapes showing significant treble rises compared to the IEC norm, as it stands, the straightforward ergonomics and basically incisive sonics must be set against wildly inaccurate frequency responses (far too large to be overlooked), the absence of low frequency fundamentals, and occasional wow and flutter problems.

TEST RESULTS

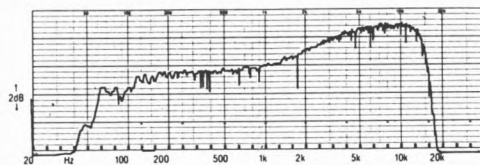
Rec/replay response - 3db ref 1kHz	
IEC Type I	60Hz-15kHz
IEC Type II	58Hz-17kHz
IEC Type IV	57Hz-19kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.011%/0.28%
Speed error	-0.1%
Type I signal/noise CCIR/ARM 315Hz	51.5dB
distortion 0dB	0.95%
Type II signal/noise CCIR/ARM 315Hz	51.0dB
distortion 0db	2.0%
Type IV signal/noise CCIR/ARM 315Hz	53dB
distortion 0db	1.4%
Channel separation 0VU/1kHz	-45.5dB
Line input sensitivity/overload	70mV/>7V
Mic input sensitivity/overload	0.35mV/15mV
Line output for 0dB/maximum	620mV/1.49V
IM distortion 10kHz/11kHz: 0dB peak, 1kHz product	12%
Azimuth check R-L phase at 8kHz	34 degrees
VU indication at IEC 0db	+3dB
Dimensions (w x h x d)	43 x 11.7 x 27cms
Typical Retail Price	£99



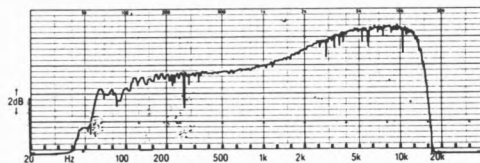
Playback only frequency response (pre-recorded tapes)



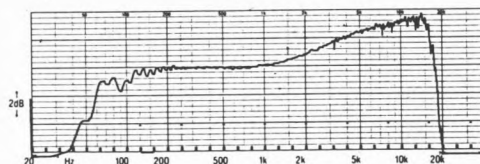
Overall record/replay response. Type I (ferric) tape



Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

SAE C102

PRESENCE AUDIO, EASTLAND HOUSE, PLUMMERS PLAIN, HORSHAM, WEST SUSSEX RH13 6NY.
TEL: (04485) 333



First appearances can be deceptive. In this case you might think that the SAE, whose home is in California but which is made in Korea, is an exotic computer controlled item of test equipment, or perhaps a CD player. In fact it's just a very unusual looking cassette deck, with the true 1980s style transport mechanism controlled by a microprocessor, instructed by a complex array of light-acting controls. The deck also has a CD style loading drawer which glides in and out — at a rate that allows plenty of time for some entertaining cursing and carrying on — though unlike a CD player, this deck works with the drawer open too.

Almost everything about the C102 (price included) exudes class. It therefore comes as a surprise to find that this is only a two head machine, with just one motor. The deck comes with rack mounting accoutrements, but wood-grain side cheeks are also supplied.

Despite the elaborately specified computer aided nature, there is an element of window dressing here too. The computer is there of course; it enables everything to happen with a slickness beyond the ability of simpler machinery. But the ergonomics are confused because control grouping and differentiation are poor, and the range of facilities is quite limited. The transport is unidirectional and equipped with

auto repeat and track skip facilities, the latter seeking out tracks numbered up to 20 from the current position forward or back.

The displays are mostly good. They include well designed but only medium range (25dB) meters with a peak hold facility above 0VU, and an LED tape counter which can be switched into either 'time to go' or 'elapsed time' modes, once the tape length has been programmed into the machine. Tape type selection is automatic when recording, with manual override. Dolby B and C noise reduction are fitted as usual. Potentially significant omissions include headphone and microphone socketry.

LAB REPORT

Mechanical behaviour is good. Wow & flutter measures just 0.07% wtd. The noise spectrum analysis shows a sharply defined centre frequency with little wander or fudge — note the very steep slopes on each side. The 50Hz fluttergram also shows a pretty clean spectrum, with low noise and few significant spectral components, the worst being a -30dB component at 6.5Hz.

Electrically the SAE is on slightly shakier ground. The important Type II frequency response is shelved up by about a dB above 1kHz, which is not exaggerated by Dolby C processing but is doubled by Dolby B. Of course a dB or

so means little between friends, except that this is a broadband effect — we're talking about quite a lot of energy when it's all integrated together.

The other record/replay responses were better controlled, but the playback shape was again poor, with significant losses from as low as 1kHz, which was partly a function of azimuth alignment. Would you believe -3dB at 7kHz ?

IEC 0VU is set high, at $+5\text{dB}$, which casts the already tolerable signal/noise figures in a very good light. However Type IV distortion levels are already at 1% at the deck's own 0VU point, and distortion with this tape type is therefore suspect. Note also the intermodulation distortion levels which are very high (just under 12%), which is indicative of poor record headroom.

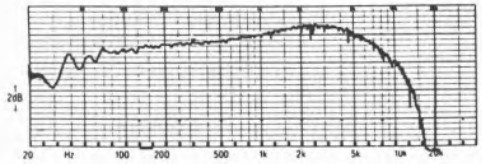
SOUND QUALITY

Point one is that the basic electronics, as monitored whilst recording and bypassing the tape itself, impose significant limitations on the sound. The sound is tight and cold, rather like one of those amplifiers with bucket-loads of feedback to make the measurements look good. Stereo perspectives are also cramped.

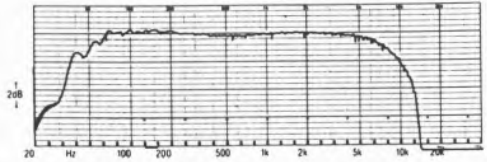
However, the good news is that the recording side of the deck imposes surprisingly little further degradation even on a good source. The SAE is very taut and clean, with dynamics well presented. In fact this deck is altogether most convincing when dealing with the grosser effects: the sudden, mind-blowing crescendos, the powerful bass passages, a well aimed rim-shot — though metal Type IV tape offered little practical advantage here over Type II.

The sound without Dolby held up well, and the deck is quiet enough to make non-Dolby recordings at least erratically viable. However, with either of the noise reduction systems engaged, the most subtle pianissimo passages sounded slightly mauled. The immediate impression was that the music sounded somehow thickened and 'bloated', with occasional odd shifts of balance and perspective — which is the classic symptom of Dolby mistracking. Pre-recorded tapes suffered in much the same way.

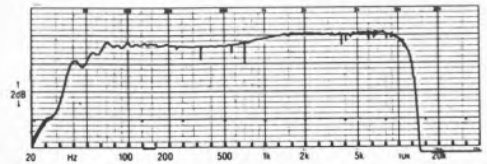
On the whole, Type II tapes sounded as good as those made with Type IV, and rather crisper and more energetic than Type I; this is the



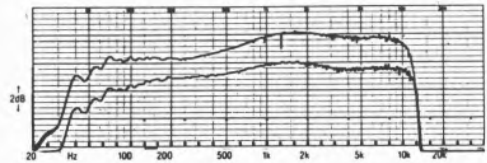
Playback only frequency response (pre-recorded tapes)



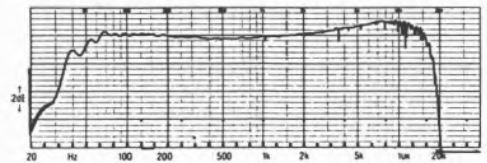
Overall record/replay response. Type I (ferric) tape



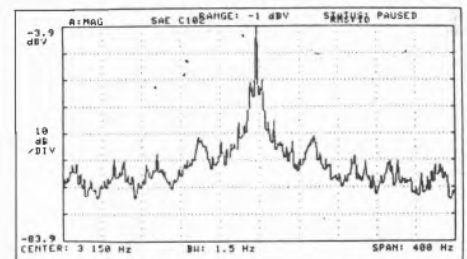
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

recommended tape group for this interesting machine.

CONCLUSIONS

A hard one to sum up, the overall conclusion is determined to a degree by the nature of the competition, which on the whole is pretty grim. Given that as a background, the SAE is a very good tape machine, capable of a very stable, dynamic performance with considerable subtlety, and a surprising absence of the fluffiness and image spread that cassette sound often brings in its wake.

The deck doesn't make the most of metal tape, and its delicate virtues are partially spoiled with Dolby noise reduction in use. It's also not at its best with pre-recorded material, evidently due to marginal setting up. Had the electronics been better, the SAE might have been close to a great

cassette deck, instead of being merely good.

TEST RESULTS

Rec/replay response - 3db ref 1kHz	
IEC Type I	34Hz-12kHz
IEC Type II	35Hz-13kHz
IEC Type IV	33Hz-19kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.07%/0.20%
Speed error	-0.2%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.55%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0db	0.6%
Type IV signal/noise CCIR/ARM 315Hz	51dB
distortion 0db	1.0%
Channel separation 0VU/1kHz	-43dB
Line input sensitivity/overload	105mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	867mV/3.4V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	11.84%
Azimuth check R-L phase at 8kHz	38 degrees
VU indication at IEC 0db	+5dB
Dimensions (w x h x d)	48 x 9 x 35cms
Typical Retail Price	£495

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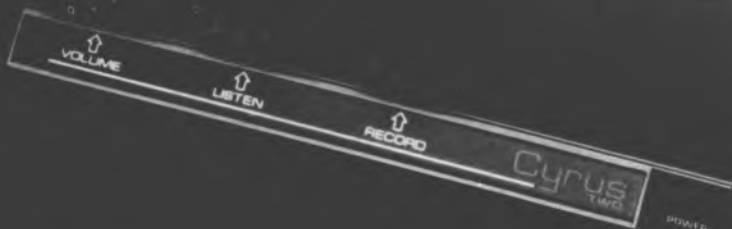


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BEST BUY

SONY TC-FX 150

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.

TEL: STAINES 61688



At the time of writing, the TC-FX150 was so absolutely brand new, there was no published information to be had beyond the £90 price.

As the guy from Sony said, the TC-FX150 'looks the biz'. Although hardly a substantial piece of engineering, it is very smooth and glossy. The transport controls are entirely unassisted mechanical press buttons. But they are well anchored and positive in feel, and also allow free interchange between fast wind and play (and *vice versa*) apparently without damage. However, normal use tends to slide the player around; this is a two-handed cassette deck.

Ultra simple 5-step meters with a bare 11dB range are the most obvious sign of cost paring. The bottom LED (set at around -10dB) is actually labelled minus infinity! Dolby C (in addition to the ubiquitous Dolby B) is the most impressive inclusion. There's a mechanical tape counter and manual tape type setting using (thankfully) a row of three appropriately labelled press buttons. On the test sample, the input level pot (not the knob) was about 60 degrees off true, which-unfortunately cannot be corrected by resiting the control knob.

LAB REPORT

Technical performance is above average —

which is more than you've any right to demand in a cassette deck that costs a paltry £90. A couple of things are open to criticism however. One of which is the suspect bass behaviour seen in the response curves: note the sharp suckout centred on 50Hz. Head contour effects are unusually extended up into the midband too, and these factors can be expected to affect auditioning.

The top end of the frequency range seems to have been set up rather erratically — the responses were run with the recommended Sony tapes as well as the normal IEC standard tapes (which actually proved marginally better suited than Sony's own). Type I tapes are rolled off a little early at HF, whilst metal tapes gave the odd camel like hump you can see in the accompanying data panel. Performance with pre-recorded cassettes was a complete joke. There was a net loss of treble when replaying Dolby'd cassettes with the Dolby de-processing switched off!

Wow and flutter levels are moderate, the spectrograms identifying several discrete components sprinkled around, with dominant wow at 5Hz, -28dB. Speed drift, however, was very low. There are noise 'shoulder' like effects on the noise spectrogram at a just respectable -32dB between ± 20 -40Hz.

Intermodulation distortion exceeding 20% is

very high indeed, which means compromised performance with complex, high level signals, especially with Type IV metal tapes. Harmonic distortion with metal tape is also very high at above 3%, but this is tied to quite good noise levels, which evens the odds to an extent.

SOUND QUALITY

The *TC-FX150* auditioned better than expected *except* with pre-recorded stuff, where sound quality doesn't even come into the equation. This is odd considering Sony have aligned the machine with absolutely zero azimuth error.

However, recording and playing back on the deck itself, led to some quite acceptable results. There wasn't enough dynamic range between the noise floor and maximum level to allow serious use of the deck without noise reduction, but with Dolby B the sound was tolerably clear and lifelike, and superior to similar recordings made with Dolby C, which sounded oddly heavy. Ferric Type I recordings tended towards 'wooliness', and metal Type IV tape failed to offer any real advantage over Type II. Overall the best bet is to use Type II tapes like TDK SA or Sony UX-S, and Dolby B.

CONCLUSIONS

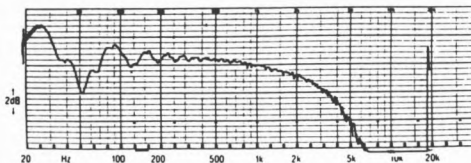
There's a lot of hedging about and many specific caveats, but the *TC-FX150* is obviously a good £90's worth, capable of results that generally deserve the high fidelity tag. Replay only performance, however, was unsatisfactory.

TEST RESULTS

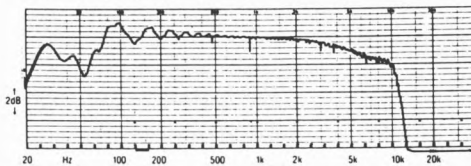
Rec/replay response - 3dB ref 1kHz

IEC Type I	22Hz-11kHz*
IEC Type II	56Hz-14kHz*
IEC Type IV	56Hz-15kHz*
Wow & Flutter - Peak DIN wrd/unweighted	0.13%/0.24%
Speed error	+1.2%
Type I signal/noise CCIR/ARM 315Hz	55dB
distortion 0dB	1.7%
Type II signal/noise CCIR/ARM 315Hz	53.5dB
distortion 0dB	53.5%
Type IV signal/noise CCIR/ARM 315Hz	54.5dB
distortion 0dB	3.2%
Channel separation 0VU/1kHz	46dB
Line input sensitivity/overload	86mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	646mV/3.36V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	20.7%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	43×11.3×24.5cms
Typical Retail Price	£90

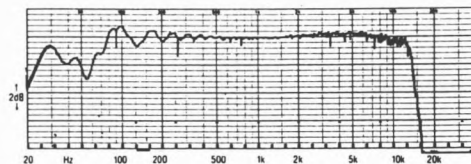
*Sony tape



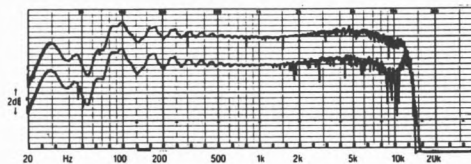
Playback only frequency response (pre-recorded tapes)



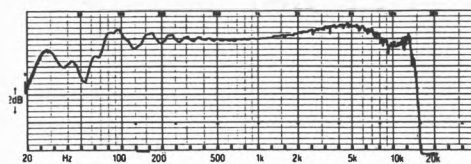
Overall record/replay response. Type I (ferric) tape



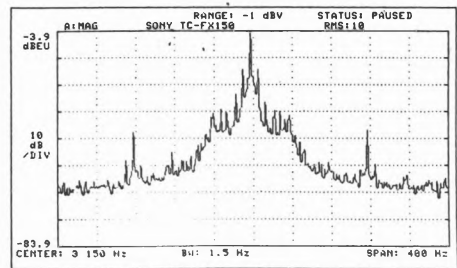
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

BEST BUY

SONY (WMD6C) WALKMAN PRO

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PE.

TEL: STAINES 61688



The editor was insistent about this one. 'It has the best midrange in the business', he said, 'make sure it's in'. But I had already requested a sample of the memorably named WM-D6C Walkman Professional. Measuring 181×40×95mm, it is a little larger than normal Walkpeople, but smaller than anything else, and weighs 640 gms with batteries. It feels chunky and solid, but will disappear into a good size coat pocket, no trouble. Of course, that's the idea . . .

The 'Professional' in the same name isn't boastful imagery or wishful thinking: it's literally true. The WM-D6C is the ideal reporter's electronic notepad where quality counts, say for broadcasting purposes. It's also perfect for bootlegging . . .

Of course it's also an excellent Walkman like any other Walkman except that in this case you get something that really sings. And it's a cassette deck, or can be used as one, with all the normal facilities of a cassette deck, including switching for the usual three tape types, here labelled Normal I, CrO2 II and Metal IV (are you reading this Nakamichi?), and Dolby B and C noise reduction. There's even a third position here called 'off' which sounds even better.

One thought that occurred to me was that in many ways the WM-D6C achieves what portable CD players set out to achieve — and

more. Portable CDs attempt to offer portability combined with excellent sound quality. What they actually offer in practice is clumsy, bulky software packaging (which is also extremely vulnerable by the way), much higher battery consumption; and mechanical performance that is fine, as long as the player is kept still and preferably level.

And just in case you're thinking, a DAT player with the practicality of this cassette player is still science fiction, and would be many times as expensive, even if there was any software available for it (there isn't). (Sony's new £5,000 pro portable DAT machine is substantially larger and heavier than the editor's lap portable computer, never mind his Pro Walkman). A thought, as I say.

The transport controls are cleverly packaged and allow the usual modes plus punch-in recording and cue and review — audible if you fiddle with the controls just so, but unmuted so you should watch the volume control if you value your tweeters. Or even your ears. Be warned also that auto-stop doesn't function from fast wind.

A simple mechanical tape counter is mounted at 90 degrees to the usual viewing angle and a 5-LED peak level meter (calibrated at -10, -5, 0, +3, +6dB) displays the levels of the highest of the two channels, and also monitors battery condition. To save battery power, make the unit

less obtrusive in clandestine situations or to improve sound quality (or all of the above) the LED can be switched off.

Other hardware includes microphone and headphone socketry, the former with a -20dB attenuator switch, and a variable playback speed pot which is active only if the quartz servo is switched out of circuit first. Naturally there are in- and outputs at line level. All socketry is based on the Walkman standard 3.5mm stereo connectors which are dictated by the size of the player. (Phono adaptor leads are readily available.)

The Sony comes with a simple but adequate case and strap and a pair of simple micro headphones (you can buy better from Sony themselves and elsewhere). As standard, power comes from 4 MN1500/HP7AA size cells (use alkalines or rechargeables), but there are several other possibilities including various AC and car units. Sony make a wide range of suitable electret microphones too, and in the case of the ECM-102 the deck even supplies the necessary polarising voltage.

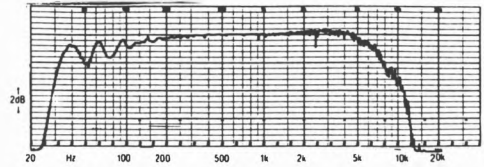
On first acquaintance, some of the controls seem unnecessarily fiddly and/or stiff. Certainly the tape selector could have been abandoned in favour of a feeler system like other modern decks, but the main point is that Sony have simply done their best to proof the deck against accidental operator errors.

LAB REPORT

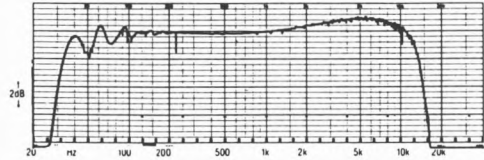
Overall the *Pro* produced a set of measurements that was altogether the equal of anything at twice the price designed purely for mains use. No excuses whatsoever need be made for its size or portability.

The noise modulation plot is a little noisy, but there are few discrete effects, and the centre frequency was very sharply reproduced indeed, with absolutely negligible spread which is the visible indication of drift. The fluttergram indicates moderate levels of wideband noise, plus some sub-5Hz wow. Wow and flutter was moderate to low elsewhere. Note the figures (0.12% peak DIN wtd, 0.30% u/w) which are astonishing for a portable machine, and satisfactory by mains domestic standards.

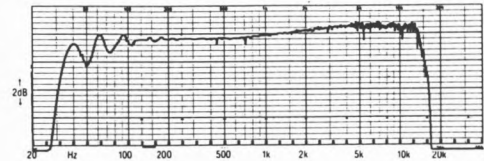
The IM distortion check gave a very low figure, 0.5% total, which means there is plenty



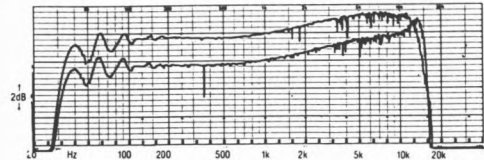
Playback only frequency response (pre-recorded tapes)



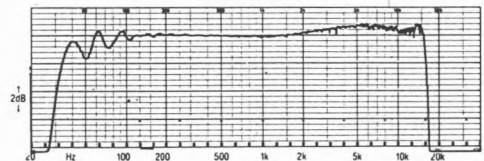
Overall record/replay response. Type I (ferric) tape



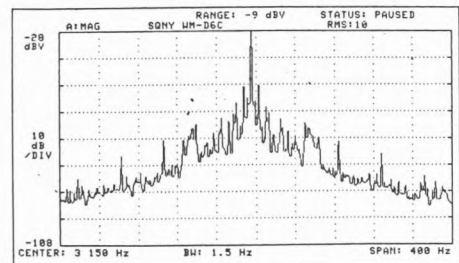
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

of headroom to exploit metal tapes fully. Azimuth was satisfactory.

Integrity of the various response curves was also of the highest order, with the solitary exception of the playback only one, which dies a bit early (-3dB, 9kHz). The record/playback responses are all flat within a 1dB envelope up to around 15kHz using IEC tapes — which indicates a standard of setting up that beats most of Sony's own home recorders flat. The LF end is also well controlled. Although the 0VU distortion levels look high, the meters themselves are set high (0VU=IEC 0dB), and the signal/noise ratios are also very good. Easing the record levels slightly will restore normality.

The only point that might cause some concern is that the line output voltage is a little low, and may not drive some amplifiers fully, though hands on experience would tend to dismiss this worry. (The headphone output can of course be used instead, but sound quality is definitely inferior in this mode.) The microphone sensitivities are low too, but adequate for the electronics Sony envisage the deck being used with.

SOUND QUALITY

In a nutshell, sound quality is excellent, though it isn't strictly neutral. As PM suggested, the Sony does have an extraordinarily lucid and 'hear through' midband, and this is certainly the deck's best feature. But it works also because the HF end is unusually clean and clear, and because the bass end is distinctly lightweight, and therefore avoids overwhelming the midband in the manner of much cassette equipment (and also cheap turntables). The secret of the clarity is probably the necessary simplicity of the Sony's circuitry — necessary both to fit in the box and to avoid consuming too much power. It's ironic that these measures, not directed at sound quality in any way, should end up helping to improve just that area of performance.

Noise levels are quite low and appear mostly as a thin, HF hiss. Certainly noise is low enough to allow Dolby-less recording with head-banging material. With more dynamic music, the Dolby B at least doesn't have too strong a negative in-

fluence (Dolby C clamps down on the range of the sound a little more noticeably). One intermittent snag is that tape tension over the head appears to be low, and dropout is a little more in evidence than usual.

All three tape groups were capable of making extremely fine recordings with the WM-D6C, but the ability to lay very high currents on tape, combined with excellent signal/noise and first class frequency domain uniformity meant that metal Type IV tape was able to demonstrate it's inherent superiority giving greater clarity and less HF 'squash' and modulation noise. Ironically, and entirely coincidentally of course, metal tape recordings were inclined to sound slightly 'metallic' and grainy, but this was a mild side-effect of the superb clarity. Subjective speed uniformity was even better than the numbers suggested, and held up remarkably well when the unit was shifted around.

CONCLUSIONS

One of the finest sounding cassette decks on the market today *regardless* of price. The fact that it fits in your pocket and works off batteries are just bonuses. An extraordinary recorder, and mandatory Best Buy material. But one minor caveat: the rumour mill suggests it is not as reliable as conventional machines — and we would hesitate to take one into the local radio shop for service.

TEST RESULTS

Rec/replay response - 3db ref 1kHz	
IEC Type I	32Hz-14kHz
IEC Type II	32Hz-16kHz
IEC Type IV	32Hz - 16kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.12%/0.30%
Speed error	-0.2%
Type I signal/noise CCIR/ARM 315Hz	55dB
distortion 0dB	3.0%
Type II signal/noise CCIR/ARM 315Hz	55dB
distortion 0dB	3.1%
Type IV signal/noise CCIR/ARM 315Hz	56.5dB
distortion 0dB	3.1%
Channel separation 0VU/1kHz	45dB
Line input sensitivity/overload	89mV/>7V
Mic input sensitivity/overload	0.34mV/10.6mV
Line output for 0dB/maximum	390mV/2.9V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.5%
Azimuth check R-L phase at 8kHz	19 degrees
VU indication at IEC 0dB	0dB
Dimensions (w x h x d)	18.1 x 4 x 9.5cms
Typical Retail Price	£249

12 OSMASTON ROAD — THE SPOT — DERBY 380385

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RECOMMENDED

SONY TC-R502ES

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.

TEL: Staines 61688



The TC-R502ES is the least expensive model in Sony's elite ES range, and paradoxically one of the best equipped. It is a full Dolby B/C auto-reverse deck, the rapid acting reverse mechanism triggered by an infra-red detector that looks for the tape/leader join.

In addition to the commonplace track search which finds the start point of the current or next track, a switch can be set to skip blank passages on playback. There are other 'trick' facilities too, including intro-scan, automatic rewind followed by play, record mute, 'punch in' recording (to enter record mode from play without stopping), one-finger record starts, and both sides sequential recording. The peak hold record level meter used also on more expensive ES decks, has excellent range, resolution and legibility. An electronic memory counter calibrated in minutes and seconds blinks like an old friend near end of side in the record mode.

There are two other important features. One is an easily set sensitivity adjustment to allow accurate Dolby B&C tracking. The other is Dolby HX Pro, which linearises recordings by holding the overall level of bias constant.

Without transcending the styling mores of the high fidelity cassette deck, the TC-R502ES achieves a level of perceived engineering integrity and finish that must be the envy and

despair of Sony's competitors.

LAB REPORT

This 502 had been well set up by the manufacturer, and was tested with appropriate Sony brand tapes. Upper frequency response is particularly well maintained with Type IV metal, but overall record/replay responses were all contained approximately within a ± 0.5 dB envelope which can't be bad. Prerecorded tapes will also play back with a flat response, truncated slightly at the HF end because of azimuth misalignment. Metal (Type IV) tapes on the other hand consistently gave a slightly elevated top in this recorder. Response runs with Dolby B and C showed consistently with each other and the Dolby-less response.

Sony metal gave significantly lower 0VU distortion (1.7% instead of 2.8%) than TDK, at the cost of 3dB extra noise. The other tape types showed less significant differences. The noise modulation spectrum was satisfactory in the sharp definition of the centre frequency, and noise energy away from this frequency was low. The high level intermodulation test gave an extraordinarily low figure.

Wow and flutter measured well, but the 50Hz fluttergram does show numerous flutter and wow components, well distributed but of sufficient energy to suggest that some blurring of fine

detail may result. In context, these are good results for an auto reverse deck (and consistent between sides by the way), but only reasonable by premium unidirectional deck standards.

SOUND QUALITY

The TC-R502ES just about qualifies as an auto-reverse deck that hasn't sold out for the sake of auto reverse operation. The deck sounded crisp, alive and gave quite good stereo and tonal quality on all recommended tape types.

There was just detectable degradation with Dolby B and C processing, in the form of a loss of impact and instrumental separation, and a slight falling apart of the sound when dealing with complex but not necessarily high level signals — full orchestral strings for example.

Metal tape recordings tended to sound a little thin and 'edgy' with some source material, but again were consistent with level. Wide dynamic range material can be handled with ease, and without noticeable compression. Pre-recorded tapes sounded spacious and alive.

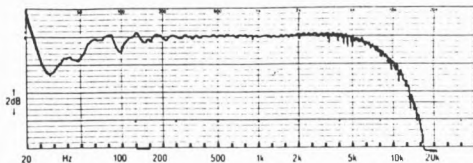
CONCLUSIONS

The 502ES is a pleasure to use and is superbly equipped with Dolby HX Pro and a fast acting auto-reverse that doesn't compromise performance unduly, though it doesn't have the on-rails type stability of some ES models.

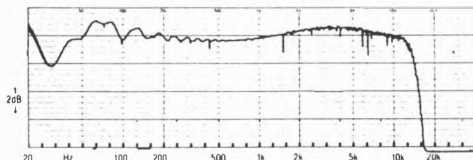
TEST RESULTS

Rec/replay response — 3dB ref 1kHz

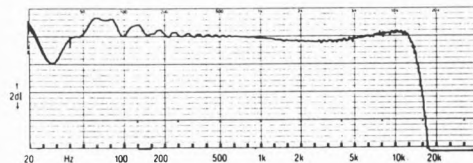
IEC Type I	<20Hz-14.5kHz
IEC Type II	<20Hz-15kHz
IEC Type IV	<20Hz-21kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.06%/0.14%
Speed error	+0.6%
Type I signal/noise CCIR/ARM 315Hz	53dB
distortion 0dB	-0.9%
Type II signal/noise CCIR/ARM 315Hz	55dB
distortion 0dB	-1.6%
Type IV signal/noise CCIR/ARM 315Hz	52.5dB
distortion 0dB	-1.7%
Channel separation 0VU/1kHz	-48.5dB
Line input sensitivity/overload	100mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	685mV/3.9V
IM distortion 10kHz/11kHz: 0dB peak, 1kHz: product	0.26%
Azimuth check R-L phase at 8kHz	16 degrees
VU indication at IEC 0dB	+2dB
Dimensions (w × h × d)	43 × 10.5 × 28.5cms
Typical Retail Price	£279



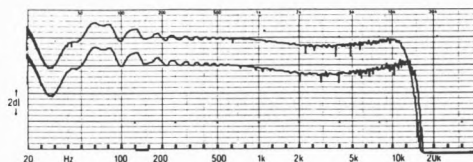
Playback only frequency response (pre-recorded tapes)



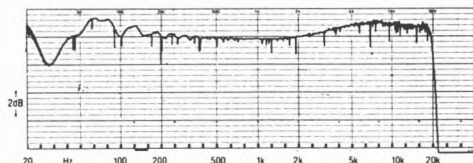
Overall record/replay response. Type I (ferric) tape



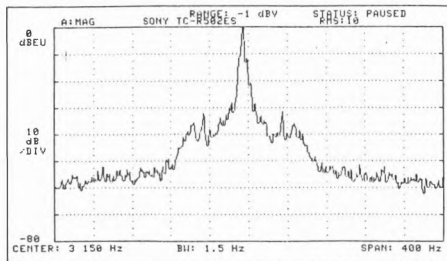
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

SONY TC-K444ESII

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.

TEL: STAINES 61688



As so often in the past, Sony have worked their subtle alchemy in brushed metalwork, plastic and panel graphics, and the TC-K444ES comes together looking like a million dollars. The loud solenoid clicks as the transport engages detract only a little.

Like all ES range equipment, the TC-K444ESII is aimed squarely at the quality end of the market. The basic features include a twin capstan 'closed loop' drive system, off-tape monitoring using a dedicated playback head, and Dolby B and C, with individual Dolby chips for the two channels. The audio amplifiers are built separately and in mirror image form. 'Punch-in' recording is possible.

The sophisticated laser-amorphous magnetic alloy heads are wired with linear crystal, oxygen-free copper, and Sony lay stress on the sound quality of the audio amplifying stages. Ditto for the mechanical integrity of the transport, which again is not normally a point which manufacturers stress.

Manual tape bias/equalisation switching caught the author unprepared on one occasion, but one potentially useful facility is the ability to fine tune record bias (Type I and II tapes only) and sensitivity levels.

The deck is straightforward in other respects. The attractive LED tape counter reads in min-

utes and seconds, and is fitted with memory stop and replay. Headphone levels are adjustable. The '444 is unusually well laid out, and is enhanced by first class record level meters with good resolution, a 48dB working dynamic range and 'peak hold'. A terminal on the rear allows the deck to be used with an optional wired remote control — not supplied for this test.

LAB REPORT

The frequency response tests were run using Sony's own recommended formulations — HF-S (Type I), UX-S (Type II) and Metal-S (Type IV), and were crosschecked with the usual IEC standard tapes used elsewhere. (Results were gratifyingly similar). With the calibration pots set to the centre (normal) position the responses above about 1kHz show a slight shelf rise, typically by one-half to one decibel, which can be expected to add a slight 'zing' to the sound.

Head contour low frequency effects were a little more pronounced than usual. The plots with noise reduction were similar in shape to the intrinsic response, bar some HF limitations: with Dolby B the deck effectively switched off and went home above 10kHz. The replay response was fine, despite large azimuth error on our sample — 32 degrees.

The noise spectrogram and the signal/noise measurements both showed that the '444 was

stable and low in noise, with clearly defined sidebands. The fluttergram was also relatively jitter free. Flutter components are visible around 33Hz, but there were few wow components.

SOUND QUALITY

The TC-K444ESII was rather sensitive to external electromagnetic fields, which will tend to determine placing considerations in practice. Regrettably some hum is mixed with the music when recording, at best making the low frequency sound rather uneven in pitch and often excessive in level. The deck was also slightly RF prone.

Without Dolby, but when using Type II and IV tapes, the Sony has a falsely lively 'edge' and on balance the best results with this deck were made with Dolby B, followed closely by Dolby C. This is clearly one of the better noise reduction installations.

However, even the best this deck had to offer wasn't truly commensurate with price. There was always some loss of midband resolution and focus, though the HF sounded clean in isolation, and image stability was first class. Pre-recorded replay sound quality also lacked resolution.

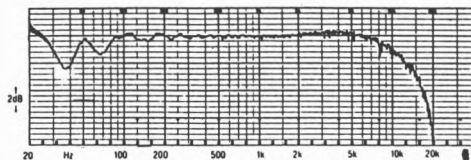
CONCLUSIONS

As real cooks everywhere already know, there's more to making a really fine cake than simply using good ingredients. This TC-K444 has some fine under-the-skin engineering, but ultimately fails to deliver the goods convincingly; in context the hum and RF problems are surprising.

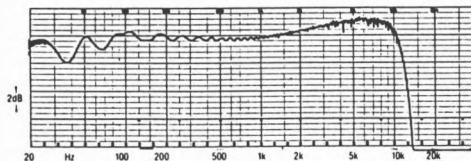
TEST RESULTS

Rec/replay response - 3db ref 1kHz	
IEC Type I	<20Hz-13kHz*
IEC Type II	<20Hz-14kHz*
IEC Type IV	<20Hz-17kHz*
Wow & Flutter - Peak DIN wtd/unweighted	0.065%/0.15%
Speed error	0.15%
Type I signal/noise CCIR/ARM 315Hz	54dB
distortion 0dB	0.8%
Type II signal/noise CCIR/ARM 315Hz	55dB
distortion 0dB	1.6%
Type IV signal/noise CCIR/ARM 315Hz	53.5dB
distortion 0dB	0.8%
Channel separation 0VU/1kHz	-46.5dB
Line input sensitivity/overload	108mV/-V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	650mV/4.27V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	2%
Azimuth check R-L phase at 8kHz	32 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	43×10.5×17cms
Typical Retail Price	£349

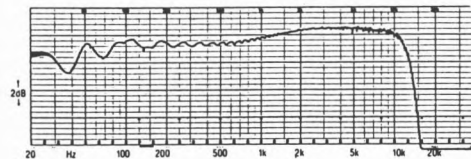
* using Sony tape - see text



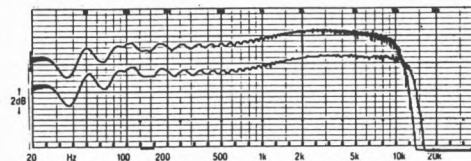
Playback only frequency response (pre-recorded tapes)



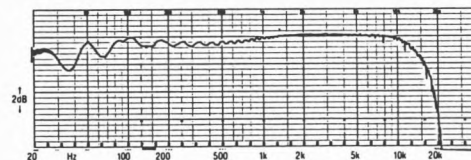
Overall record/replay response. Type I (ferric) tape



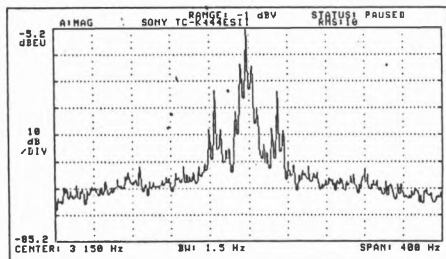
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

SONY TC-K700ES

SONY (UK) LTD, SONY HOUSE, SOUTH STREET, STAINES, MIDDLESEX TW18 4PF.

TEL: STAINES 61688



Another immaculately engineered cassette deck in Sony's prestigious ES range, the TC-K700ES is based loosely on the facilities of the TC-K444 and the audio circuitry of the earlier but highly ranked TC-K777. However, target performance standards are higher still, and the TC-K700ES has a price to match its own unique identity too, mostly due to the unusual positioning of the illuminated cassette compartment in the centre of the fascia.

The deck is based around a unidirectional, dual-capstan, three-head transport which allows instant source/tape checks to be made *via* a front panel switch. The dual capstan drive effectively locks the mechanics of the cassette out of the speed stability and tape to head contact equation. Sony were the first to use this system with compact cassette, something like a decade ago. When executed properly, this approach is generally accepted as being 'A Good Thing'.

The rather 'clanky' transport is operated by a well organised bank of light-touch switches, and allows 'punch-in' recording (hold 'play' and press 'record') and automatic four second mutes. The tape counter does its arithmetic in minutes and seconds, and has a memory and auto-play features. Unusually, the memory functions from the point where the feature was invoked, irrespective of the counter reading at the time.

Sony's record level meters have long been a strong point, and these are no exceptions. They have a wide 48dB range spaced over 16 steps, with peak hold LEDs which stay lit for a short while after the peak has passed. Tape type selection is fully automatic (this being the only obvious feature to separate the TC-K700ES from the TC-K444ES), but bias and sensitivity settings — which affect the tracking integrity of the Dolby circuits — can be adjusted manually.

Socketry is limited to amplifier interconnections, and a variable output headphone socket. Noise reduction is by Dolby B and C, with switchable multiplex filtering. As usual, the MPX filters should be switched off except in the comparatively rare cases of tuners with high levels of 19kHz multiplex signal on the output. (In reality the only valid reason for such filters is that Dolby Labs prefer it that way.)

For once, the inside of this deck is worthy of notice in its own right. This is one of the very few existing cassette decks (apart from those made by cassette specialists like Nakamichi) where mechanical integrity and resistance to microphony is rightly elevated to the status of an obsession. The transport mechanism, main transformer and rectifier are rigidly secured to a block, itself firmly attached to the middle of a stiff chassis which is supported by four solid feet. All other structural elements are designed

to resist mechanical excitation in similar manner — even the cover. To reduce induction or power supply imprinting problems on the audio circuits from the control side, these two sections are disposed each side of the transport, and fed with their own dedicated power supplies.

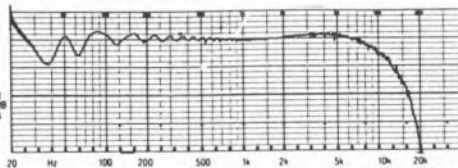
Other improvements over previous Sony top end cassette decks include new digital servo IC electronics, and new, smoother running motors (there are two, a reel motor and a capstan motor, the latter under the control of a quartz oscillator.) The audio amplifiers employ high quality audio grade components and are laid out to minimise interaction with other parts of the deck.

LAB REPORT

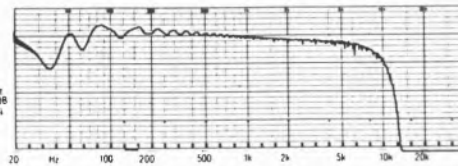
Most of the frequency responses gave classic text book results with a characteristically downwards tilt at the HF end which was both mild and linear. Metal tape responses were well extended into the treble, but the lower energy formulations were clearly bandwidth limited. One particularly pleasing point is that the response shapes didn't alter perceptibly at all with the two noise reduction systems switched in. Of course they can also be tuned at will using the front panel calibration controls.

The tests were run using Sony's own tapes (*HF-S*, *UX-S* and *Metal-S*; Types I, II & IV respectively). Cross-checks with the usual IEC reference tapes actually gave slightly more linear results still, but Sony Tape II was a full 1.5dB quieter at 53.5dB for 0.95% THD (0VU) and Type IV similarly measured 3dB better at -56dB for 0.75% THD (again at 0VU). The metal figure is outstanding, a credit to both tape and machine. Azimuth alignment is good but not wonderful, and the replay response shape was duller than ideal.

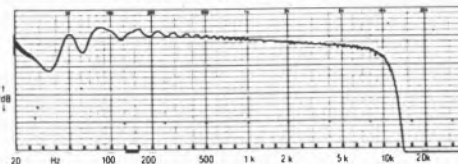
The fluttergram showed a curious cyclic pattern, which suggests that one of the capstans might have been slightly out of true. Even so, the Sony behaves really well mechanically, with very low levels of both wow and flutter. The 0.033% wow and flutter figure is itself outstanding. The spectrogram backed the noise measurements with very low noise modulation, a cleanly



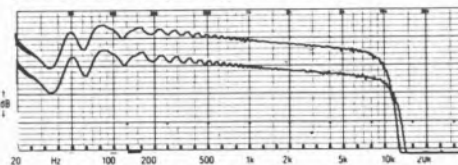
Playback only frequency response (pre-recorded tapes)



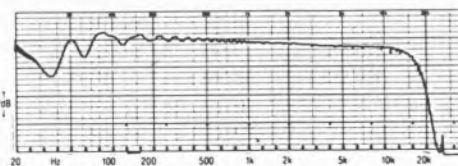
Overall record/replay response. Type I (ferric) tape



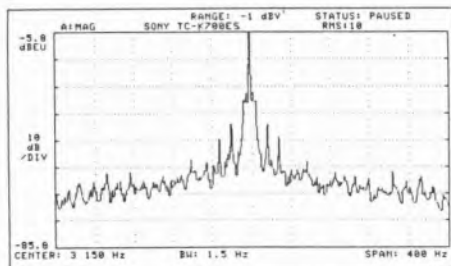
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

Continued over the page

Sony TC-K700ES

Continued from previous page

defined pitch centre frequency, and very little that is not random and at low level elsewhere. Altogether this is an impressive machine on the test bench.

SOUND QUALITY

Futhermore, this is an impressive machine on audition too. The audio results of the TC-K700ES fully justify the sophistication and engineering that have gone into it, both compared to the TC-K444ES and in its own right.

Where the 700 excels (and most cassette decks conspicuously fail) is in the way stereo depth and breadth is preserved, without loss of image precision. Instrumental separation was fundamentally better than with most decks, and there was almost none of the impression that dominant instruments were modulating others. The sound as a whole stayed stable and was aurally coherent. The deck is extremely easy to listen to because the sound isn't constantly changing in minute ways unrelated to the music, and confusing for the brain.

The strengths of the Sony were apparent on all tape types, with the higher energy formulations offering a real advantage on music with a lot of HF energy. Furthermore, this is one of the few decks where the sound doesn't deteriorate substantially when Dolby processing is added into the equation. Dolby C mildly softened the impact of transient leading edges, but the integrity of the sound stayed high and the lack of noise is its own benefit of course. At all times, the character of what background noise remained stayed smooth and innocuous. Replay

performance of prerecorded cassettes was excellent, whilst in no way matching record/replay performance for resolution and focus.

About the only real criticisms are of a slightly cold, 'sterile' feel which can be heard *via* the electronics alone as well as *via* tape — the electronics of this deck are good, but they're not great — and the bass which in normal cassette fashion tends to be rather loose and vague in pitch and impact. Even here, however, the Sony was comfortably above average.

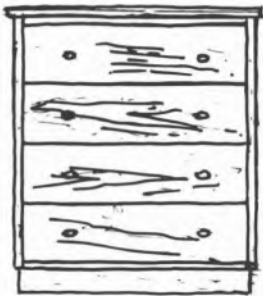
CONCLUSIONS

With the '700ES, Sony have placed a cassette deck firmly in the esoteric league which is as supremely well designed and easy to operate as it is to listen to. Best points are the first class stability and image focus. It just doesn't sound much like a cassette deck — what better compliment can be paid?

TEST RESULTS

Rec/replay response — 3db ref 1kHz	
IEC Type I	<20Hz-12kHz*
IEC Type II	<20Hz-12kHz*
IEC Type IV	<20Hz-19kHz*
Wow & Flutter — Peak DIN wtd/unweighted	0.03%/0.11%
Speed error	-0.45%
Type I signal/noise CCIR/ARM 315Hz	52dB
distortion 0dB	0.6%
Type II signal/noise CCIR/ARM 315Hz	53.5dB
distortion 0dB	0.95%
Type IV signal/noise CCIR/ARM 315Hz	56dB
distortion 0dB	0.75%
Channel separation 0VU/1kHz	-45dB
Line input sensitivity/overload	94mV/7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	662mV/6V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	1.2%
Asymmetry check R L phase at 8kHz	+6 degrees
VU indication at IEC 0dB	0dB
Dimensions (w x h x d)	43 x 12.5 x 35cm
Typical Retail Price	£499

*using Sony tape — see text



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RECOMMENDED

TEAC V-200

HARMAN (AUDIO) UK LTD, MILL STREET, SLOUGH, BERKS SL2 5DD.

TEL: (0753) 76911



Teach have always concentrated on the budget end of the market, and this deck costs a mere £79.95, making it amongst the least expensive you can lay hands on, and a full £10 below the first popular price point.

At £80 you don't get fireworks. The transport controls are an old fashioned if practical set of power assisted piano keys. They wobble alarmingly, but they work, even allowing free movement from mode to mode without passing through stop. So the style of the deck is a bit agricultural, but is there anything so wrong with farming?

Facilities? Not really. You do get Dolby B, and tape type switching of the type that uses inscrutable permutations of two push buttons to cater for the three tape groups. Included is a mechanical tape counter, and around the rear DIN socketry parallels the phono sockets. The record level meters are very simple, with five active steps over a narrow 16dB range, plus a power status indicator misleadingly labelled 'infinity'.

The list of omissions includes a balance control, headphone and microphone socketry. There isn't even autostop on rewind or fast forward, which is practically prehistoric.

LAB REPORT

The story is much as it is with the other Teac

decks in this issue. Distortion is high and speed stability is suspect, whilst the frequency responses are all over the shop. But there are two important differences between this machine and others in the range. One we've already discussed: it's cheaper. The other is that the measurements aren't too appalling.

Noise modulation just scrapes an acceptable rating, though there is some highish mod noise around -23dB down between 20Hz-40Hz. Wow and flutter is poor, with prominent flutter components at -25dB, and a fair amount of audible wow below 7Hz.

IM distortion using the usual test is 10%, and harmonic distortion at 0VU is below 2% with a sufficiently good signal/noise ratio to make it practical to keep record levels well down. Still, this deck has a comparatively narrow working dynamic range, and as such is not well enough equipped to make much of metal tapes. The record/replay responses are almost a repeat run of some other Teac models, with Type II and IV tape being balanced to sound bright, and ferric Type I tape handled most neutrally of the lot. As you might have noticed though, nothing sits below 80Hz. However, the playback only response is good, being essentially accurate through the midband with the -3dB point at 15kHz.

SOUND QUALITY

Forget the measurements, this deck works.

Perhaps because it's so simple inside, the sound isn't as thoroughly processed as usual. Maybe there's another reason. Who knows?

It isn't a perfect recording machine. With ferric tapes it's inclined to sound 'woolly', and there are occasional traces of flutter and drop-out. With higher bias tapes the sound comes to life, albeit with a tendency to compress and fall apart rather early at higher record levels. At other times the sound is a little jangly — incipient mistracking (I jest)? — but is otherwise surprisingly good. There is less midband, mid-level compression than usual and the soundstage remained surprisingly stable.

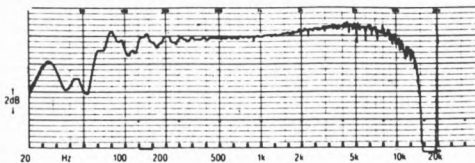
Transient edges are reproduced well, and the overall impression is that although this deck may not sound very expensive, it does sound fundamentally articulate, which is more than a lot of much more sophisticated decks can manage. The measurements indicate bass shortcomings, but in practice the main limitation was the waffly, blurred character that is frequently part of competing packages. Pre-recorded material was handled every bit as impressively.

CONCLUSIONS

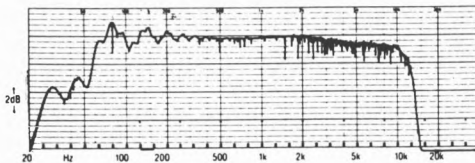
The V-200, as represented by our sample, offers real value for money. The only problems are that it looks cheap and nasty, and build quality really isn't up to much. The tape switching is obstructive and the metering scarcely less so. But the deck as a whole is open and honest, with less blurring of transients than usual.

TEST RESULTS

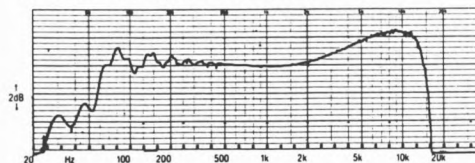
Rec/replay response — 3dB ref 1kHz	
IEC Type I	56Hz-13kHz
IEC Type II	56Hz-16kHz
IEC Type IV	54Hz-16kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.20%/0.40%
Speed error	+0.8%
Type I signal/noise CCIR/ARM 315Hz	53dB
distortion 0dB	0.9%
Type II signal/noise CCIR/ARM 315Hz	53dB
distortion 0dB	1.9%
Type IV signal/noise CCIR/ARM 315Hz	55dB
distortion 0dB	1.9%
Channel separation 0VU/1kHz	-45dB
Line input sensitivity/overload	91.5mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	620mV/3.5V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	10%
Azimuth check R-L phase at 8kHz	15 degrees
VU indication at IEC 0dB	+6dB
Dimensions (w x h x d)	43.5 x 12 x 21.5cms
Typical Retail Price	£80



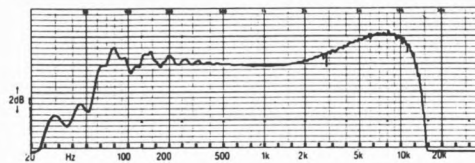
Playback only frequency response (pre-recorded tapes)



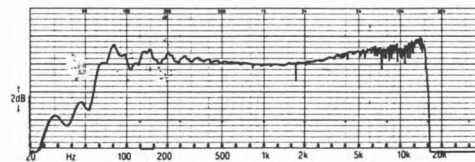
Overall record/replay response. Type I (ferric) tape



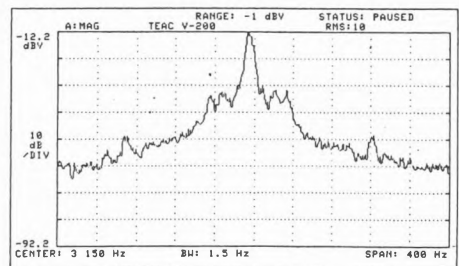
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

TEAC V-210C

HARMAN (AUDIO) UK LTD, MILL STREET, SLOUGH, BERKS SL2 5DD.

TEL: (0753) 76911



This is the alternative, slightly 'up-market' version of the Teac V-200, though £99 is a novel interpretation of the term up-market that could cause heebie-jeebies amongst Teac's closest competitors, some of whom don't sell decks as cheap as this. The basics of the machine are similar to the V-200, classically laid-out with a set of power assisted closet-mechanical controls situated immediately beneath the cassette flap. To the right, a row of press buttons select the tape type (two of them in an arrangement best described as archaic) and select Dolby noise reduction. And it's here that one of the major differences from the V-200 is to be found: the 210C has Dolby C as well as Dolby B. Immediately to the right is the other important facility missing from the cheaper model — a knob to tweak record bias.

The V-210C also has a mechanical tape counter (no memory) and some garish looking record level LED meters with a mere 5 active steps over a very restricted operating range. Like its close relatives, the V-210C feels flakey and lightweight. There are no LED status indicators for Dolby operation or tape type, and not even a headphone socket.

LAB REPORT

The numbers don't always tell the story like it

is, but in this case they do. The noise modulation plot for example is very poor. There's no real pitch centre at all, and noise modulation levels are high. Similarly, the fluttergram simply shows lots of wow and lots of flutter. The nature of the spectra is such as to make the raw wow and flutter measurement (0.27% wtd) seem modest, if not a lucky break.

OVU signals/noise figures are good, but the deck is well into clip at these levels, according to both the intermodulation and harmonic distortion figures. Using a central setting for the fine bias adjustment knob the record/replay frequency responses are all over the place. Of course the grosser inaccuracies can be tuned out with the bias knob, but not completely, and in the end you're still going to end up choosing your own preferred set of tonal anomalies. In all cases bass output is on the decline from 80Hz. One good feature is that although Dolby does make matters worse, it doesn't do so severely.

Note that absolute running speed is quite fast, which will knock about 40 seconds or so from each side of a C90, and intensely annoy pre-recorded cassette users with absolute pitch. (Those who can put up with the wow and flutter, that is.) In other respects prerecorded tapes are surprisingly well catered for.

SOUND QUALITY

Sound quality is much poorer than with its kissing cousin, the V-200. The V-210C sounds considerably more opaque, with much less resolution, though there is just as much treble output.

Pitch stability, suspect with the cheaper model, was well beyond the pale in this case. It was undoubtedly responsible for some of the 'roughness' in the sound, but this was also one of the very few decks whose pitch would be heard slowly wandering on a variety of material, rather like a video recorder linear soundtrack where the video servos are working overtime. Sustained piano notes fared worst, with a general lack of precision and obvious if intermittent flutter.

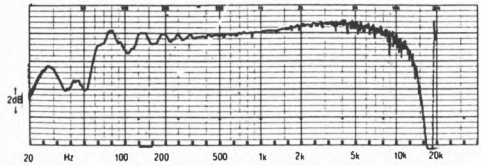
Pre-recorded material did at least sound reasonably neutral tonally, and reproduction quality here was as good as with a number of more expensive decks. The fine bias adjustment facility enables the majority of tapes to be matched to the recorder, but this is of little practical importance when the more basic elements are wrong.

CONCLUSIONS

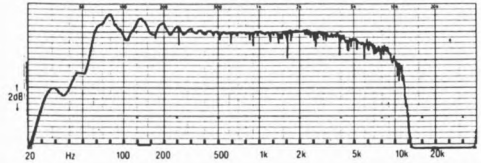
Dolby C and control over bias cannot compensate for inadequate speed stability. The V-210C sounds messy and constrained, with clear indications of wow and flutter. It's quite possible that sample variations are at play here, and that the next one off the production line might have achieved a better standard.

TEST RESULTS

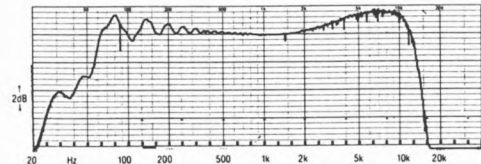
Rec/replay response - 3db ref 1kHz	
IEC Type I	54Hz-12kHz
IEC Type II	54Hz-14kHz
IEC Type IV	54Hz-16kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.27%/0.45%
Speed error	+1.5%
Type I signal/noise CCIR/ARM 315Hz	53dB
distortion 0db	1.0%
Type II signal/noise CCIR/ARM 315Hz	54dB
distortion 0db	2.4%
Type IV signal/noise CCIR/ARM 315Hz	54.5dB
distortion 0db	3.3%
Channel separation 0VU/1kHz	-47dB
Line input sensitivity/overload	93mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	640mV/2.23V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	-8.4%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0db	0dB
Dimensions (w×h×d)	43.5×12×21.5cms
Typical Retail Price	£99



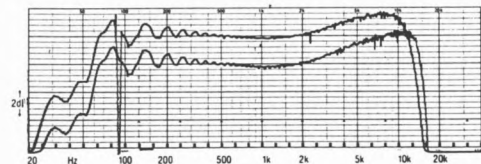
Playback only frequency response (pre-recorded tapes)



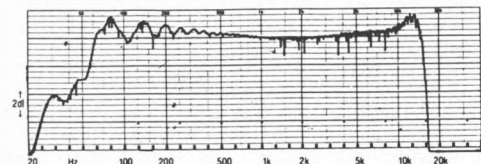
Overall record/replay response. Type I (ferric) tape



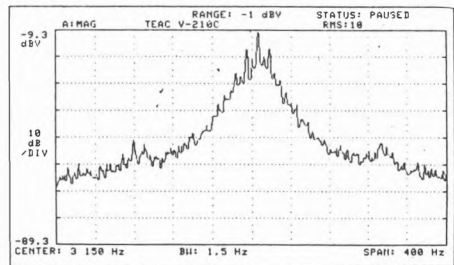
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

TEAC W300

HARMAN (AUDIO) (UK) LTD, MILL STREET, SLOUGH, BERKS SL2 5DD.

TEL: (0753) 76911



One hundred and fifteen pounds for a twin cassette deck with high speed dubbing? Well here is just such an animal. This type of deck has been slow to catch on with the separates buyer, most of whom realised that you can't spread the butter twice as far without the coating ending up rather thin. In this case, spreading the butter thinner means assisted mechanical lever transport controls, very simple meters and other facilities, a tacky appearance, and ultra-lightweight build. But it is cheap.

Only one of the transports records, the other is used for playback only, the latter selecting 70 μ s equalisation automatically as required. The record capable deck must be set manually.

The deck also has Dolby B noise reduction. Setting the playback deck to 'play' and pressing record on the other deck starts the dubbing process, either at normal or double speed according to the setting of a tape speed switch. A record level control, a mechanical tape counter and a 5-step record level meter that spans a full 16dB (!) completes the gadget count, except that this Teac will also perform continuous playback.

LAB REPORT

A frequency response plot was run by dubbing a test tape at high speed, the outcome looking rather like Brighton Pier viewed during a storm.

From a base level near 400Hz, the output rises and rises, eventually peaking a full 7dB up at 5kHz, before starting on a terminally declining slope. And that says nothing about the per-mutated wow and flutter components which make a joke of even semi-serious listening to anything other than speech.

In common with other Teac cassette decks, which place IEC 0dB at 0VU, harmonic distortion levels are exceptionally high. In the case of Type II and IV cassettes, distortion exceeds the 3.3% limits of the test equipment, and IM distortion is also exceptionally high.

The problems are mechanical as well as electrical. The noise spectrogram speaks of a generally poor noise envelope surrounding a poorly defined centre frequency, and sidebands at ± 125 kHz. Flutter components are concentrated around 11kHz, but there's no shortage elsewhere either.

All record/replay responses are bright bar the Type I ferric one which is flat. There's little bass below 80Hz, which is bound to reflect on audition. The replay only response, however, is excellent.

SOUND QUALITY

The W-300 is definitely a mixed blessing. It does a good job with prerecorded cassettes though critical program exposes the mechanical prob-

lems of the deck; poor tape-to-tape contact leads to frequent dropout as well as uncertain pitch stability. Home made tapes tend to sound rather rough and ready, but as with some of the other Teacs there is a certain underlying integrity — a transparency and unfettered sense of dynamics, that can make for very enjoyable listening. It may not be hi-fi, but . . .

The caveats are these. Bass generally sounds thin. Metal tape offers no discernible advantage over chrome (Type II), and in fact can sound rather wiry and harsh. Type II tapes tend to sound brighter but less edgy, and may be preferred. Ferric tapes work well too, and technically suit the deck best. But in practice they lacked both energy and top end dynamics.

Dubbed recordings sound considerably worse than first generation recordings, but high speed dubs bring a whole new layer of meaning to the term 'considerably worse'. Not only does dropout increase exponentially and all sense of resolution fly out of the window, the pitch of the final recording even managed to shift by about a semitone!

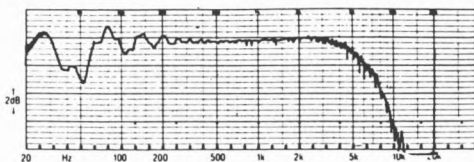
CONCLUSIONS

As a bare bones way of buying a viable machine to copy tapes, the W-300 is about as cheap as they come. It can even make acceptable sounding first generation recordings. But the capabilities are very circumscribed, and don't extend to making decent quality dubs especially in high speed mode.

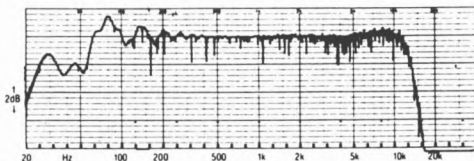
TEST RESULTS

Rec/replay response — 3db ref 1kHz:

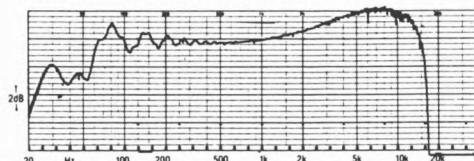
IEC Type I	23Hz-13kHz
IEC Type II	56Hz-16kHz
IEC Type IV	40Hz-17kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.38%/0.50%
Speed error	-0.05%
Type I signal/noise CCIR/ARM 315Hz	53dB
distortion 0dB	<1.7%
Type II signal/noise CCIR/ARM 315Hz	53dB
distortion 0db	>3.3%
Type IV signal/noise CCIR/ARM 315Hz	54.5dB
distortion 0db	>3.3%
Channel separation 0VU/1kHz	46dB
Line input sensitivity/overload	91.5mV/7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	625mV/2.7V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	14%
Azimuth check R-L phase at 8kHz	17 degrees
VU indication at IEC 0db	0dB
Dimensions (w×h×d)	43.5 × 12 × 21.5cms
Typical Retail Price	£115



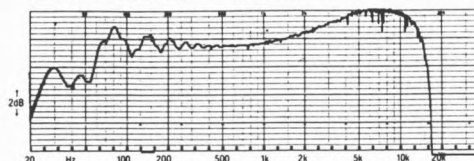
Playback only frequency response (pre-recorded tapes)



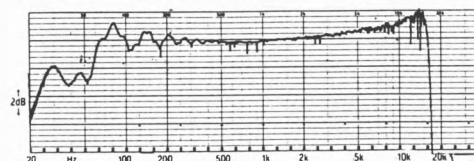
Overall record/replay response. Type I (ferric) tape



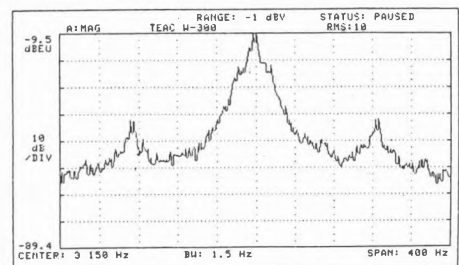
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

TEAC W-310C

HARMAN (AUDIO) UK LTD, MILL STREET, SLOUGH, BERKS SL2 5DD.

TEL: (0753) 76911



As the model number suggests, the W-310C is closely related to the W-300. It is in fact its uncle, based on exactly the same basic design, but £129 instead of £115 buys Dolby C and a fine bias adjustment facility to straighten the inherently rather wobbly response curves.

Otherwise it's the W-300 reincarnated, featuring twin transports, only one of which records, configured for dubbing at normal or double speed, and continuous play (one side of each tape in turn). There are some nice minor features, such as a reflective panel in each cassette well so that you can see how much tape remains. Just as well really; the tape counter only works for the record/playback transport. There's no headphone socket either.

It's pretty sparse elsewhere too: there are few telltales, and auto tape selection only operates on the playback mechanism. The transport controls feel flimsy and the complex switching for the simple functions isn't very ergonomic.

LAB REPORT

The noise modulation spectrogram is pretty poor stuff. There are serious $\pm 130\text{Hz}$ sidebands, and the pitch centre resolution is more a suggestion, a presentiment, than the real thing. The story the fluttergram tells is that the Teac is better in the low rate (wow) area than else-

where. There is strong 12Hz flutter at -15dB , for example; wow (low rate speed variations, usually audible as a wavering of pitch) is merely very high.

IM distortion is extremely high at 14.1%, and the harmonic distortion plot shows that the electronics are all but in full clip at 0VU, though signal/noise is good. Best to keep the left hand down a bit when setting recording levels.

The Type IV record/replay response shape is good, and the others are a little bright (Type II) and dull (Type I) using the IEC reference tapes with the bias control centred. This can be largely cured with appropriate settings of the bias adjustment facility. The replay only response is actually quite good despite a 30 degree azimuth error, and Dolby noise reduction does little to alter the equation.

SOUND QUALITY

Despite the 'immediate' tonal balance, high frequencies sounded curiously dull and constricted with all three tape types. This applied especially at higher record levels, which suggests a distortion mechanism at work. The debilitating effects of wow and flutter were also all too apparent, though erratically so, but longer term and quite severe variations in pitch made a complete nonsense of high speed dubbed tapes.

There were azimuth differences between the

transports too, so that, for example, a tape on the record/playback transport reproduced with severely reduced treble on the playback mechanism. On the positive side the bass and mid-band sounded quite spacious and unstrained, and the bass in particular was tuneful, though light in balance.

Altogether, the ability of the W-310C to justify a high fidelity label doesn't really survive detailed analysis. There are too many ways in which the sound fails or at least sails too close to the wind. But the fact that Dolby C leads to almost silent backgrounds, and that the bias adjustment facility mean that most Type I and II tapes can be persuaded to offer a flat tonal response with the minimum of Dolby mis-tracking helps improve the value for money ranking of an otherwise 'iffy' mixture.

CONCLUSIONS

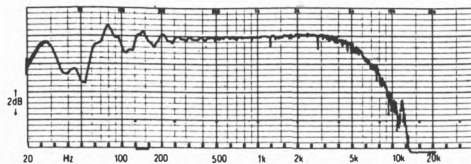
The fine bias facility overcomes one limitation of the cooking W-300 version, at relatively little additional cost to the user, and Dolby C effectively silences the tape itself. But neither tape matching nor noise reduction standards define the area that needs the most attention, which is the mechanical standards of the transport. Dubbing performance is poor, especially when using the high speed mode, but normal record/replay and replay only performance standards are not too bad.

TEST RESULTS

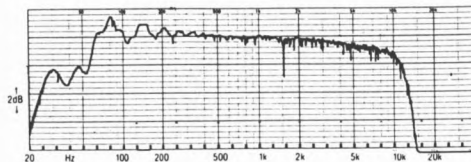
Rec/replay response - 3dB ref 1kHz

IEC Type I	40Hz-12kHz
IEC Type II	55Hz-15kHz
IEC Type IV	53Hz-16kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.75%/0.17%
Speed error	-0.1%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.9%
Type II signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0dB	1.0%
Type IV signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	1.1%
Channel separation 0VU/1kHz	-52dB
Line input sensitivity/overload	70mV/2.86V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	1V/4.7V
IM distortion 10kHz/1kHz: 0dB peak, 1kHz product	0.07%
Azimuth check R-L phase at 8kHz	+ 36 degrees
VU indication at IEC 0dB	+ 3dB
Dimensions (w x h x d)	43.5 x 12 x 21.5cms
Typical Retail Price	£129

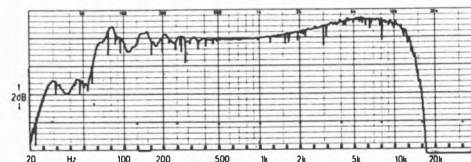
N.B. bias adjust at centre position for all tests



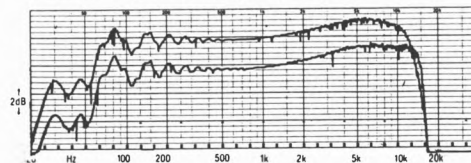
Playback only frequency response (pre-recorded tapes)



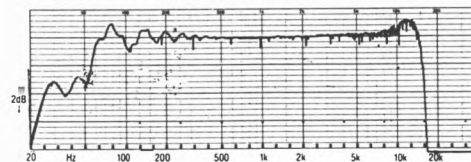
Overall record/replay response. Type I (ferric) tape



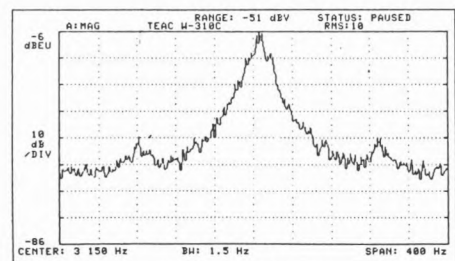
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

BEST BUY

TECHNICS RS-B305

PANASONIC (UK) LTD, 300-318 BATH ROAD, SLOUGH BERKS SL1 6JB
TEL: (0753) 34522



Whilst standing clear of the truly low cost end of the market, the RS-B305 gives a taste of what a sensibly engineered few-frills cassette deck can be like.

Light-touch powered transport keys include one that mutes the record circuitry for four seconds before switching to record standby. The input level arrangements consist of separate rotary level and balance controls; stereo stability during fades therefore depends entirely on the channel tracking integrity of the pot, which was OK. Crude 5-stage record level meters have coarse 5dB steps below 0VU, and 3dB steps above indicated in a different colour.

A vertical row of press buttons adjusts the recorder for the three tape types, but it would have been better had this been automatic; cheaper too, probably. Dolby B and C noise reduction are selected using an awkward twin switch configuration.

Other features include a simple mechanical tape counter, a timer switcher (record or play) and socketry for headphones and two microphones. The headphone outlet is at a fixed level and is best suited to moderate or low impedance cans. The transport logic control is extremely effective in all modes, and the transport itself is a relatively sophisticated two motor type with

separate drive to the reels and the capstan/pinch roller. The mechanism is smooth and quiet once it's spinning, but there is a sharp click as functions engage (or disengage).

LAB REPORT

There was some HF loss replaying prerecorded tapes (-3dB at 11kHz), much of which is due to an azimuth error calculated at around 19 degrees. The measured record/replay responses, however, were excellent on IEC Type I and II tapes, with virtually no Dolby tracking errors evident; the slightly truncated HF responses are due to the non-defeatable MPX filtering. The IEC Type IV (metal) response shape indicates very mild underbiasing.

This deck is on strong ground mechanically. Wow and flutter measures well, and spectrum analysis shows that frequency components are particularly low in level, a sure sign of a basically sound tape path design. Distortion levels are also satisfactory, and electrically the Technics seems quite clean. With better azimuth alignment back at the factory, this deck could be above easy criticism.

Recording levels can be allowed to stray several dB over 0VU (by about 3dB-5dB for each tape type) without fear of severe compression or distortion.

SOUND QUALITY

In a word, and taking cost into the equation, the 305 sounded excellent. Even the audio amplifiers fitted are of good basic sound quality.

Notwithstanding the slightly poorer measured Type IV performance, it was with metal tapes that the Technics sounded at its most convincing. The strongest points were fortuitously in just those areas where inexpensive cassette decks most often come adrift. The 305 had a quality of solidity and stability in its music making, a sureness of pitch in the bass and an absence of flutter-related problems that was most welcome.

However, recordings made on Type I and II tapes sounded mildly flattened both dynamically and spatially: Type IV sound quality was simply livelier and more realistic. The marginally bright sound didn't seriously detract from this, but it wasn't the reason for the good results either.

There was relatively little loss of resolution with Dolby C switched in, though where noise was well masked by the music, non Dolby recordings sounded better still, followed in the rankings by those made with Dolby B.

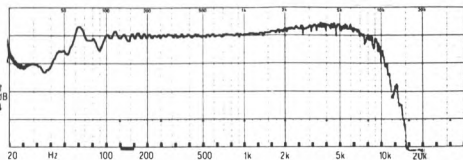
CONCLUSIONS

This is an excellent deck, well worth the price premium over the true budget price models for its stable build and sound quality. Though pre-recorded material sounded less good than the home-brewed variety, this is but a mild blot on an otherwise clean copybook.

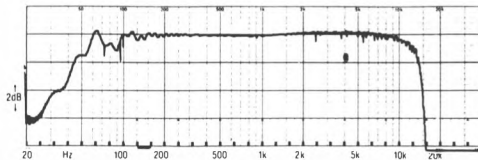
TEST RESULTS

Rec/replay response - 3db ref 1kHz

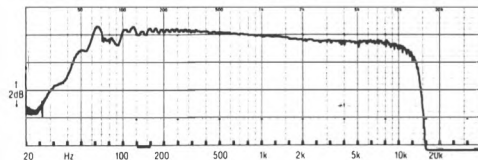
IEC Type I	40Hz-15kHz:
IEC Type II	40kHz-14kHz:
IEC Type IV	40kHz-16kHz:
Wow & Flutter - Peak DIN wtd/unweighted	0.075%/0.27%:
Speed error	-0.3%:
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.6%
Type II signal/noise CCIR/ARM 315Hz	50.5dB
distortion 0dB	0.6dB
Type IV signal/noise CCIR/ARM 315Hz	51.0dB
distortion 0dB	0.8%
Channel separation 0VU/1kHz	-49.5dB
Line input sensitivity/overload	650mV/ >7V
Mic input sensitivity/overload	0.66mV/225mV
Line output for 0dB/maximum	650mV/2.25V
IM distortion 10kHz/11kHz: 0dB peak, 1kHz: product	0.18%
Azimuth check R-L phase at 8kHz	+31 degrees
VU indication at IEC 0dB	+3dB
Dimensions (w x h x d)	43 x 10.2 x 23.7cm
Typical Retail Price	£139.95



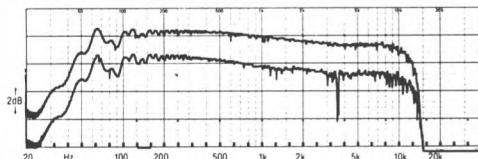
Playback only frequency response (pre-recorded tapes)



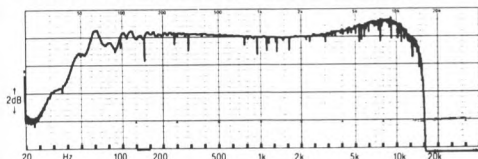
Overall record/replay response. Type I (ferric) tape



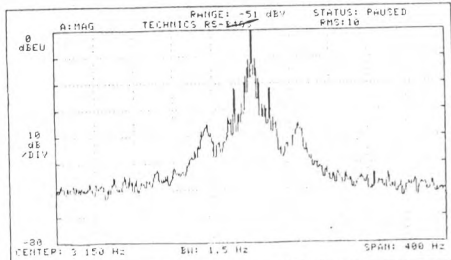
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape

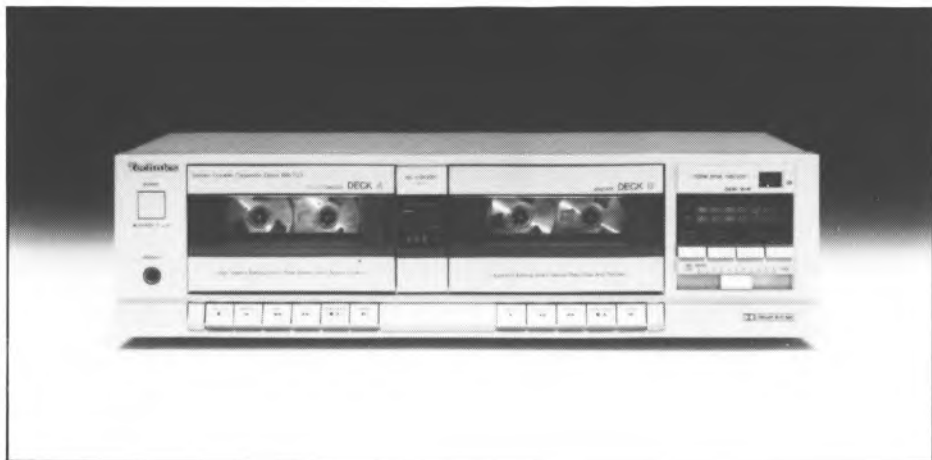


Noise modulation spectrum analysis

TECHNICS RS-T22

PANASONIC(UK)LTD, 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB.

TEL: (0753) 34522



Technics' latest twin-deck recorder was flown in especially for this project, only just in time to beat the deadlines. It's a budget twosome, capable of dubbing in real time or at double speed, and of sequential play. Otherwise it's very simple. Both transports have automatic tape type selection, and both offer Dolby B and C. There is a speed switch (see above), and one labelled 'editing/auto space' to leave a few seconds between tracks. There's a headphone socket, a tape counter and a simple record level control too, but no balance adjustment.

Although the controls are power assisted, they are not logic controlled. You cannot go straight from play (or record) to fast wind or rewind without passing through stop on the record/replay deck. Curiously, you're not prevented from trying the same thing with the replay only deck, though what you get is a form of cueing, with an only just audible output from the heads whilst so doing. One area where the Technics scores heavily is where many manual and assisted setups have failed in the past: these transport controls are firmly anchored in place.

The record level meters have a mere 5 active steps and a 16dB dynamic range, but their scope is widened by a 'digital peak indicator' — a numerical indicator which reads the current level of the sound in decibels (in this case over

a range of about 26dB) with a time constant just sufficient to make the data readable. Such indicators first saw light of day as supplements to normal wide-ranging meters, where they were designed to read out, say, the highest peak registered during a session, whilst the main meters carried on with their job. The readout fitted to the Technics does nothing of the sort, and the way it works violates all the rules of human engineering. Otherwise the RS-T22 may well be the simplest twin deck to use yet.

LAB REPORT

Against all the odds (two decks into £150 shouldn't really go), the RS-T22 performs remarkably on the test bench. For the most part, the record/replay responses couldn't have been drawn flatter with a draughtsman's — er, drawing implement. The azimuth check showed no error, and the replay only response was -3dB above 10kHz, after a very shallow rise. Only the merest hint of Dolby C mistracking let the deck down a little. A plot made using the high speed dub option led to much less distortion of the source plot than usual, though the steep, localised HF rise looks nasty enough. IEC 0dB is at +5VU, so recordings can be peaked well into the red, improving signal/noise.

Wow and flutter levels are remarkably low for a deck at this price — never mind two decks

at this price. The noise modulation result is very clean indeed, with just minor 'shoulder' effects, whilst the flutter analysis showed moderate wow at -30dB , and a few well distributed flutter components.

SOUND QUALITY

The pre-recorded test programme was flunked by this deck, the tapes sounding uniformly dull and coarse. The background hiss seemed 'shaped', with something of a sting in the treble.

Dolby B Type IV recordings sounded rather furry around the edges. The music was curiously transient-led, yet muffled through the LF and midband areas. Using Dolby C instead led to slightly less muffling (strange but true), whilst tonally the picture seemed more brightly lit and distinctive. In practice, lower bias tapes seemed preferable.

High speed dubs sounded poor by normal standards. There were severe additional losses of detail, and dropout increased strongly. Nevertheless, they sounded better than similar recordings made on double speed dubbing decks at twice the price or more. Finally, pitch stability was of a high order — *except* when dubbing.

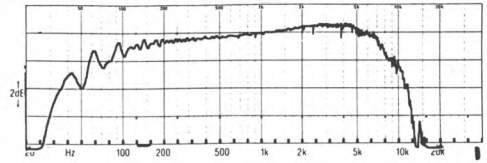
CONCLUSIONS

This must be about the most unlikely winner, so accurately set up it seems almost too good to be true. Unfortunately, sound quality was nothing like as good as the numbers implied. Although exceptionally good value by twin-deck standards, the RS-T22 doesn't really compare to the single transport competition.

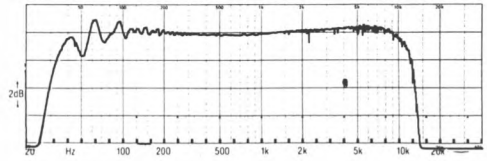
TEST RESULTS

Rec/replay response -3dB ref 1kHz

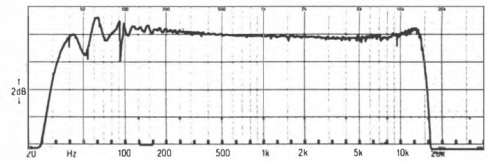
IEC Type I	31Hz-13kHz
IEC Type II	30Hz-15kHz
IEC Type IV	29Hz-16kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.08%/0.18%
Speed error	0.2%
Type I signal/noise CCIR/ARM 315Hz	47.5dB
distortion 0dB	0.5%
Type II signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	0.44%
Type IV signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0dB	0.5%
Channel separation 0VU/1kHz	47dB
Line input sensitivity/overload	117mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	695mV/2V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	6%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0dB	+5dB
Dimensions (w×h×d)	43×12×22.8cms
Typical Retail Price	£150



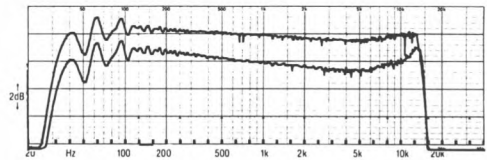
Playback only frequency response (pre-recorded tapes)



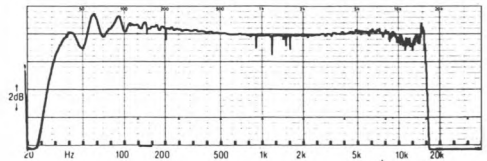
Overall record/replay response, Type I (ferric) tape



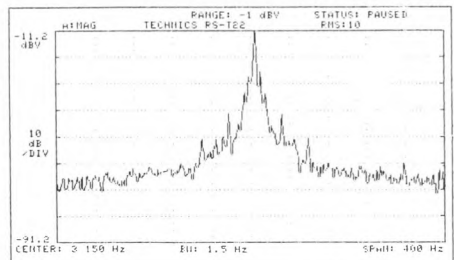
Overall record/replay response, Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response, Type IV (metal) tape



Noise modulation spectrum analysis

TECHNICS RS-B405

PANASONIC (UK) LTD. 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB.

—TEL: (0753) 34522—



The RS-B405 is a kind of 'grown-up' '305. They share most of the same key features, including the basic disposition of controls and readouts, the ganged rotary input level control, the smaller, separate rotary balance control and so on. They also share some less desirable features such as manual tape type switching. The main difference lies in the inclusion of *dbx* noise reduction, which supplements Dolby B and C.

Compared to its cheaper cousin, the record level meters have finer graduations and more of them, along with three readout colours along go/caution/stop lines. The tape counter is electronic but lacks a memory stop, a 'music search' function finds next and last track starts, and Technics have included automatic record muting.

Fixed level headphone monitoring is complemented by twin microphone sockets. The transport keys are fully logic controlled, but the transport itself is rather noisy and pause mode is very slow to lift. However, recordings can be initiated in two steps with one finger, which is an advantage.

The transport has two motors, separately driving the capstan motor and the reels: this configuration generally improves mechanical integrity, because it allows better control of tape

tension and the capstan drive.

LAB REPORT

There were some wow components and low frequency variations down to 10Hz and below, with amplitudes as high as -12dB in places. The noise modulation spectrogram showed good centre frequency definition and sharp, well controlled sidebands — a good result. Notice the way most of the speed variations are clumped around the test frequency.

Replay head azimuth measured 19 degrees adrift, and the replay response was -3dB at 13kHz. However the record/replay responses were characterised by a flat, even midband, with HF well maintained, before rolling off sharply into the MPX rejection area. The typical LF response is clearly tied to head geometry.

IEC 0VU corresponds to +4dB on the deck's meters. This and the low distortion figures for all tape types suggests that record levels can be allowed to peak well into the red, which will make the already satisfactory noise figures even better.

SOUND QUALITY

Much of the sound quality degradation imposed by this deck can be heard simply by auditioning the line amplifiers whilst a recording is taking place. They are clearly not designed to high

audio standards, and cause a surprising amount of clutter and constriction of depth information, as well as sounding rather 'sat upon' in the treble.

Even taking this into account, however, the deck could sound pretty good, which suggests that apart from the line amp circuits, Technics have done a good job. But it was necessary to avoid *dbx*, which made metal tapes sound 'thin' in balance and dynamically 'messy' as well as seeming rather distorted. Dolby C recordings sounded the other way — dull.

With or without Dolby B, however, the RS-B405 sounded well controlled and quite tidy by cassette standards, with acceptable bass definition and top end 'air.' Image stability was of a high order, a clear reflection of the (mostly) well behaved transport. Type II tapes represent optimum value for most applications, but there is a strengthening of dynamics and a more consistent quality through changes in the music with metal tape.

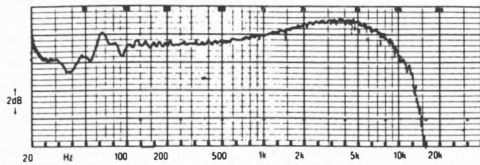
CONCLUSIONS

Automatic tape selection would have made the ergonomics almost unbeatable, and better audio electronics would have lifted it onto another plane. Even so, this is a mostly competent deck which has the potential to transcend the stereotypes. Not with *dbx* though!

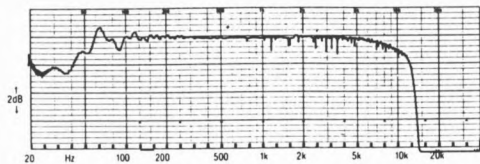
TEST RESULTS

Rec/replay response — 3dB ref 1kHz

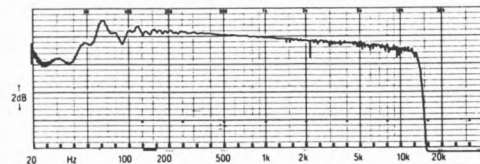
IEC Type I	<20Hz-13kHz
IEC Type II	<20Hz-14kHz
IEC Type IV	<20Hz-18kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.09%/0.24%
Speed error	+0.1%
Type I signal/noise CCIR/ARM 315Hz	47.5dB
distortion 0dB	0.7%
Type II signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.55dB
Type IV signal/noise CCIR/ARM 315Hz	51.5dB
distortion 0dB	0.7%
Channel separation 0VU/1kHz	47.5dB
Line input sensitivity/overload	130mV/>7V
Mic input sensitivity/overload	0.56mV/27mV
Line output for 0dB/maximum	660mV/3.1V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.14%
Azimuth check R-L phase at 8kHz	+19 degrees
VU indication at IEC 0dB	+4dB
Dimensions (w × h × d)	43 × 10 × 24cm
Typical Retail Price	£170



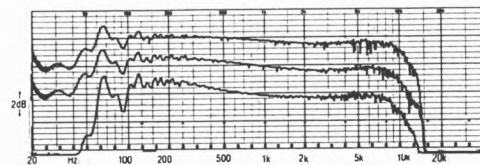
Playback only frequency response (pre-recorded tapes)



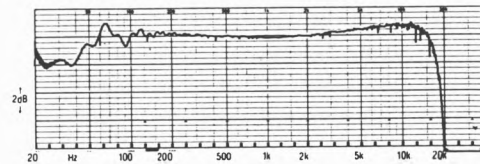
Overall record/replay response. Type I (ferric) tape



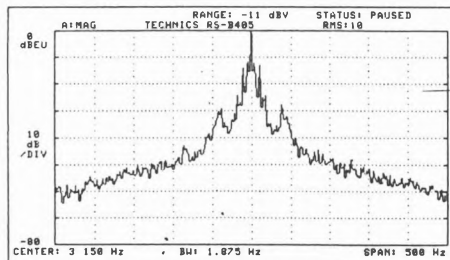
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

TECHNICS RS-B705

PANASONIC (UK) LTD, 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB

—TEL: (0753) 34522—



The RS-B705 is a new model aimed at aspiring owners of 3-head cassette decks with off-tape monitoring, who can't run to the usual entry fee.

The transport is slick and smooth-acting in the best Technics tradition, and does tricks like searching for the current or next track start. Of course the deck has the usual Dolby B and C noise reduction processors, and in common with some other recent Technics models also comes equipped with Dolby HX Pro.

A set of short and gruesome-looking peak-reading record level meters cover a 29dB range, from -20dB to +9dB. Alongside is an electronic tape counter, unfortunately bereft of time or memory facilities. The tape type in use is selected manually, and a pair of push buttons call up Dolby B or C noise reduction. Technics also provide a bias adjustment control to tweak the mid and high frequency response shapes of all tape types — not just Type I and II tapes as is usual with most such decks.

In the author's personal opinion, the RS-B705 is a rather derivative looking product — almost a caricature of the Technics house style with its chocolate brown fascia, the faint yellow panel graphics and other such details. It could be accused of being a little awkward in presentation, partly because some of the detail work

is rather fussy. But as usual with this marque, the important things like build, fit and finish are up there with the best. There are some excellent minor touches too, for example the way the 'play' tell-tale flashes to show what action is required next when you're sitting in pause or record-pause. There is also an automatic record mute button.

LAB REPORT

The noise spectrogram gave good centre definition, but poorer than average noise modulation within +/-100Hz. The fluttergram looked pretty good, though the distribution of noise effects suggest it may not sound as transparent in the treble as the good wow & flutter figure (0.085% peak DIN wtd) suggests.

The playback only response shape is well contrived, with an extremely flat midband area. With more accurate head alignment (see azimuth results) the HF extension would have been improved still further.

In contrast the record/replay frequency responses are all well extended into the treble, and in some cases a little peaky to boot. This is not necessarily desperately important in itself, especially for a 3-head deck like this with adjustable bias, since it is easy to make effective correction by increasing bias whilst checking source against tape until the spectral balance is similar. What

does hurt, however, is the severe Dolby C mistracking, which is certain to have consequences on audition.

SOUND QUALITY

In fact Dolby mistracking was very apparent indeed, but for much of the time it actually helped. With ferric Type I tape stock especially Dolby B led to some thickening and muddying of textures, and flattened stereo depth. With Dolby C the sound was similar but brighter, and the effect was more palatable.

Type IV metals always sounded a little under-biased on this machine — thin and light regardless of fine bias settings — and the outcome was invariably a rather edgy, unnatural sound. Type II tape didn't suffer in the same way, but did faithfully expose this deck's weakness: it reduces the music in stature by robbing it of resolution and smearing many of the subtle cues that produce believable stereo, ambience and other important humanising touches.

Pre-recorded material reproduced very poorly indeed. The tonal quality was very dull, and the loss of clarity and information was severe to put it mildly. There were in fact signs of quality underneath everything, but with the RS-B705 this meant doing quite a lot of digging.

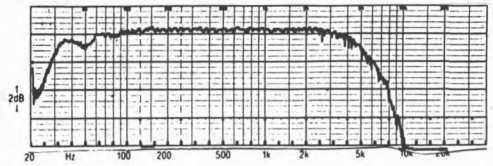
CONCLUSIONS

The RS-B705's main claim to fame is the low price asked for a full 3-head deck with off-tape monitoring. Trouble is, it doesn't turn this into a sonic advantage. And pre-recorded tapes sounded positively awful.

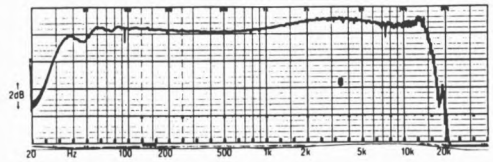
TEST RESULTS

Rec/replay response — 3db ref 1kHz

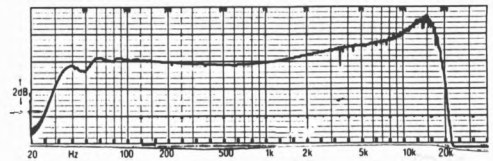
IEC Type I	27Hz-17kHz
IEC Type II	27Hz-21kHz
IEC Type IV	26Hz-22kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.085%/0.26%
Speed error	-0.5%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.75%
Type II signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	1.15%
Type IV signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	1.5%
Channel separation 0VU/1kHz	47dB
Line input sensitivity/overload	71mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	366mV/3.2V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	0.25%
Azimuth check R-L phase at 8kHz	90 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	43×28.6×11cms
Typical Retail Price	£250



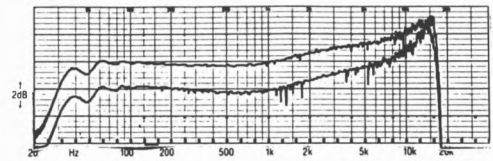
Playback only frequency response (pre-recorded tapes)



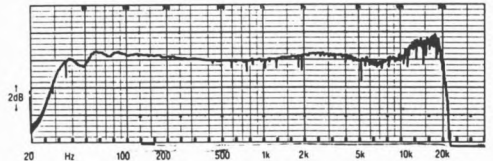
Overall record/replay response. Type I (ferric) tape



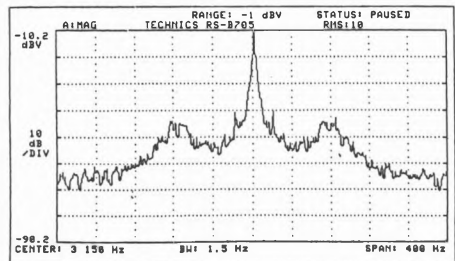
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

TECHNICS RS-T80R

PANASONIC (UK) LTD, 300-318 BATH ROAD, SLOUGH, BERKS SL1 6JB.

TEL: (0753) 34522



The RS-T80R is a well-equipped dual transport deck, and is one of very few with any pretensions to decent sound quality. Under the skin engineering quality appears good, and the deck is as smooth and slick to use as a comparably priced single transport deck from the same stable. However, transport engagement is accompanied by a loud 'click', and it's not possible to get a rapid enough start after releasing pause.

Both two-head transports offer full auto-reverse operation, with switching for single pass, reverse at tape end or continuous auto reverse at both tape ends (the latter of course for playback only). Unusually both decks are fully record capable, which allows series recordings on both sides of one tape followed by both sides of another. Series playback and simultaneous recording (the pirate mode) in which a record or CD is copied on to two separate tapes at the same time are also available, and tapes can be dubbed in real time or at twice normal speed.

A number of thoughtful aids facilitate fool-proof copying, such as one-touch synchronised starts (with the source tapes in dubbing operations being given a 0.4 sec lead), synchronised stop (the recording tape halts when the source tape runs out), and automatic record mute. Tape type recognition is automatic and independent

on the two transports — except, inexplicably, when dubbing. The record level meters have a 19dB dynamic range and adequate resolution. A blank skip feature (switchable) is also fitted. The tape counter is connected only for one of the two transports.

Technics are confirmed backers of the powerful *dbx* noise reduction system which is fitted alongside Dolby B and C, but the RS-T80R can strip out *dbx* processing whilst dubbing so that copies can be used in cars or elsewhere where *dbx* isn't available.

LAB REPORT

Most of the response tests showed a gently declining response at HF, the sole exception being Type IV metal. The playback only response was fine and head azimuth wasn't excessively in error: consistency between the two transports (not reproduced) gave excellent results. The final response run reproduced here demonstrates the effect of the various noise reduction systems in the frequency domain, in particular the way *dbx* causes the high frequencies to roll away quite rapidly above 5kHz; the -3dB point is at 12kHz with *dbx*, 15kHz without.

Weighted wow & flutter on our sample was a very poor 0.25% on both transports, with high levels of sidebands around the centre frequency (eg 35Hz, -21dB), and some multiple harmonic

wow components at a pretty high level down as far as 20Hz. Noise and distortion results were satisfactory.

SOUND QUALITY

The inability of the transport to keep a stable pitch was more than just obvious on test, robbing the sound of integrity. The dbx circuit had a similar effect, tending to squash the sound and also affecting pianissimo passages, which sounded unsettlingly duller than others. There was little advantage in using metal tapes, and on balance Dolby B noise reduction offers about the optimum compromise between low noise and reasonable fidelity with most wide-ranging material. Music for head-bangers, however, will be better served using no noise reduction at all.

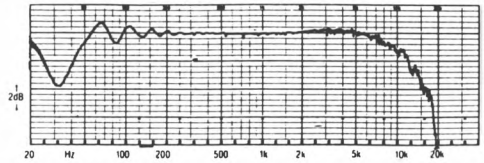
In the final analysis, however, the problems with the transport make such considerations academic, even for normal use, whilst pre-recorded material lacked life and energy. Worst of all, the high speed dubbing option was plain laughable. I couldn't keep a straight face as the pitch of the dubbed tape meandered drunkenly around, the bass changed into something with the consistency of cotton wool, and all the energy drained from the top couple of octaves. And this is what the BPI are worried about?

CONCLUSIONS

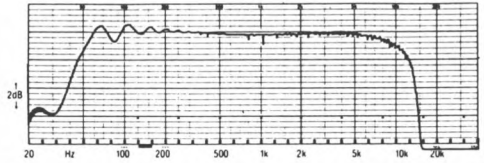
The RS-T80R is a classic example of an over-ambitious deck that fails to do the basic things right. It is amazingly flexible and pleasant to use, but on musical grounds barely qualifies as a high fidelity component.

TEST RESULTS

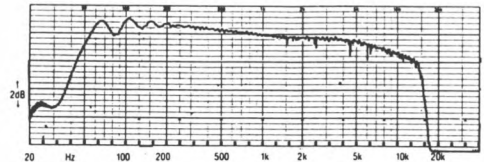
Rec/replay response - 3db ref 1kHz	
IEC Type I	40Hz-13.5kHz
IEC Type II	40Hz-15kHz
IEC Type IV	40Hz-21kHz
Wow & Flutter - Peak DIN wtd/unweighted	
	0.025%/0.27%
Speed error	
Type I signal/noise CCIR/ARM 315Hz	-0.5%
distortion 0dB	0.55%
Type II signal/noise CCIR/ARM 315Hz	50.5dB
distortion 0db	0.6%
Type IV signal/noise CCIR/ARM 315Hz	51.5dB
distortion 0db	1.0%
Channel separation 0VU/1kHz	47dB
Line input sensitivity/overload	88mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	700mV/4V
IM distortion 10kHz/1kHz 0dB peak, 1kHz product	0.63%
Azimuth check R-L phase at 8kHz	+10 degrees
VU indication at IEC 0db	+6dB
Dimensions (w×h×d)	43×11×27cm
Typical Retail Price	£400



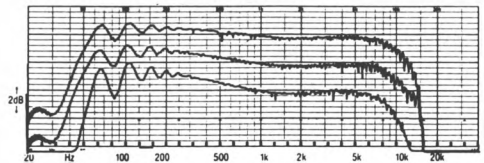
Playback only fr. frequency response (pre-recorded tapes)



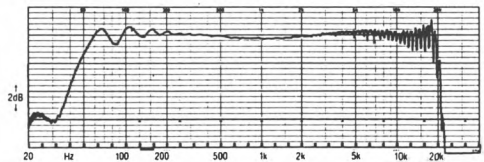
Overall record/replay response. Type I (ferric) tape



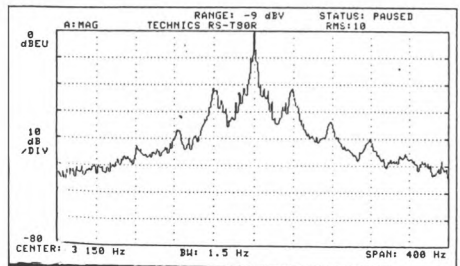
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

BEST BUY

YAMAHA KX-200

YAMAHA HOUSE, 200 RICKMANSWORTH ROAD, WATFORD, HERTS WD1 7JS.

TEL: (0923) 33166



Although the KX-200 is constructed to an adequate commercial standard, and although the transport works with acceptable levels of smoothness and finesse, there is no excess of build quality over what is basically necessary. The controls and displays are grouped according to function, and the deck is undoubtedly workmanlike. However, control graphics are mostly a little too faint to be readily distinguishable under some lighting, whilst the record level meters simply look cheap and flashy.

The KX-200 is a unidirectional deck with two heads and two motors — one for the reels, the other the capstan. Noise reduction is courtesy of the ubiquitous Dolby B and C. Headphones are fed at fixed level, but microphones are not accepted. The record level meters have five active steps, plus one which is permanently lit and behaves as a power on indicator.

Although basically straightforward, the KX-200 is well equipped, and includes track search, intro scan, automatic 4 second mutes at the press of a button, a repeat mode that will either repeat complete sides or between two previously set markers, and automatic tape type recognition. One unusual provision is a socket for an optional infra-red remote control.

Recordings may be started with one finger though you might have more trouble doing a

fade with the twin rotary input pots, and pause only operates in the record mode. One nice touch: if you stop a recording by using the rewind button, the deck rewinds only the start of that recording, and is therefore either ready to start over again or replay what has just been recorded. The deck also handles 'punch in' recording by holding the play button in and pressing record/pause. (This facility is completely uncatalogued.)

LAB REPORT

Both metal and chrome tapes (Types IV and II) are a little underbiased on this machine, which in the case of the IEC Type II leads to a substantial response lift centred on 5kHz, but starting below 2kHz. The bass lift around 50Hz is also unusual, and is of course substantially independent of tape type. The replay only trace shows a typical Yamaha characteristic: slightly, bright in the mid treble.

The KX-200 is a little noisy, but well behaved. The noise spectrogram shows that it has a good stab at the pitch centre, with the main sideband shoulders a satisfactorily low -40dB. Wow and flutter measures rather high at 0.12% weighted; this is explained by the 50Hz fluttergram which shows -30dB harmonic flutter components at 30Hz and 40Hz. However, the overall base level of this speed instability analysis is quite low.

SOUND QUALITY

At its price, the Yamaha proved excellent bordering on exceptional. The basic electronics monitored via the system amplifiers (for example whilst making a recording) sound surprisingly un-electronic and un-processed in character. Sound quality from pre-recorded tapes was most satisfactory — indeed surprisingly good.

Much the same holds for recordings made on this deck. On the negative side there is a tendency to flatten imagery, the sound is a little soft and wayward at times, and is also surprisingly lacking in bass weight and impact, though the quality of the bass that remains is quite good. What impresses however, is the clean, open mid and top end. The softness is not terminal, and is often only heard at all on a direct A-B comparison, while the lasting impression is of a fluent likeable performer that does real justice to the music it serves.

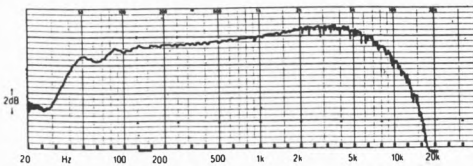
In this instance, somewhat unusually, Type I and IV tapes provide the best match overall — the latter preferable for the utmost clarity and precision (at the cost of a little steeliness). Most good chrome bias tapes simply sound harsh.

CONCLUSIONS

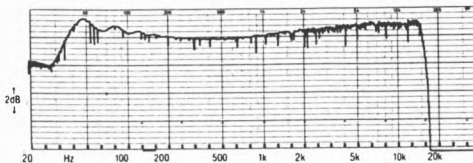
Cheap, well equipped and workmanlike, sound quality is less obviously processed than usual, and altogether this is one of those decks where the whole is more than the sum of the parts.

TEST RESULTS

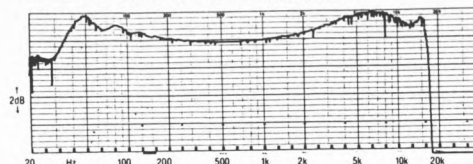
Rec/replay response — 3dB ref 1kHz	
IEC Type I	<20Hz-17kHz
IEC Type II	<20Hz-17kHz
IEC Type IV	<20Hz-17kHz
Wow & Flutter — Peak DIN wrd/unweighted	0.12%/0.31%
Speed error	+0.4%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.85%
Type II signal/noise CCIR/ARM 315Hz	49.5dB
distortion 0dB	1.4%
Type IV signal/noise CCIR/ARM 315Hz	51dB
distortion 0dB	1.5%
Channel separation 0VU/1kHz	48dB
Line input sensitivity/overload	80mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	538mV/2.83V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	3.2%
Azimuth check R-L phase at 8kHz	+10 degrees
VU indication at IEC 0dB	+6dB
Dimensions (w×h×d)	43.5×11.2×27.2cms
Typical Retail Price	£140



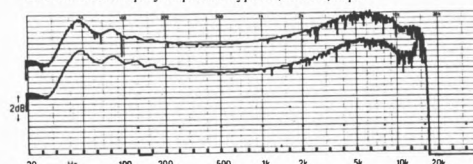
Playback only frequency response (pre-recorded tapes)



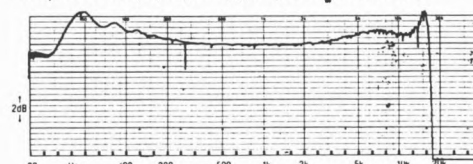
Overall record/replay response. Type I (ferric) tape



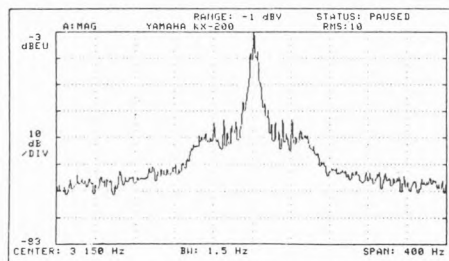
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

YAMAHA K-340

YAMAHA ELECTRONICS LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD, WATFORD,
HERTSWDI 7JS. TEL: (0923) 33166



From the outside the K-340 is not dissimilar to the KX-200. In fact it's a grown-up version of that model, at a suitably grown-up price, equipped with a long-life Sendust record/playback head where the cheaper model slums it with permalloy, plus Dolby HX Pro.

For the rest, it's the usual slightly quirky but mostly likeable Yamaha. Strong points are the quiet and slick logic transport controls, which can perform tricks like finding the start points of recordings simply by selecting rewind directly from record mode. Then there are various search modes including intro scan, standard track search, blank skip, block and tape side repeat plus more. Dolby types B and C do the honours on the noise reduction side, and the record level meters look less crude than those on the 200 and 400, though range and resolution (7 steps, 3dB best case resolution) are still limited.

The tape counter is mechanical with no counter memory (despite the ability to find record starts). The MPX filters cannot be switched off, and there is no provision for microphones. On the other hand, remote control can be had using an optional infra-red receiver that plugs in at the rear.

There are a number of ergonomic failings, including what some people may perceive as a lack of legibility in the panel graphics. Some

of the controls are awkwardly designed, in the case of the record level pots making accurate fades almost impossible to achieve without image shifts.

LAB REPORT

Despite the Sendust head, something is acting to block high levels, as the measured 24% (!) 10/11kHz 0VU intermodulation distortion clearly shows. This is the kind of result that suggests something seriously remiss, and in this case Dolby HX Pro must be seen as an act of stable door bolting, or perhaps just blind faith.

The signal/noise figures look poor until you note the distortion figures they correspond to, and then note that IEC 0dB actually corresponds to a full +6VU. However, the nature of the noise was relatively innocuous according to the noise modulation spectrogram. Wow and flutter components were well distributed too, though there were signs from the fluttergram that wow components were a little high, which would tend to be confirmed by the measured wow and flutter figures.

The record/replay responses all show a rising trend into the treble, which is significant in relation to the bandwidth over which it happens. The results suggest that the deck may have been set up 'bright' to allow for head de-homing or some other bedding-in process. Re-

sponse integrity was well preserved with Dolby B, but slightly less so with Dolby C. The same upwards tilt is seen in the playback only plot, but the effect is not large.

SOUND QUALITY

A curate's egg, this one. Basic sound quality *via* the deck's amplifiers (forgetting tape at this point) is clear and unmuddled, but it all tended to fall apart when the tape was brought into the equation. Wow was perfectly audible, especially using the classic test of reproducing a clean piano recording. Secondly, the sound tended to become muddled at high level with all tapes types, probably partly a reflection of the high intermodulation distortion, and rhythmic and pitch integrity in the bass was suspect; put bluntly, it didn't play 'tunes'.

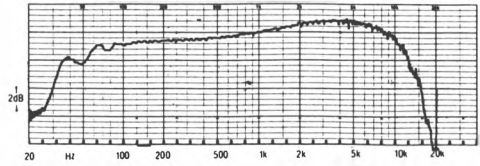
At medium levels, and when reproducing less pitch-sensitive material, the K-340 gave a much better account of itself, sounding quite detailed and refined. Playback of prerecorded material was consistent with these remarks or even a little better.

CONCLUSIONS

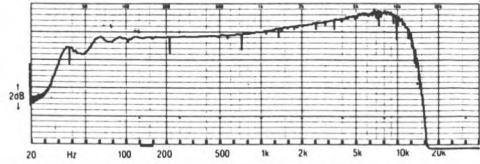
Given the nature of the competition, there is no reason to make excuses. This deck doesn't make the grade on the grounds of poor perceived speed stability, and an unwelcome degree of record level dependency.

TEST RESULTS

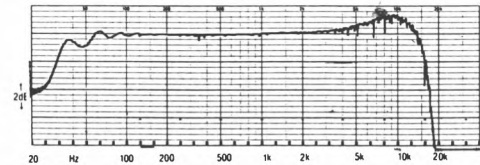
Rec/replay response - 3db ref 1kHz	
IEC Type I	29Hz-14kHz
IEC Type II	28Hz-16kHz
IEC Type IV	28Hz-20kHz
Wow & Flutter - Peak DIN wrd/unweighted	0.17%/0.28%
Speed error	+0.7%
Type I signal/noise CCIR/ARM 315Hz	47dB
distortion 0dB	0.85%
Type II signal/noise CCIR/ARM 315Hz	48dB
distortion 0db	0.7%
Type IV signal/noise CCIR/ARM 315Hz	49dB
distortion 0db	0.75%
Channel separation 0VU/1kHz	-47.5dB
Line input sensitivity/overload	95mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	538mV/2.6V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	24%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0db	+6dB
Dimensions (w×h×d)	43.5×11.2×27.3cms
Typical Retail Price	£159.95



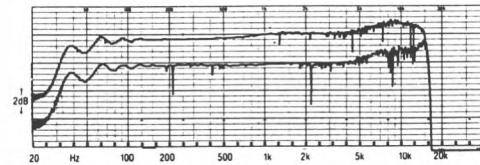
Playback only frequency response (pre-recorded tapes)



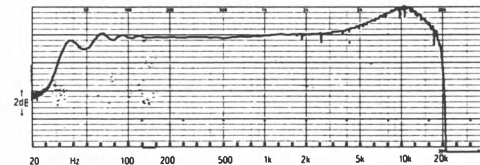
Overall record/replay response. Type I (ferric) tape



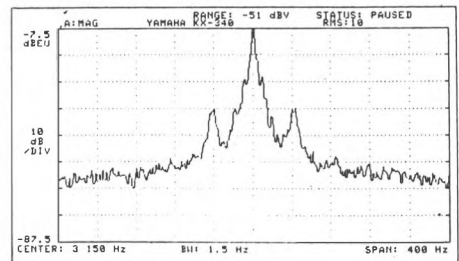
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

YAMAHA K222

YAMAHA ELECTRONICS LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD,
WATFORD, HERTS WD1 7JS. TEL: (0923) 33166



Two hundred pounds buys this smart looking and well finished twin cassette deck, with one record/replay transport and one for play-back only.

There's none of the flakiness that afflicts many double cassette decks, and build quality is excellent. The best feature, however, is the cleverly rationalised transport control system. One bank of light-acting controls operates either transport, according to the status of a 'deck selector' button, though it will usually default automatically to the deck with the tape. Free interchange of modes is allowed as usual with a logic controlled deck, plus track search, auto rewind to the start of the recording (available when exiting from record mode only), automatic tape type selection on both decks — you know the form.

Special features include dubbing and continuous play (one side of two tapes in turn). The dubbing procedure starts with a single push of one of two dubbing keys, one for normal speed dubs, the other for double speed dubs complete with consequent quality loss. The meters have a narrow 16dB range and only five active steps, and the counter is mechanical and devoid of memory facilities. Inevitably, noise reduction is by Dolby B and C.

LAB REPORT

Weighted wow and flutter is relatively poor, but the unweighted figure is rather better. For each of the three tape types the signal/noise and distortion mix is just below average, suggesting a narrower than usual operating range as defined by tape hiss and terminal distortion.

The record/replay responses are also a little erratic. The LF end is interesting for its early roll off, and for the high-Q peak at 65Hz. At the other frequency extreme the deck behaves OK, though Type IV metal is a little peaky at the very top. The replay only response favours the treble slightly, and measures -3dB at a reasonably satisfactory 12kHz.

Problems start to arise at this point. First, Dolby tracking integrity is poor, the Dolby C response run amounting to no less than a disaster on wheels. A response run made from a test tape dubbed at high speed also gave very peculiar results (it made peculiar noises to match), with a rising response to 2kHz following some very pronounced head contour effects, a severe 4dB dip in output centred on 7kHz, and rapid recovery thereafter. High speed dubbing may have practical uses, but they don't include making tapes for the pleasure of listening to music.

More pertinently because it affects all recordings, the HF IM distortion figure reaches

a disastrous 16.8dB at 0VU; notwithstanding the much healthier harmonic distortion figures at the same level, high level sounds should become audibly fuzzy. The noise spectrogram bears witness to some quite severe flutter sidebands, and the fluttergram shows moderate levels of wow and a highish (-20dB) flutter effect at 27Hz.

SOUND QUALITY

Sound quality is poor. Pre-recorded material sounded disembodied and muddled in the mid-band, noisy at HF, and was finally undermined by a thin, wobbly bass. Background hiss levels were high, and there was considerable roughening of textures and some pitch uncertainty, though it stopped short of a definable pitch wobbliness.

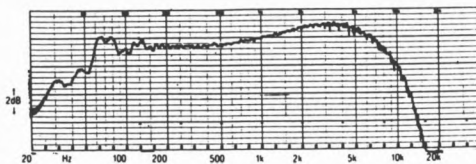
The messiness continued through to the record/replay sound. Best of a bad bunch, Type IV metals offered a degree of audio integrity, but here too there were severe underlying problems — notably a heavy, 'siney' lower midband that lost separation as soon as the music showed signs of complexity, and some rather murky, unstable effects at the frequency extremes. The Dolby circuits robbed the music of further detail, and stereo placement was imprecise, tending to gravitate towards the image centre.

CONCLUSIONS

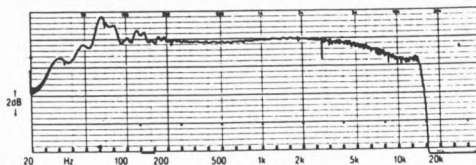
Not recommended unless you must have a high speed dubbing machine, the K-222 is beautifully made, but makes little sense in purist audio terms.

TEST RESULTS

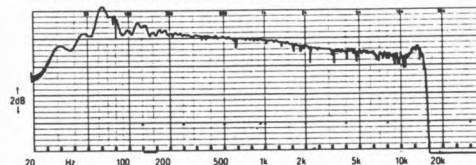
Rec/replay response - 3dB ref 1kHz	
IEC Type I	24Hz-15kHz
IEC Type II	20Hz-15kHz
IEC Type IV	20Hz-16kHz
Wow & Flutter — Peak DIN wtd/unweighted	0.018%/0.22%
Speed error	+0.6%
Type I signal/noise CCIR/ARM 315Hz	48dB
distortion 0dB	0.75%
Type II signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	1.1%
Type IV signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	1.0%
Channel separation 0VU/1kHz	-46dB
Line input sensitivity/overload	59mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	560mV/2.6V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	16.8%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0dB	+3dB
Dimensions (w×h×d)	43.5×11.2×27.3cms
Typical Retail Price	£200



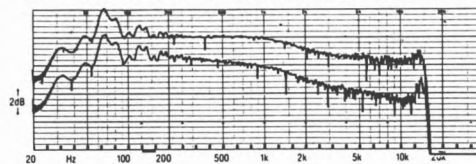
Playback only frequency response (pre-recorded tapes)



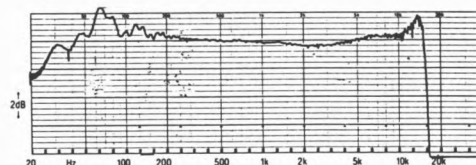
Overall record/replay response. Type I (ferric) tape



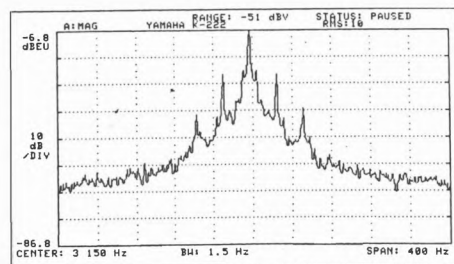
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

RECOMMENDED

YAMAHA KX-400

YAMAHA ELECTRONICS LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD, WATFORD,
HERTS WD1 7JS. TEL: (0923) 33166



None of Yamaha's cassette decks could be called poorly equipped, though the 'rob Peter to pay Paul' principle can mean tradeoffs elsewhere. The trick Yamaha have pulled is to steer these tradeoffs into areas of secondary importance like finish and the extensive use of plastic body panels.

The KX-400 is an auto-reverse deck, capable of bi-directional recording and continuous auto-reversing in the play mode. Dolby B and C noise reduction are fitted along with separate MPX switching. Dolby HX Pro is also included. There are many other handy features, including some negative ones like the ugly and badly scaled record level meters. A plethora of tape search features are fitted including track search, intro search, blank skip, plus phrase (*aka* brickwall or A-B) and track repeat. When aborting recordings by means of the rewind key, the deck returns with great precision to the start of the recording. Recordings can be faded in and out using a push button. But there's no pause mode when playing tapes (there is when recording), and no counter memory.

The Yamaha will accept an infra-red remote control handset, using an optional outboard receiver. Headphones can be connected; microphones can't.

LAB REPORT

Bench test performance is good. Absolute levels of wow and flutter are not up to the standards of a similarly priced unidirectional deck, but the shortfall is quite small, and the 50Hz fluttergram indicates that the misspent energy is almost randomly distributed, which is a good sign. The noise modulation spectrogram is similarly satisfactory. The major sidebands are around the -30dB level at 44Hz, and the centre frequency is sharply defined, implying good pitch resolution.

The rather dropout-prone nature of the response traces suggests that tape to head contact could be improved. The deck is otherwise well set up except that all three main IEC tape types were mildly underbiased. The Dolby response run shows how these circuits modify the amplitude/frequency behaviour of the deck, Dolby C especially. Nevertheless, the Yamaha has clean, flat midrange responses, and head contour effects in the bass are reasonably restrained. The playback-only response rises slowly to peak between 3-4kHz, and then rolls slowly away.

Absolute noise levels are about average in relation to the distortion figures at 0VU, except that ferric Type I tapes came over as slightly noisy. Intermodulation levels were fair.

SOUND QUALITY

On the whole, this is a very clean sounding deck. In all modes of use except when playing prerecorded cassettes, the *KX-400* manages to sound 'airy' and 'spacious' without loss of image precision or resolution. It's not unusual for cassettes to sound cramped and monophonic, but the *KX-400* offered a surprisingly tangible sound, with a soundstage that breathed, and where depth information was preserved.

It's difficult to pin down the reason for this unexpected strength on audition, but the Dolby HX Pro circuitry may have something to do with it. Several factors point towards this, for example the convincing way the deck maintains top end dynamics with lower energy ferric Type I cassettes without the usual compression.

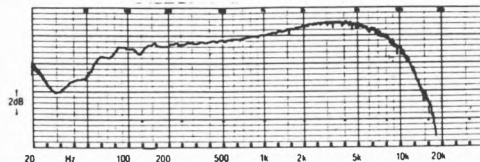
Prerecorded tapes tended to sound a little 'plodding', apparently due to the uneven way harmonics were handled. Tapes often sounded slightly thin and bright, but the lack of real top-end robbed the sound of the more subtle qualities needed to separate individual instruments and singers in complex recordings — a common cassette medium shortcoming. Even here though the deck sounded OK.

CONCLUSIONS

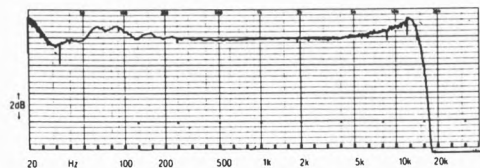
In summary, the *KX-400* is a highly commercial package featuring every widget under the sun, many of which (eg Dolby HX Pro) are of real value. Happily, it also sounds surprisingly good most of the time, and can be confidently recommended.

TEST RESULTS

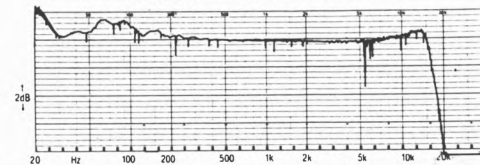
Rec/replay response - 3db ref 1kHz		
IEC Type I		<20Hz:-17kHz;
IEC Type II		<20Hz:-18kHz;
IEC Type IV		<20Hz:-21kHz;
Wow & Flutter - Peak DIN wtd/unweighted		0.12%/0.20%
Speed error		+0.5%
Type I signal/noise CCIR/ARM 315Hz		47.5dB
distortion 0dB		1.0%
Type II signal/noise CCIR/ARM 315Hz		49.0dB
distortion 0dB		0.9%
Type IV signal/noise CCIR/ARM 315Hz		51.0dB
distortion 0dB		1.1%
Channel separation 0VU/1kHz		-47dB
Line input sensitivity/overload		73.5mV/>7V
Mic input sensitivity/overload		n/a
Line output for 0dB/maximum		536mV/3.3V
IM distortion 10kHz/1kHz: 0dB peak, 1kHz: product		-1.6%
Azimuth check R-L phase at 8kHz		+31 degrees
VU indication at IEC 0dB		+3dB
Dimensions (w×h×d)		43.5×11.2×27.2cms
Typical Retail Price		£200



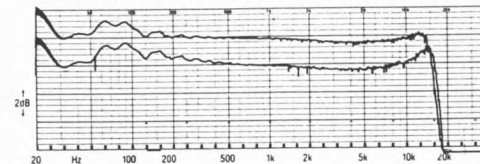
Playback only frequency response (pre-recorded tapes)



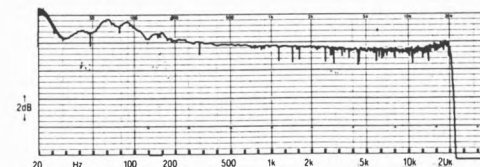
Overall record/replay response, Type I (ferric) tape



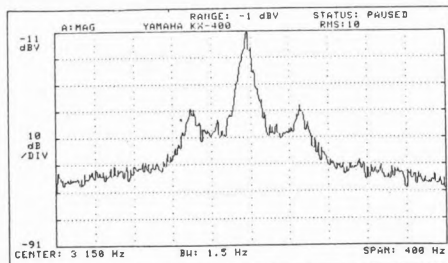
Overall record/replay response, Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response, Type IV (metal) tape



Noise modulation spectrum analysis

YAMAHA K-540

YAMAHA ELECTRONICS LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD, WATFORD,
HERTS WD1 7JS. TEL: (0923) 33166



Yamaha have chosen the *other* way of going upmarket for the K-540. Most of what makes the 540 different from cheaper Yamahas comes under the heading of gadgetry, and some of it is of dubious merit.

The transport is logic controlled and features one finger two operation recording starts, and automatic search for the recording start point at the time of recording (but not subsequently). The fast wind keys give an extra fast wind when the buttons are held, a feature which proved of value in tape scatter on the takeup reel (so why not standardise on the higher speed?)

A variety of search options include intro scan and track search. Individual recorded segments or complete tape sides can be repeated at will. Twin output level pots are supplemented by a ganged fader (which wouldn't have been necessary with a more sensibly designed main level control). The noise reduction switch includes separate MPX switching.

The record level meters have a reasonable range (28dB), good resolution (best is 1dB) and peak-hold LEDs. Tape type sensing is automatic and the tape counter shows actual elapsed time on a fluorescent display (remaining time is also available, but requires that the tape be wound to the end then back, which is tedious in the extreme.) Finally, the headphone outlet and line

output are under control of a front panel potentiometer. Ideally, this pot should have been devoted to the headphones only, leaving the amplifier feed as pure (and at as low an impedance) as practical. Microphones are not accommodated.

LAB REPORT

As with some other Yamaha decks, 0VU on the record level meters is a long way below IEC 0dB — 5dB in fact. This leads to unrealistically poor signal/noise figures; the correct action is to set record levels to peak well above the line. But this doesn't explain why the 0VU distortion figures are so high.

However, the nature of the noise residual is innocuous enough. The spectrogram shows a sharply defined pitch centre and sidebands around ± 39 Hz. Unweighted wow & flutter is highish, the fluttergram showing significant and probably audible wow components around 4Hz, but it's not a bad analysis otherwise, and the basic weighted figure is OK.

The least happy aspect of the K-540 is yet to come. Type I tapes are quite well catered for, but Type II and IV tapes are progressively more underbiased and bright. The Dolby plot shows just how these NR systems murder measured overall responses if the inherent shape is adrift: with Dolby C the HF peak at 16kHz is little

short of 4dB above the line! However, the playback only response is rather better controlled, the -3dB point being around 12kHz with head azimuth alignment almost spot on.

SOUND QUALITY

The K-540 is not without merit on audition. There is a certain transparency to the deck, based partly on quite good (audio) quality electronics, but the sound starts to fall apart at the seams at high levels, where the deck sounds 'grubby' and progressively loses detail, particularly when used with Type II and Type IV tapes almost all of which will sound bright in balance.

The Dolby circuits add a detectable glaze to the sound, and this isn't the quietest of decks without noise reduction, so Dolby-less use is probably impractical. The deck sounded fine with prerecorded material without in any way distinguishing itself.

Speed stability was better than expected purely on the basis of the numbers. Some fast wow was heard intermittently on a couple of occasions, but dropout was a more frequent problem.

CONCLUSIONS

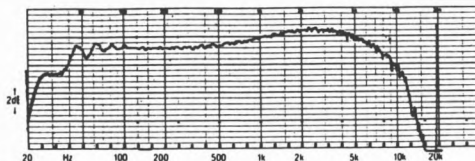
The Yamaha K-540 is a satisfactory but not especially satisfying deck, in some ways rather gimmicky. In our judgement it failed to match or beat the good-performance-at-the-price ratings of more basic Yamaha models.

TEST RESULTS

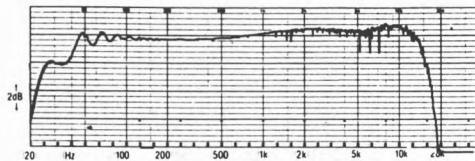
Rec/replay response -3dB ref 1kHz

IEC Type I	25Hz-16kHz
IEC Type II	28Hz-19kHz
IEC Type IV	23Hz-22kHz
Wow & Flutter - Peak DIN wtd/unweighted	0.10%/0.24%
Speed error	+0.4%
Type I signal/noise CCIR/ARM 315Hz	45dB
distortion 0dB	1.4%
Type II signal/noise CCIR/ARM 315Hz	47dB
distortion 0dB	1.2%
Type IV signal/noise CCIR/ARM 315Hz	48.5dB
distortion 0dB	1.7%
Channel separation 0VU/1kHz	47dB
Line input sensitivity/overload	103mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	556mV/2.7V*
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	1.2%
Azimuth check R-L phase at 8kHz	2 degrees
VU indication at IEC 0dB	5dB
Dimensions (w x h x d)	43.5 x 11.2 x 27.3cms
Typical Retail Price	£209.95

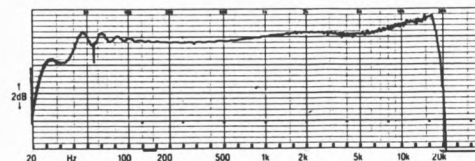
*limited by input overload



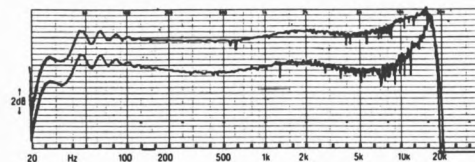
Playback only frequency response (pre-recorded tapes)



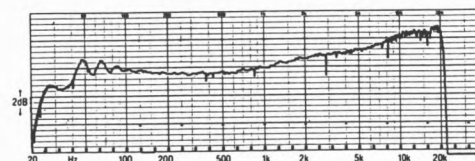
Overall record/replay response. Type I (ferric) tape



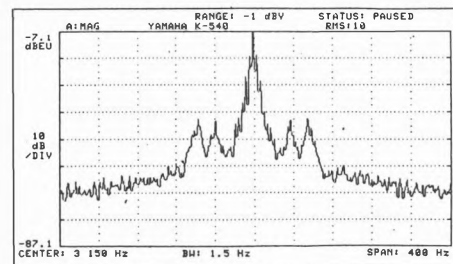
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

YAMAHA KX-1200

YAMAHA ELECTRONICS LTD, YAMAHA HOUSE, 200 RICKMANSWORTH ROAD,
WATFORD, HERTS WD1 7JS. TEL: (0923) 33166



At first sight, Yamaha's flagship KX-1200 doesn't look the all-singing, all-dancing model it really is. Until that is you notice that the large and completely blank panel on the fascia conceals a veritable rat's nest of buttons and rotary pots, and that included with the packaging is a full-feature infra-red remote control handset. This is one of the small handful of cassette decks so equipped. And I should add that the KX-1200 is magnificently built and very smooth in operation.

The first and most important feature therefore is — ease of use. There are limitations imposed by the sheer range of facilities, but there's nothing wrong with the ergonomics and the full feature remote control handset eases access to the more complex commands as well as the simpler ones.

The basic configuration is a unidirectional transport with twin capstans, dedicated reel and capstan motors, and independent record and playback heads. The latter means that real-time off-tape monitoring is possible. Tape/source switching is automatic, with override available. On the electrical side, noise reduction philosophy follows the scattergun approach — it has Dolby B and C and also *dbx*, all with double *en/decoders* so that the non-compressed signal can be monitored in real time, and with separate MPX filtering.

Then there are the peripheral facilities, enough to fill a couple of pages. They include intro scan, programmable running order (up to 9 selections, *via* the remote control only), a variety of repeat modes, a real-time tape counter with 'time to go' available when the tape length has been programmed, dual speed fast wind, 'return to record start', a master fader (puff, puff), and an output level control which feeds the headphone socket and main amplifier output. Finally, the deck has adjustable bias with a novel graphical method of getting the bias right (it works rather like an old fashioned optimum tune indicator on an FM tuner), and a superb set of record level meters with 50dB dynamic range, excellent resolution and a 'forbidden zone' start point that alters according to the deck status.

LAB REPORT

For once, our policy of running response curves up to 40kHz instead of the usual 20kHz paid off. The KX-1200 has a record/playback frequency response using Type IV metal tape which extends to an astonishing 32kHz for -3dB. Noise and distortion are not sacrificed to achieve it either. The other tapes were treated well but more conventionally. Note the small but noticeable HF rise with Type I ferric tape, which can however be tuned out using the bias adjust facility. The three noise reduction systems have little effect on the intrinsic response curves, but they do effect bandwidth, *dbx*

especially.

More important than the wide Type IV bandwidth is the mechanical behaviour of the transport, and here the Yamaha is on equally strong grounds. The noise floor on the noise spectrogram is very good, below -60dB at $\pm 40\text{Hz}$ out. The centre frequency peak is sharp and well defined, but there are some fine wow sidebands, which (if you like to put it this way) is what makes the summit look scaleable. The fluttergram catalogues multiple but very moderate wow components, and reveals excellent flutter — an outstanding result.

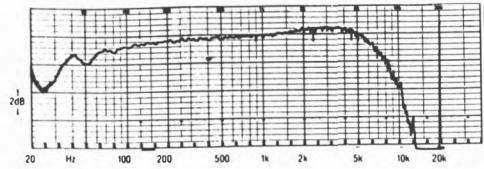
High level intermodulation distortion is extremely low, and azimuth errors are zero, which is even lower. This is a deck with a wide working dynamic range, even before noise reduction is brought into the equation.

SOUND QUALITY

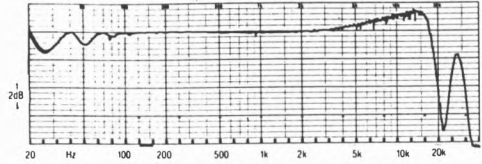
The KX-1200 turned out to be a surprisingly fine playback machine for pre-recorded material. The transport is not only extremely stable, it also has a positive effect on tape-to-head contact integrity. Dropout, which is a commonplace fact of life with much pre-recorded stuff due to the semi-naïf tape stock often employed, was noticeable only by its absence. Apart from such purely mechanical considerations, the Yamaha also sounded relatively expressive and clear — but see below.

The '1200 also turned out to be a supremely competent recorder in a purely technical sense. Pitch stability was nothing short of remarkable. Modulation noise was almost completely absent, whilst the two frequency extremes offered a taste of compact disc style control and precision, especially (not surprisingly) when using Type IV metal tape stock.

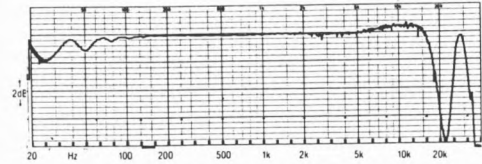
Yet for all the positive features already outlined, the Yamaha had a critical failing. The music it made, whether processed simply by the deck's electronics, or recorded and played back from tape, sounded just that — processed. With all tape types there was a tightness, a coolness in the way tonal colours were presented, and a thickened quality, which made it difficult to 'hear through' known musical passages. Pitch information tended to be indeterminate, and



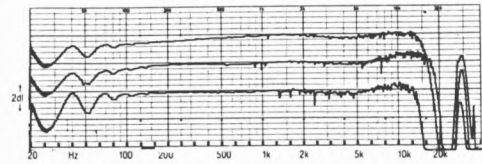
Playback only frequency response (pre-recorded tapes)



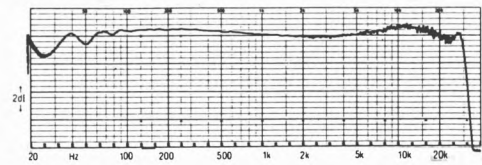
Overall record/replay response. Type I (ferric) tape



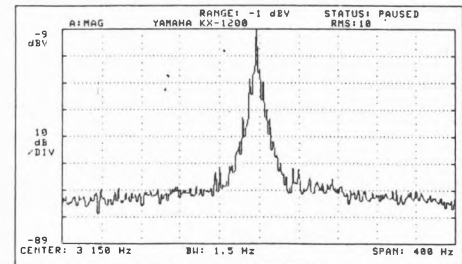
Overall record/replay response. Type II (chrome) tape



Overall record/replay response (Type II) noise reduction active



Overall record/replay response. Type IV (metal) tape



Noise modulation spectrum analysis

Continued on page 145

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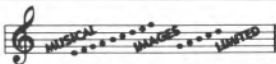


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Yamaha KX-1200

Continued from page 143

dynamic information felt suppressed.

In short the Yamaha sounded like a typical mass market amplifier. The situation was at its worst with any of the noise reduction systems engaged, and especially *dbx* which sounded anomalous in a number of ways: the stability of stereo imagery for example went to pot, and there was a constant emphasis on the leading instrument or voice in a mix.

CONCLUSIONS

This is very nearly a magnificent recorder. It has all the facilities anyone could wish, and a user interface that integrates them into something you could even purchase for granny — well, possibly. The tape transport is magnificent, and the deck returns the kind of measurements that anyone would be proud of. But at the last post it fails because — more than the cheaper models in the range — the sound is almost self-consciously 'hi-fi-ish'. It lacks an essential simplicity of sound.

Ironically the very completeness of this deck

is probably largely to blame. The music sounds like water must feel after it has been boiled and dripped one drop at a time through ground coffee and filter paper. Finally, including both *dbx* and Dolby C smacks of fence sitting. In the context of this machine, it is plain that *dbx* causes insupportable losses to the more subtle aspects of music making; so why include it?

TEST RESULTS

Rec/replay response — 3db ref 1kHz

IEC Type I	<20Hz-19kHz
IEC Type II	<20Hz-18kHz
IEC Type IV	<20Hz-32kHz
Wow & Flutter — Peak DIN wrd/unweighted	0.07 5%/0.10%
Speed error	+0.6%
Type I signal/noise CCIR/ARM 315Hz	48.5dB
distortion 0dB	0.65%
Type II signal/noise CCIR/ARM 315Hz	49dB
distortion 0dB	0.6%
Type IV signal/noise CCIR/ARM 315Hz	50dB
distortion 0dB	0.55%
Channel separation 0VU/1kHz	-46.5dB
Line input sensitivity/overload	60mV/>7V
Mic input sensitivity/overload	n/a
Line output for 0dB/maximum	581mV/3.7V
IM distortion 10kHz/11kHz 0dB peak, 1kHz product	0.3%
Azimuth check R-L phase at 8kHz	0 degrees
VU indication at IEC 0dB	0dB
Dimensions (w×h×d)	43.5×13.4×37.9cms
Typical Retail Price	£500

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FEATURES

	Single-deck	Dual-deck/ single-record	Dual-deck/ dual-record	High-speed dub	Real-time counter	Counter memory	Auto-reverse play	Auto-reverse record	Track (music) search	Dolby B
Aiwa AD-F260	✓									✓
Aiwa AD-R460	✓									✓
Aiwa AD-F770	✓				✓	✓	✓	✓	✓	✓
Akai GX-6B	✓				✓				✓	✓
Denon DRM07	✓									✓
Denon DR-M10	✓									✓
Denon DR-M12HX	✓					✓				✓
Denon DR-M30HX	✓					✓				✓
Denon DR-M44HX	✓				✓	✓				✓
Harman Kardon TD202	✓									✓
Harman Kardon CD491	✓				✓	✓			✓	✓
Hitachi D-007		✓		✓			✓	✓	✓	✓
Hitachi D-707 II	✓				✓	✓			✓	✓
JVC TDX202	✓									✓
JVC TDX502	✓								✓	✓
JVC TD V66	✓				✓	✓			✓	✓
Kenwood KX550HX	✓								✓	✓
Luxman K100	✓									✓
Luxman K105	✓						✓	✓	✓	✓
Marantz SD-35	✓									✓
Marantz SD-45MkII	✓									✓
Marantz CP230	✓					✓				✓
Nakamichi BX-125E	✓					✓				✓
Nakamichi BX-300E	✓					✓				✓
Nakamichi CR7E	✓				✓	✓				✓
Nakamichi Dragon	✓					✓	✓			✓
Onkyo TA2130	✓								✓	✓
Pioneer D-1000 (DAT)	✓				✓	✓			✓	n/a
Revox B215	✓				✓	✓				✓
Rotel RD-830	✓									✓
SAE C102	✓				✓				✓	✓
Sony TC-FX150	✓									✓
Sony WM-D6C Prowalkman	✓									✓
Sony TC-R502ES	✓					✓	✓	✓	✓	✓
Sony TC-K444ESII	✓				✓				✓	✓
Sony TC-K700ES	✓			✓			✓		✓	✓
Teac V200	✓									✓
Teac V210C	✓									✓
Teac W300		✓		✓						✓
Teac W310	✓				✓	✓				✓
Technics RS-T22		✓		✓			✓			✓
Technics RS-T80R			✓	✓			✓	✓	✓	✓
Technics RS-B305	✓									✓
Technics RS-T405	✓	✓								✓
Technics RS-B705	✓									✓
Yamaha KX200	✓					*			✓	✓
Yamaha KX400	✓						✓	✓	✓	✓
Yamaha K-222		✓	✓	✓		✓			✓	✓
Yamaha K-340	✓								✓	✓
Yamaha K-540	✓				✓	✓			✓	✓
Yamaha KX-1200	✓				✓	✓			✓	✓

COMPARISON CHART

Dolby C	dbx	Dolby HX Pro	Auto tape sensing	Tape alignment adjustment	Tape azimuth adjustment	Record bias adjust.	Remote control avail. (see text)	Auto repeat	Pitch control	
✓			✓			✓				Aiwa AD-F260
✓			✓			✓				Aiwa AD-R460
✓		✓	✓	✓			✓	✓		Aiwa AD-F770
✓			✓			✓				Akai GX-6B
✓			✓			✓				Denon DRM07
✓			✓			✓				Denon DR-M10
✓		✓	✓			✓				Denon DR-M12HX
✓		✓	✓			✓				Denon DR-M30HX
✓		✓	✓	✓	*	✓	✓			Denon DR-M44HX
✓						✓				Harman Kardon TD202
✓		✓				✓		✓		Harman Kardon CD491
✓			✓					✓		Hitachi D-007
✓						✓	✓			Hitachi D-707 II
✓							✓	✓		JVC TDX202
✓							✓	✓		JVC TDX502
✓							✓	✓		JVC TD 66
✓		✓	✓							Kenwood KX550HX
✓			✓				✓			Luxman K100
✓			✓				✓	✓		Luxman K105
✓			✓			✓				Marantz SD-35
✓			✓			✓				Marantz SD-45MkII
✓						✓			✓	Marantz CP230
✓						✓		✓		Nakamichi BX-125E
✓			✓	✓	✓	✓	✓	✓	✓	Nakamichi BX-300E
✓			✓	✓	✓	✓	✓	✓		Nakamichi CR7E
✓			✓	✓	✓	✓	✓	✓		Nakamichi Dragon
✓			✓	✓	✓	✓	✓	✓		Onkyo TA2130
n/a	n/a	n/a	✓	n/a	n/a	n/a	✓			Pioneer D-1000 (DAT)
✓			✓	✓			✓	✓		Revox B215
✓										Rotel RD-830
✓			✓*					✓		SAE C102
✓										Sony TC-FX150
✓									✓	Sony WM-D6C ProWalkman
✓		✓	✓	✓		✓	✓	✓*		Sony TC-R502ES
✓				✓*		✓	✓			Sony TC-K444ESII
✓				✓	✓				✓	Sony TC-K700ES
✓										Teac V200
✓						✓				Teac V210C
✓										Teac W300
✓						✓				Teac W310
✓		✓	✓							Technics RS-T22
✓	✓									Technics RS-B305
✓										Technics RS-B305
✓								✓		Technics RS-T405
✓		✓				✓			✓	Technics RS-B705
✓			✓				✓		✓	Yamaha KX200
✓		✓	✓				✓	✓		Yamaha KX400
✓			✓							Yamaha K-222
✓		✓	✓					✓		Yamaha K-340
✓		✓	✓				✓	✓		Yamaha K-540
✓	✓	✓	✓			✓	✓	✓		Yamaha KX-1200

CONCLUSIONS, BEST BUYS & RECOMMENDATIONS

The overall findings of this project served to confirm certain pre-conceptions. The most notable was to affirm just how little progress has been made during the past decade and a half, despite the continuing excellent health of the compact cassette medium.

Looking at specific problem areas, astute readers may just have detected a degree of disappointment with the effect of Dolby noise reduction on the sound quality of a high percentage of the players tested. They may even have come to the conclusion that the author doesn't like Dolby NR. Not necessarily so.

But there is ample evidence that the problems with Dolby B and C are of the type that arise when any unnecessary circuitry is introduced into a piece of audio equipment, especially if it is of poor intrinsic audio quality itself. The other very common cause of problems is where inadequate setting up causes mistracking between record and replay. The decode circuits try and operate on the wrong signal, which invariably messes up the sound.

However, the noise reduction effect of Dolby processing is very welcome. And, given the current state of the art, it is probably necessary with most types of music. Dolby B at least is best considered a necessary evil, using the basic principle that the least noise reduction is the best. It is often possible to drive tape hard enough to suppress noise quite effectively without extra processing, but usually at the risk of considerable compression.

Dolby must also accept its share of the blame for the engineering stagnation that has afflicted the cassette deck field. In the author's opinion, the introduction of Dolby B gave a wrong, de-motivating message to designers. With a large

part of the audible noise spectrum taken care of by the magic of compression-based noise reduction, the heat was off trying to make the system inherently quieter and/or better behaved, and underlying problems were conveniently swept under the carpet.

It has taken domestic VHS and Beta video — and latterly of course 8mm Video and DAT — to provide any real spur to technology. Most of the improvements that have been wrought have been spin-offs from video related development work. Right now, the 'best' and most sophisticated tapes are not available for use in compact cassette housings. What tape technology did the tape makers borrow to fulfill the stringent demands of DAT? That's right, 8mm Video, which remember is an analogue medium.

I was also disappointed that so many manufacturers have done so little to tackle one of the most obvious afflictions of the compact cassette medium. This is the azimuth alignment problem which prevents the clear majority of cassette decks from making the most of pre-recorded material. Nakamichi are the only company represented in this project to have done anything positive in this direction, by providing a ready means of azimuth adjustment. Yet the correct engineering solutions should be to improve standards at the tape duplication stage, and to improve azimuth alignment of tape travel over the heads. The second of these can be facilitated using Philips' elegant and largely unused Aztec tape guidance system — other manufacturers might care to note that Aztec has not one moving part.

At the risk of sounding a little disingenuous, I should add my opinion that pre-recorded cassettes are still very much the poor relations of

home-made recordings. Without denying that real strides have been made in some instances, overall prevailing standards of mass duplication remain erratically abysmal. The handful of musicassettes I bought for use during this project — all of material already possessed in other forms — probably won't see much further use until the next!

Despite the general stagnation, the last year or so has seen something of an upswing in some ways. After a very long period of mass contemplation of navels, the industry has woken up to the benefits of Dolby *HX Professional*; this very simple, elegant process (based on a B&O development originally) is now being widely used. Its spread corresponds to the predictions of the domino principle: enough key makers had committed themselves, and most of the rest didn't want to be seen without.

Other good news. The threatened encroachment of *dbx* into the domestic arena seems to have been halted. Taking into account the inevitable side effects of the system — the background pumping and the general sterility of the sound so processed — this can only be applauded as good news.

Perhaps best of all, a small but significant number of manufacturers — apparently responding to Japanese home market requirements — are now looking at the fundamentals of their designs a little more closely. The stress is on traditionally neglected areas such as power supply design, the auditioning quality of capacitors (three years ago this was dangerous elitist nonsense — now even the Japanese electronics majors take it seriously), and the general topology and implementation of the audio circuits. Even microphony is becoming the subject of design work aimed at minimising audible problems and improving subjective performance. Just tap a cassette while it's playing if you don't think the phenomenon exists.

It's noticeable that most of the improvement has been through the efforts of some of the smaller more audio-aware manufacturers. Denon is one good example; another is the audiophile/enthusiast partnership of Ken Ishiwata and Steve Harris at Marantz. Today, these are the ones making the real contributions.

Next, there is the vexed question of gadgetry

and gimmickry. There have been some improvements here, but the majority of manufacturers pay scant regard to addressing the problem of finding a specific place on the tape, which is more difficult and long winded with the cassette than with any other medium. Track search features certainly help, albeit erratically due to the crude way in which they go about their business. But why omit the ordinary counter memory? Why not add time access, especially to those decks with real time counters? Why not be able to ask a machine to find a point 10 minutes into the tape?

On a related ergonomic topic, it's good to see that more manufacturers are fitting automatic tape type recognition, but disappointing that so many don't. There's no real excuse either, since manual switching probably costs more, not less. I'm going to recommend that those who persist in fitting two buttons to select between the three tape types, or for that matter between Dolby B, C and off, should be the first up against the wall when the revolution comes.

And one final point. How is it that one of the finest machines all round, objectively and musically, is an only moderately expensive battery powered portable, the Sony *WM-D6C*? Answers on a post card please . . .

BEST BUYS BELOW £150

Sony TC-FX150 — £90

This one breaks the mould. It is up against very stiff competition from much more glamorously packaged and better equipped competitors at the price. But the Sony walks it on sound.

Denon DR-M07 — £140

Like other Denons, the *DR-M07* shows what a little extra care in the design of the audio circuits can do. The gadget count is short, and the deck both feels good and handles well. It makes good metal recordings, but is slightly disappointing with pre-recorded stuff, and when using Dolby C.

Technics RS-B305 — £140

Manual tape switching and two-button Dolby selection jar, but the *RS-B305* is electrically sound and mechanically well above average, leading to a very stable sound. Pre-recorded replay was a weakness, but the Dolby installation is good and metal recordings especially sound excellent.

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Yamaha KX-200 — £140

Well equipped with search facilities including the ability to rewind to the start of a recording you've made, ready to start over or play, and an option to take an outboard infra-red remote control, sound quality is simply good, with a lightweight but taut and tuneful bass.

RECOMMENDED BELOW £150

Teac V-200 — £79

The Teac V-200 is no bundle of miracles, but it does have a special place in this project because it's cheap, cheap, cheap. The extra £11 for the Sony TC-FX150 would be worthwhile, but the Teac works adequately if you don't mind the tacky '60s packaging.

Onkyo TA-2130 — £140

This deck has some peculiarly thoughtless ergonomic shortcomings, but nothing that can't be accommodated given a little practice. Nevertheless it's a fundamentally sound design, with a consistency in its music making with all tape types and pre-recorded material too that should win it many friends.

BEST BUYS — £151-£300

Marantz SD-35 — £160

The SD-35 is the first fruit of Ken Ishiwata's interest in the world of cassette decks (see earlier). A basically modest but well built product has been modified in the audio circuitry along established lines (better capacitors etc). Combined with a surprisingly good transport the result is a high level of clarity and stability. Almost uniquely, pre-recorded material sounded bright.

Sony WM-D6C — £249

Very simply, this is amongst the finest half dozen cassette decks of all types on the market today — battery, mains or wind powered for that matter. It has excellent quartz-locked mechanics, even when judged without reference to size, and simple electronics that work. Incidentally, it is much better sounding than a personal portable CD, and more practical too.

RECOMMENDED £150-£300

Denon DR-M10 — £180

The DR-M10 is a very purposeful model, with the bare minimum of facilities, so that resources are concentrated where they matter most. The

transport is cam-operated and quiet, with a rather better performance than the crude measure of wow and flutter reveals. Pre-recorded tapes can sound a little grubby, but recordings made on board are musical and enjoyable. A good buy.

Marantz SD-45II — £200

Rather like the SD-35, the SD-45 is the outcome of the application of a series of measures involving systematic upgrading of audio signal processing components. Pitch stability is only reasonable, but the electronics sound less compressed and processed than normal.

Yamaha KX-400 — £200

This is a very modestly priced but quite well equipped auto-reverse deck. Although pre-recorded material playback is suspect, the KX-400 makes excellent recordings, even on Type I ferric tapes, thanks to Dolby HX Pro. Tradeoffs due to auto-reverse working are modest.

Denon DR-M12 — £210

The consistency in allowing audio ideals to predominate over gadgets and facilities marks the Denon range out, and the DR-M12 is typical. A kind of up-market DR-M10, the 12 has a very ordinary set of controls and displays which include good meters and an electronic memory counter. The transport is cam operated and very slick, but not as pitch stable as some. However, sound quality is excellent all round.

Marantz CP230 — £260

The appeal of this deck is rather different from other Marantz models. It is larger than the Sony WM-D6C (one of the only near-equivalents available), and not as high flying sonically as that model. On the other hand it is very flexible, manages to sound pretty good, and doesn't cost an arm and a leg. An excellent multipurpose machine.

Sony TC-520ES — £279

Now here's a rarity — an auto-reverse cassette deck that performs as well as a unidirectional one. Like most Sonys it's a highly polished machine, with an accomplished user interface which includes record sensitivity adjustment and a real time electronic counter.

Aiwa AD-F770B — £300

This is Aiwa's 3-head, unidirectional deck which boasts Dolby HX Pro and an automatic bias/eq/sensitivity set-up facility called DATA. Although slightly tacky in styling, the Aiwa is

a very modern and convenient package. It performed well on pre-recorded cassettes, but sounded at its most convincing with metal tape.

RECOMMENDED £301-£450 **Denon DR-M30HX — £319**

Unusually the '30HX comes with a (simple) remote control. The deck also has three heads (for off-tape monitoring), and the excellent cam operated transport. Replay of pre-recorded material was excellent, and although metal tape tended to sound a little over the top, the deck was well suited to Type I and II formulations.
Akai GX-6 — £350

Intriguing features of this well finished deck include a software-set 'stop' point on the (excellent) record level meters, an electronic time reading tape counter that can work out what length of tape you've inserted and a powered eject and loading system. Mid and treble sound quality were very clear and transparent, but bass was poorly resolved.

Nakamichi BX-125E — £395

This is the entry level Nakamichi. Naturally, engineering integrity can be taken for granted, and almost equally naturally, the controls eschew ease of use, and feature Nakamichi tape type labels. Pre-recorded cassettes are not handled particularly well, but this is a very fine performer in other applications. Type IV metal tape sounded best.

Denon DR-M44HX — £399

Denon's top model at present, the '44HX boasts full off-tape monitoring, Dolby HX-Pro, and automatic tape bias, equalisation and sensitivity adjustment. It is distinguished by a very slick cam operated transport, remote control is available as an option, and sound quality is aided by good electronics and an unusually stable transport.

RECOMMENDED ABOVE £450 **SAE C102 — £495**

Not quite as well equipped as first appearances suggest, the 2-head SAE nevertheless lacks little of importance save a headphone socket. Aesthetics are unusual, ergonomics require some familiarisation, but the SAE should grow on you; the solutions are unusual, but they are solutions. Happiest with Type II tapes, preferably without Dolby, sound quality can be quite

concise and un-cassette-like.

Sony TC-K700ES — £500

There's a lot of fresh thinking in this deck, right down to the organisation of the front panel. The range of facilities offered is spartan for the price, but those it does have are very well designed and include 3 heads for off-tape monitoring. For once, the insides are interesting for their emphasis on performance, including often ignored considerations like resistance to microphony. Excellent soundstage resolution and separation were apparent on all tape types, with or without Dolby — even on pre-recorded material.

Harman/Kardon CD491 — £599

This rather bluff instrument belongs to the macho school of cassette deck design, but as long as you have the patience, this 3-head Dolby HX Pro model can do the lot. It even includes adjustable (but not automatic) tape biasing and sensitivity adjustment facilities. Under the skin engineering matches the exterior, happily, and this deck can be confidently recommended.

Nakamichi BX-300E — £645

Like some other Nakamichis, the 3-head BX-300 is rather switch-bound. However, build and inherent engineering quality are good, and sound quality goes quite a long way towards justifying the extravagant looking price tag. Unfortunately pre-recorded material sounded surprisingly bad on the review sample: at this price, accurate setting up ought to be taken for granted.

Nakamichi CR-7E — £1500

Arguably the finest sounding cassette deck on the market today, the unidirectional CR-7E, Nakamichi's most recent model, is also their most user friendly, even going so far as sporting automatic tape type selection and bias/sensitivity set-up. Replay head azimuth setting is available but manual. Technically the CR-7E may be marginally inferior to the Dragon; sonically it eats it alive.

WORTH CONSIDERING

The following nearly made it to the recommended category, and remain well worth considering:

Technics RS-T22 — £150

Technics RS-T405 — £170


Revox B215 — £1462


Nakamichi Dragon — £1750

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SWIFT OF WILMSLOW, 4-8 St Annes Parade, Wilmslow. (0625) 526213. A&R, Aiwa, Denon, Dual, Marantz, Mission, Monitor-Audio, Pioneer, Trio, 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, Visa. Service dept. BADA MEMBER 


CORNWALL

TRURO HI-FI & E.T.S. Ltd, 25 King St, Truro. (0872) 79809. A&R, Denon, Dual, Heybrook, Linn, Mission Cyrus, Nad, Quad, Rotel, Thorens. Dem facilities: Single speaker studio. Open Mon-Sat 8.45-5.30. Home trial facilities, credit up to £1,000. Credit cards: Access, ETS Visa. Service dept.

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ACTIVE AUDIO, 12 Osmaston Rd, The Spot, Derby. (0332) 380385. Meridian, Mission, Denon, Yamaha, Rotel, A&R Cambridge, Monitor Audio, Trio, Marantz. Demonstration facilities. Open 9.30-6.00 — early closing Wednesday. Home trial facilities: credit up to £1,000. Credit cards: Access, Barclaycard, Diners, American Express. Service dept. BADA MEMBER 

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A.T. LABS, 442/4 Cranbrook Rd, Gants Hill, Ilford. (01) 518 0915. Open Mon-Sat, 10-6. Two single speaker dem rooms. Credit cards: Access, Amex, Visa. BADA MEMBER 

BEECHWOOD AUDIO, 6 Market St, Braintree. (0376) 29060. A&R, Ariston, B&W, KEF, Meridian, Musical Fidelity, NAD, Nakamichi, Pink Triangle, Quad, Rotel. 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, Amex, Diners, Visa.

BRENTWOOD MUSIC & HI-FI CENTRE, 2 Ingrave Rd, Brentwood. (0277) 221210. B&W, Denon, Harmon Kardon, JBL, QED, Quad, Rotel, Tannoy, Trio, Yamaha. Dem facilities available. Open Mon-Sat 9.30-5.30. Home trial facilities, free installation, credit facilities. Credit cards: Access, Visa. Service dept.

GLOUCESTERSHIRE


ABSOLUTE SOUND AND VIDEO, 40/42 Albion St, Cheltenham. (0242) 583960. A&R, Denon, Dual, Linn,

Meridian, Mission, NAD, Rotel, Technics, Yamaha, etc. (Closed Wed). BADA MEMBER 

AUDIO EXCELLENCE, 58 Bristol Road, Gloucester. (0452) 300046. Audio Research, Dual, Krell, Linn, Magneplanar, Naim, NAD, Yamaha and lots more. Closed Mon.


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TRUE-FI SOUND AND VISION, 10/12 Grosvenor Rd, Aldershot. (0252) 26390. Akai, Aiwa, B&W, Nakamichi, Hitachi, JPW, Mission, Mordaunt-Shorr, 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, Denon, Magneplanar, Quad, Rogers Meridian, TDL, Jadis, Krell. 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. BADA MEMBER 

THE AUDIO FILE, 40 Hockerill St, Bishops Stortford, Herts. (0279) 506576. Linn, Roksan, Rega, Naim, A&R (Camb), Heybrook, Rotel, Denon, Epos, QED. Demonstration facilities, no appointment required. Open 9.30-5.30 Mon-Sat. Home trial facilities. Free installation, credit facilities up to £1,000. Credit cards: Access, Visa, Diners, Amex. Service dept. available.

W. DARBY & CO. Ltd, St Peter's St, St Albans (0277) 50961. B&O, SonyES, Quad, A&R Cambridge, Revox, Denon, Yamaha, Luxman, Ariston, Thorens. Demonstration facilities, no appointment required. Open Mon-Fri 9.00-5.30. Home trial facilities, free installation, credit facilities. Credit cards: Access and Barclaycard. Service dept.

KENT

JOHN MARLEY HI-FI CENTRES, 2 Station Rd West, Canterbury (Canterbury) 69329. Also at Dover — (0304) 207562. 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 closed Thurs. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa, Creditcharge. Service dept.

LANCASHIRE


HI-TECH AUDIO, 7 Moor Lane, Clitheroe, Lancs BBY 1BE. (0200) 26563. Mission, Audio Innovations, Rogers, Quad, Rotel, NAD, Elite Rock, B&W, Castle, Wharfedale. Dem facilities, appointment required. Open 9.30-5.00, closed Wednesdays. Home trial facilities, free installation, credit up to £1000. Credit cards: Access, Visa, Amex, Diners. Service dept. Mail order.

MONITOR SOUND, 54 Chapel St, Chorley (02572) 71935. A&R, Dual, Mission, Quad, Rogers, Rotel, Spendor, Thorens, Nakamichi, Yamaha, etc. Dem facilities. 2 dem rooms. Open Mon-Sat, closed Weds. Free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.


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SOUND ADVICE, The Sound Factory, Duke St, Loughborough LE11 1ED. (0509) 218254. A&R, Creek, Linn Products, Epos, Mission Cyrus, Naim, Rega, Roksan, Rotel, Yamaha. Dem facilities, domestic size and furnished studios. Callers welcomed. Demonstrations by appointment. Open 9.30-6.00 Mon-Sat. Free installation. Credit facilities. Credit cards: Access, Visa, Amex. Service dept.


LONDON

A.T. LABS, 159 Chase Side, Enfield, Middlesex. (01) 367 3132. Open Mon-Sat 10-6. Two single speaker dem rooms. Export worldwide. Service dept, car park. Amex, Visa, Access. BADA MEMBER 

AUDIO T, 190 West End Lane, London NW6. (01) 794 7848. Open Mon-Sat, 10-6.00. Two single speaker dem rooms. Access, Amex, Visa. BADA MEMBER


BILLY VEE, 248 Lee High Rd, Lewisham, London SE13 5PT. (01) 318 5755/852 1321. Aiwa, A&R, Creek, Dual, KEF, Linn, Heybrook, Quad, Naim, Rega. Dem facilities: 2 single system studios ring for appointment. Open Mon-Sat 10-7, closed Thurs. Home trial facilities, free installation, interest free credit up to £750.00. Credit cards: Access, Visa. Service dept. BADA MEMBER 

CORNFLAKE SHOP, 37 Windmill Street (just off Tottenham Court Road), London W1 (01) 631 0472. 10am-7pm, Mon-Sat. Cambridge, DNM, Epos, Koetsu, Naim, PS Audio, Roksan, SME, Van den Hul. Excellent demonstrations, 2 demo rooms, full delivery and installation service. Full credit facilities. Credit cards: Access, Visa.

DOUG BRADY HI-FI, 18 Monmouth St, London WC2H 9HB. (01) 379 4010. Wide range of top specialist hi-fi from Britain, America and Japan. Dem facilities. 3 Dem rooms. All credit cards. BADA MEMBER 

GRAHAMS HI-FI, 86-88 Pentonville Rd, London N1. (01) 837 4412. 'FBA Dealer of the year 1985'. 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 9-1. instant credit up to £1,000. Credit cards: Access, Visa, Diners. Service dept.

K.J. LEISURESOUND, 48 Wigmore Street, London W1. (01) 486 8262/3. Most major brands; 2 dem studios, appointment preferred. Open 10-6 Mon-Sat. Credit cards: Access, Visa. BADA MEMBER 

MUSICAL IMAGES, 45 High St, Hounslow, Middlesex. (01) 570 7512. AR, A&R, B&W, Bose, Denon, Dual, Harmon Kardon, Musical Fidelity, Nakamichi, Quad. Single speaker dem room. Open 9.30-6 Mon-Sat. All credit cards.



SUBJECTIVE AUDIO, 12 Park Avenue, Palmers Green, London N13. 01-886 2650. A&R, Burmester, Krell, Magneplanar, Meridian, Linn, Nakamichi, John Bowers. Dem facilities: 3 single speaker dem rooms, appointment required. 10-6 Tues-Fri, 9-5 Sat. Home trial facilities, instant credit up to £1,000. 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 9-6, Sat 9.30-4. Home trial facilities, free installation, credit facilities. Credit cards: Access, Amex, Diners, Visa. Service dept.


THE SOUND ORGANISATION Ltd, No 1, Cathedral St, London Bridge, London SE1 9DE. (01) 403 2255/3088. Counterpoint, Denon, Exposure, Koetsu, Linn, Naim, PS Audio, Roksan, Rega, SME and others. Dem facilities available, ring for appointment. Open Tues-Sat, 10-7. Free installa-

installation. Credit cards: Access, Visa. Service dept. BADA MEMBER

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CLEARSTONE HI-FI, 62 King St, nr. Kendals. (061) 835 1156. Best makes, Linn, Creek, NAD, Naim, etc. Dem studio, Compact Disc centre, video and TV. BADA MEMBER 
CLEARSTONE HI-FI, 235 Blackburn Rd, Bolton. (0204) 31423. Best makes, Linn, Creek, NAD, etc. Dem studios. Laser vision and compact disc centre. BADA MEMBER 
THE MUSIC ROOM, 50 Bridge St, Manchester. (061) 835 1366. Dem room, service dept. Competitive credit and charge card facilities. BADA MEMBER

MERSEYSIDE


ABOUT SOUND, 116 Bold St, Liverpool L1 4JA. (051) 709 4865. Mordaunt-Short, Musical Fidelity, Myst, Quad, Revox, Sansui, Sugden, Thorens, Walker, Yamaha. Dem facilities single speaker room. Ring for appointment. Open Tues-Sat 9-5.30. 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 credit cards. 3 dem rooms. BADA MEMBER 

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ALTERNATIVE AUDIO Ltd, 93-95 Hobs Moat Rd, Solihull. (021) 742 0254 (sales), 0248 (service). A&R, Audiolab, Denon, KEF, Marantz, Meridian, Mission, M.A., The Source, Philips. Dem facilities available, appointment required. 10-6 Tues-Sat, closed Mon. Home trial facilities, 3 demo rooms, service dept, free installation, instant credit. Credit cards: Access, Visa, Amex.
FIVEWAYS HI-FIDELITY Ltd, 12 Islington Row, Edgbaston, Birmingham. (021) 455 0667. A&R, Denon, Dual, KEF, Meridian, Musical Fidelity, Nakamichi, Philips CD, Quad, Revox, etc. Dem facilities. Single speaker dem room. Open 9.30-6 Tues-Sat. Home trial facilities, free installation, credit facilities. Credit cards: Access, Visa. Service dept.
GRIFFIN AUDIO Ltd, 94 Bristol St, Birmingham. (021) 692 1359. Linn, Naim, Rega, Creek, Denon, Nakamichi, Kef, Quad, Mission, Marantz. Dem facilities 2 single speaker rooms. Open Mon-Sat 9.30-6. Home trial facilities, free installation, interest free credit. Credit cards: Access, Visa. BADA MEMBER 
NORMAN H. FIELD LIMITED, 35-37 Hurst Street, Birmingham B5 4BJ. (021) 622 2323/3619. AR, B&W, Denon, Dual, Monitor Audio, Kenwood, Mordaunt Short, NAD, Technics, Yamaha. Dem. facilities available. Open 9.15-6.00, Saturday 9.00-6.00. Closed Weds. Home trial facilities on selected systems. Credit up to £1,500. Credit cards: Access, Visa. Service dept.
WARSTONES HI-FI STUDIO, 54a Warstones Rd, Penn, Wolverhampton. (0902) 345114. Dem facilities 3 rooms. Open Mon-Wed 10-6. Thurs-Fri 10-9. Sat 10-6. Home trial facilities, free installation. Credit cards: Access, Visa, Eunocheque. Service dept.

OXFORDSHIRE

ABSOLUTE SOUND AND VIDEO, 19 Old High St, Headington, Oxford. (0865) 65961. A&R, Denon, Linn, Mission, NAD, Rotel, Yamaha. Also 256, Banbury Rd, Summertown. BADA MEMBER 
ASTLEY AUDIO LTD, 3 Marker Place, Wallingford. (0491) 39305/34349. A.R. Dual, Kenwood, Mordaunt Short, Mission, Monitor Audio, Philips, Technics, Tannoy, Yamaha.

Open Tues-Fri 9-5.30, Sat 9-5. Records, tapes and 1000+ CDs. Service dept. Access, Visa, Diners.
WESTWOOD AND MASON, 46 George St, Oxford. (0865) 247783. Linn, Naim, Rega, A&R, Heybrook, Dual, Mordaunt-Short, Spondor, 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 9-5.30. Free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

SHROPSHIRE

AVON HI-FI Ltd, 12 Barker St, Shrewsbury. (0743) 55166. A&R, B&W, JBL, Dual, NAD, Nakamichi, Revolver, Trio, Quad, Yamaha. Dem facilities available. Open Mon-Sat 9-5.30, closed Thur. Home trial facilities, free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.



SOMERSET

WATTS RADIO — THE ENGINEERS, Jim Badman, 1 West Street, Somerton. (0458) 72440. Quad, Dual, Denon, KEF, Mordaunt-Short, Ortofon, Castle, Rogers, Thorens, Yamaha. Dem facilities available. Open Mon-Sat 9-1, 2-5.30, Wed 9-1. Home trial facilities, free installation. Credit up to £1,000. Credit cards: Access, Visa. Service dept.



SUFFOLK

BEECHWOOD AUDIO, 3 Brentgovel St, Bury St Edmunds. (0284) 68351. A&R, Ariston, B&W, Kef, Meridian, Musical Fidelity, Nad, Nakamichi, Pink Triangle, Quad. Single speaker dem room. Open Mon-Sat 9.30-6. Home trial facilities, free installation. Instant credit up to £1,000. Credit cards: Access, Amex, Diners, Visa.

SURREY

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 
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.
UNILET PRODUCTS Ltd, 35 High St, New Malden, Surrey KT3 4BY. (01) 942 9567. Mon-Sat 9-6. Thurs 9-7. Credit cards: Amex, Access, Diners, Visa. Dem facilities. Large stock. BADA MEMBER 

SUSSEX (EAST)

JEFFRIES 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 
JEFFRIES 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 9-6. Home trial facilities. Free installation. Credit facilities. Credit cards: Access, Amex, 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 9-5.30, Weds 9-1. Home trial facilities free installation, instant credit up to £1,000. Credit cards: Access, Visa. Service dept.

CHICHESTER HI FI, 40 Little London, Chichester PO19 1PL. Tel: (0243) 776402. Linn, Naim, Rega, Creek, Nakamichi, A&R, Denon etc. Demonstration facilities available — no appointment required. Open Tues-Sat. 10-1, 2-5.15 (closed Mon.) Free installation, interest free credit. Credit cards: Access + Visa. Service dept. BADA MEMBER 

TYNE AND WEAR


RED RADIO SHOP AND HI-FI CENTRE, 11 Olive St, (Off Park Lane) Sunderland. (Sunderland) 5672087. Aiwa, Bose, Denon, JVC, Luxman, Michell, Pickering, Spendor, Thorens, Trio. Dem facilities available. Open Mon-Sat 9-5.30. Free installation, interest free credit. Credit cards: Visa. Service dept.

WILTSHIRE


ABSOLUTE SOUND AND VIDEO, 60 Fleer Street, Swindon. (0793) 38222. A&R, Denon, Dual, Linn, Meridian, NAD, Rotel, Technics, Yamaha. (Closed Wed). BADA MEMBER 

YORKSHIRE (NORTH)

ELITE HI-FI, 178 Kings Road, Harrogate HG1 5JG (0423) 521 831. Voyd, Elite Rock, Systemdek, Celestion, Helius, Audionote, Snell Acoustics, JPW, Nakamichi, Teac. Dem facilities — 2 dem rooms. Open 7 days a week 9-6. Free installation. Service dept. CARA MEMBER

THE SOUND ORGANISATION, 36 Gillygate, York. (0904) 27108. Linn, Naim, Rega, Roksan, Epos, Ruark, Gale, Denon, Rotel, Mantra. Dem facilities available. Open Tues-Sat 10-6. Home trial facilities, free installation, instant credit (written details on request). Credit cards: Access, Amex, Visa, Diners. Service dept. BADA MEMBER 

YORKSHIRE (WEST)

AUDIO PROJECTS, 45 Headingley Lane, Leeds. (0532) 789115. A&R, Audiolab, Creek, Heybrook, Linn, Musical Fidelity, Naim, Quad, Rega, Rogers. Dem facilities available, ring for appointment. Open Tues-Fri, 9.30-6, 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, Hi-Fi Experience, Fotosonic House, Rawson Square, Bradford. (0274) 309266. Dem facilities. Sales/service agents for A&R, Linn, Quad, Naim, Nakamichi, Mission etc. BADA MEMBER 

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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, Visa. Service dept.

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. Free installation, instant credit. Credit cards: Access, Visa. Services dept.


THE MUSIC ROOM, 221 St. Vincent St, Glasgow. (041) 248 7221. Demroom, service dept. competitive credit and charge card facilities. BADA MEMBER 


KIRKCALDY

ANDREW THOMPSON, 3 Whytescausway, Kirkcaldy. (0592) 205997. Denon, Dunlop Systemdek, KEF, J A Michell, Nakamichi, Quad, Revolver, Tannoy, Yamaha. Dem facilities: 4 rooms. Appointment preferred. Open Mon-Sat 9-5.30 cl. Wed. Home trial facilities, free installation, credit facilities up to £3,000. Credit cards: Access, Creditcharge, Visa. Service dept.

WALES

GLAMORGAN

AUDIO EXCELLENCE, 134 Crwys Road, Cardiff. (0222) 28565. Audio Research, Dual, Krell, Linn, Magneplanar, Naim, NAD, Yamaha and lots more. Closed Mon. BADA MEMBER 

AUDIO EXCELLENCE, 9 High St, Swansea. (0792) 474608. Audio Research, Dual, Krell, Linn, Magneplanar, Naim, NAD, Yamaha and lots more. Closed Mon. BADA MEMBER 

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**Hi-Fi Choice on:
01-631 1433**

CASSETTE TAPES

In the comprehensive series of tests that follows, what you will *not* learn is how well tapes will resist the ravages of life on the road; how much high frequency energy is lost as a result of ageing processes (there are several); how much like the tape you buy now will be the one you buy in six months time; how smooth the tape surface is (and how rough it needs to be); how dropout increases with time and usage . . .

You get the idea I think. Tape testing is full of these kinds of pitfalls, so any test that claims to be fully comprehensive almost certainly isn't.

Partly for this reason, some of the easier and more facile value judgements have been avoided. A tape may have a response shape that looks like the Eiger, but this isn't necessarily bad unless left uncorrected. The tape, which otherwise might sound very thin and bright may be correctable using an automatic tunings system, or a simple fine bias adjust knob of the kind that graces many modern cassette decks. Similarly, if a tape has a high noise floor, this may be a Bad Thing. But if it also has a high operating ceiling, well that isn't so bad at all, as long as the deck concerned can deliver the hottest signals the tape can accommodate. What really counts therefore is the available dynamic range, and this will be apparent in one form or another on all tape machines and is a major criterion in the tests.

Dynamic range can be inferred from the noise and overload performance data, but the spectrum analysis plots give much more useful data, which can be assessed in relation to the usual distribution of energy peaks within music. It has become fashionable to assess tapes for their headroom near 20Hz, but this is quite unrealistic. For interest, we took two spectrum analysis plots showing the peak levels reached in frequency bands over a period of a minute or so (not reproduced). One was run with the opening of Tchaikovsky's *1812 Overture* (EMICDL 7 47375 2). The other, also on CD, is taken from *True Blue* by Madonna (which has more HF energy than most). Even here, HF levels are well down on levels in the 200-2.5kHz region.

In certain respects, the tape tests that follow

are similar to those in previous projects. However, there are also important differences. For example, no figures are given for modulation noise, since the standard tests correlate poorly with the perceived problem. Note that the different test procedures meant that data cannot be compared directly to similar data from previous issues.

Of course there have to be 'standard' tapes. For this project we chose to use the alignment tapes used almost exclusively within the manufacturing industry: AC-713, AC-513 and AC-223. They are manufactured by TDK, and employ calibrated AD (Type I), SA (Type II) and MA (Type IV) stock. For the most part, they correspond to IEC standards. Sensitivity figures, responses and so on are referred to these three tapes.

Equipment used for the tests included Nakamichi recorders (mostly a CR-7E), and a variety of test equipment such as a Gen Rad spectrum analyser, a Nakamichi T-100 test set and Neutrik generator, chart recorder, filter and sync modules and so on . . .

The spectrum analysis plots (see below) were carried out at the laboratories of Memorex, but the tests themselves were run by the author and his assistant, Robert King. All remaining testing was done by the author in his own (modest) lab. Finally, each and every tape was auditioned with real music, which is reported upon as and where appropriate.

TECHNICAL TESTS

Sensitivity. Measured at 1kHz. Abnormally high or low figures could result in Dolby mis-tracking unless the sensitivity of the cassette deck can be adjusted.

Noise. This is the CCIR/ARM weighted signal/noise figure, referred to IEC 0dB (+3dB on the Nakamichi CR-7E record level meters, corresponding to 250nWb/m).

Distortion. THD, measured at the same point.

3% distortion indicates the number of dB headroom above IEC 0dB within a 3% distortion level at 4kHz. In some cases (notably with the metal tapes) there wasn't enough gain in the system to achieve 3% distortion. In these cases,

the distortion level is in parentheses.

3% Compression. This figure shows the amount of signal compression measured at the 3% distortion level, again at 4Hz — see above. High levels of compression indicate an inability to track volume changes.

Two spectrum analysis plots were run with each tape. One was a pseudo music signal (pink

noise) recorded about 5dB into the 'red' (+2VU). The other was of the noise floor of the tape with the input gain reduced to zero. They are not reproduced here, but the information is used in the text of the reviews.

Three or four C90 samples of each tape were submitted and used, for all but the spectrum analysis work.

FERRIC TAPES — TYPE I

Tape Type	Sens	Noise	Distortion	3% Dist	Compression (ref % Dist)
IEC Reference	+0.4dB	-51.5dB	0.55%	5dB	1dB
Agfa Superferro HDX	-3.6dB	-52.5dB	0.9%	4dB	3dB
BASF LH-EI	+1.0dB	-49.0dB	0.7%	7dB	1dB
BASF LH-MI	+0.8dB	-51.5dB	0.65%	7dB	2dB
Boots Ferric I	+1.2dB	-49.5dB	0.70%	7dB	1dB
Boots Super Ferric I	0dB	-49.0dB	0.7%	6dB	1dB
Fuji DR	-3.0dB	-51.5dB	1.0%	3dB	2dB
Fuji FR	+1.2dB	-51.5dB	1.15%	>7dB (2.5%)	1dB
Fuji FR-1 Super	+1.2dB	-50.5dB	0.85%	>7dB (2%)	1dB
JVC FI-IS	-4.0dB	-51.5dB	1.2%	4dB	3dB
Maxell UR	+0.6dB	-50.0dB	0.65%	6dB	1dB
Maxell UDI	+2.7dB	-51.0dB	0.7%	7dB	0dB
Maxell XL1-S	0dB	-52.5dB	0.7%	5dB	1dB
Memorex MRX1 S	+1.2dB	-49.5dB	0.75%	4dB	0dB
Memorex dB5	0dB	-51.0dB	0.65%	5dB	1dB
Philips FE*1	0dB	-50.5dB	0.67%	6dB	1dB
Philips UF*1	+2.0dB	-48.0dB	0.8%	7dB	1dB
Saisho Ferric	+0.5dB	-49.5dB	0.75%	5dB	1dB
Saisho Super Ferric	+1.0dB	-49.5dB	0.7%	6dB	1dB
Scotch XS-I	+2.8dB	-51.0dB	0.65%	5dB	0dB
Scotch BX	-1.0dB	-48.0dB	0.85%	4dB	1dB
Scotch CX	+0.5dB	-49.5dB	0.7%	6dB	1dB
Sony HF	+0.3dB	-49.0dB	0.65%	6dB	1dB
Sony HF-S	+2.5dB	-51.5dB	0.65%	7dB	0dB
Sony HF-ES	+3.0dB	-51.5dB	0.70%	>7dB (2.4%)	0dB
TDK AD	+1.0dB	-53.0dB	0.70%	5dB	0dB
TDX AD-X	+2.2dB	-50.5dB	0.93%	>7dB (2.0%)	0dB
That's FX	+2.0dB	-50.5dB	0.75%	7dB	0dB
WH Smith FE-1	+0.5dB	-51.5dB	0.7%	6dB	1dB

AGFA SUPERFERRO HDX

Though Agfa *Superferro HDX* has a noise spectrum essentially the same as the reference, it has usefully more top, which extends the HF dynamic range. Noise is satisfactorily low, but there is considerable compression when the tape

is driven hard. When it isn't, it sounds very bright. Adding these factors to the very low sensitivity, we end up with a capable tape, but one that is hard to suit. Definitely a tape for the deck with auto-setup and, even then there is little discernible advantage over more conventional tapes.

BASF LH-EI & LH-MI

These two IEC compatible tapes from Europe's leading cassette manufacturer have good sensitivity and saturation figures, and in the case of *LH-MI* very good noise figures too. Both offer a wide working dynamic range, especially *LH-MI*, which is also balanced a little brighter than normal. *LH-EI* is more neutral (it is the official IEC Type 1 reference), sometimes sounding slightly 'squashed' in a direct comparison, and is also a little noisy. Both are excellent all-rounders that will suit almost any recorder, but *LH-MI* has the greater ultimate capabilities.

BOOTS FERRIC I & SUPER FERRIC I

Boots' own-label ferrics are both poor quality tapes. Curiously, the ordinary *Ferric I* version has a superior dynamic range to *Super Ferric I*, especially at high frequencies, but both have noise at a consistently higher level across almost the entire audio frequency band than the reference tape, whilst the operating ceiling is lower. In theory both can accept quite high treble levels without flinching, but the sound is compressed even when working well within normal margins. At lower levels recordings tend to be hiss-bound.

FUJI DR, FR & FR-1 SUPER

DR is not an especially satisfying tape, on a number of grounds. Although the noise levels are satisfactory, sensitivity is a full 3dB below normal, which will cause Dolby mistracking if allowed to pass uncorrected. There is some HF rolloff, and although the midband is tonally neutral, the tape will not accept strong signals without compression. Sound quality is unexceptional.

FR and *FR-1 Super* measure and sound as though they are the same tape (which could well be the case). There are few substantive differences, price apart. The 1dB difference in signal/noise, for example, all but disappears when the tape is subject to a spectrum analysis, which shows a localised effect that has influenced the figure without having much effect over a wider bandwidth. But these are both good tapes, with lowish background noise, the ability to record very high levels of signal without

distortion or compression, and a characteristically rather bright but still very musical, detailed sound. A little tape tuning tames the top nicely, whilst relegating noise to even lower levels.

One sample was noisy when winding, though the others were satisfactory.

JVC FI-IS

FI-IS offers a damped, constrained sound. Noise levels are no worse but no better than average, but in practice recordings tend to be strongly hiss-bound if audible compression is to be avoided, especially with treble rich material, because the tape can't take level. Saturation occurs very early indeed, especially above 3kHz. This tape has little to do with high fidelity.

MAXELL UR, UDI & XLI-S

UR has a little less HF than normal along with highish noise levels. Sonically nondescript, it was not at all unpleasant.

UD-1 is well above normal sensitivity (+2.7dB). Like *UR* it has a flat frequency response under IEC operating conditions, but has more output than the reference over most of the frequency range (up to about 10kHz) and can be driven very hard indeed without distress. The operating dynamic range is high: this is an excellent high performance tape that will stretch many good decks, but ideally should be teamed with a deck with adjustable sensitivity.

XLI-S is a fine tape capable of making good recordings of 'difficult' material, but it is far from flat tonally at normal bias settings. Sensitivity is normal, but the tape will require rebiasing unless you like bright sounding recordings. Noise levels are very low, permitting Dolby-less use in some circumstances. With suitable retuning the noise levels could drop another 2-3dB at HF, making this amongst the quietest ferrics of all.

So here we have two excellent tapes, one with standard parameters except for sensitivity, the other with standard parameters except for frequency response. A tape that combined the best of the two would be practically unbeatable and would work in almost any recorder!

MEMOREX MRXI S & dBS

MRXI S suffers through having a rather narrow operating envelope, as defined by slightly

restricted headroom at HF, and a much higher than normal noise floor. The response shape is quite accurate, and Dolby tracking shouldn't be unduly compromised by the +1.2dB sensitivity. Sound quality was considered surprisingly crude and messy, especially in the presence of a lot of HF energy.

*dB*S offered more conventional levels of background hiss, but a falling HF response, placing it in a swings and roundabouts relationship with *MRX1 S*. In practice *dB*S sounded the sweeter and purer of the two, but neither match the best standards at the price.

PHILIPS FE*1 & UF*1

Philips *FE*1* has a dull, leaden sound and high hiss levels. It is consistently noisier than average throughout the audio frequency band, as the spectrum analysis showed. It's difficult to see how this one escaped, unless indeed there are people out there with a voracious appetite for dull, leaden music making.

*UF*1* is even noisier — the noisiest in this highly variable group in fact. On the other hand treble output is quite strong. On a deck with IEC biasing, the sound has an attractive immediacy, but it also sounds thickened, and the noise contribution is often obvious.

SAISHO FERRIC & SUPER FERRIC

These two tapes, sold through Dixons, have several Philips hallmarks, which unfortunately is far from being a good thing. Both have severely falling responses at high frequencies. *Super Ferric* offers very slightly higher HF maximum output levels (MOLs), but the differences amount to little, and as the other differences between the two tapes are vanishingly small, it's probably safe to assume that *Super Ferric* is just a selected version of standard *Ferric*. Neither is worth considering.

SCOTCH XS-I, BX & CX

XS-1 is a high sensitivity tape, with well controlled background hiss and the ability to record a very strong signal across the frequency range with imperceptible compression. Frequency response at normal levels is accurate, and recordings can be safely peaked well into the treble — as long as the recorder can cope —

possibly avoiding the necessity for noise reduction altogether. *XS-1* has a lively, energetic and involving sound quality with a lot of detail, but a touch of edginess — despite the figures. But Dolby users should be cautious of the high sensitivity.

Neither *BX* nor *CX* are in the same league. *CX* has restricted HF headroom, while *BX* is short of headroom over the whole band. *BX* is also very noisy indeed. *CX*, although better, could hardly be described as a quiet tape, and both suffer from falling high frequency output. In this case, the advantage goes to *BX*, but it's a close run thing.

SONY HF, HF-S & HF-ES

There's a readily discernible hierarchy here. Sony *HF* is a noisy tape, but with standard sensitivity and frequency balance. As with many cheap ferrics its major limitations occur at high frequencies, and it could hardly be described as having a wide dynamic range.

HF-S gets much closer. Noise levels are within spitting distance of the reference tape under spectrum analysis, and the output curve also shadows that tape. However the Sony tape has an extended dynamic ceiling and in practice is very difficult to overload. Sensitivity is high, and this should be noted to avoid mistracking when recording with Dolby. *HF-S* made some clear, articulate recordings on test — good value.

Finally, *HF-ES* has broadly similar noise levels, but a worthwhile increase in headroom at all frequencies. Like *HF-S*, the frequency response is just slightly bright on paper. In practice it will usually pass unnoticed. However, sensitivity is even higher.

TDK AD & AD-X

TDK AD is our reference tape for this issue, and the standard ferric tape used for production line testing by the majority of Japanese deck manufacturers. It is an adequate-or-better performer with a clean, strongly characterised sound, and — by definition — a flat frequency response. It will also accept high treble levels without distress.

AD-X on the other hand has slightly more background hiss, but makes up for this by being able to accept very high signal levels throughout the frequency band. The response is a touch

brighter than AD, and this reflects in a slightly clearer sound, but sensitivity is high, which makes it borderline for Dolby record/playback integrity unless a sensitivity adjustment is made.

THAT'S FX

That's FX is one of a new breed of wide dynamic range ferrics, characterised by low noise and a bright frequency balance with a high operating ceiling. Sound quality is good, though definitely a little tippy (but not objectionably so) unless tweaked, for example with a fine bias control.

WH SMITH FE-1

In a field of very mixed capabilities, this was poorest of all the tapes tested. The mid-frequency signal/noise figure looks OK, but spectrum analysis shows unusually high LF noise, which lies largely outside the weighting curve. It was also seen to vary by about a dB over a period of some seconds when connected to the real time analyser. The HF end was severely curtailed, falling below the bottom of the chart at 20kHz (poorer than -6dB ref 1kHz) and the result was dull, lacking in detail, and almost bereft of dynamics.

CHROME TAPES — TYPE II

Tape Type	Sens	Noise	Distortion	3% Dist	Compression (ref % Dist)
IEC Reference	0dB	-53.0dB	0.55%	4dB	0dB
Agfa Superchrome HDX	-1.8dB	-57.5dB	1.9%	4dB	4dB
BASF CR-EII	-3.8dB	-57.0dB	0.95%	6dB	2dB
BASF CR-MII	-2.0dB	-57.0dB	1.1%	5dB	2dB
Boots Super Chrome II	-5.5dB	-58.5dB	1.35%	5dB	4dB
Fuji FR-II	0dB	-55.5dB	0.55%	5dB	1dB
Fuji FR-II Super	0dB	-55.5dB	0.55%	6dB	2dB
JVC UFII	-1.0dB	-56.5dB	0.8%	4dB	1dB
Maxell UDII	-1.4dB	-54.5dB	1.2%	4dB	3dB
Maxell XLII	-1.6dB	-56.0dB	0.95%	4dB	2dB
Maxell XLII-S	-0.4dB	-56.5dB	1.0%	4dB	1dB
Memorex CDXII	+2.4dB	-54.0dB	1.1%	3dB	1dB
Memorex CRX II	-2.0dB	-54.0dB	1.25%	3dB	2dB
Memorex HBX II	+1.6dB	-55.0dB	0.65%	6dB	1dB
Osawa CR60	-1.0dB	-54.0dB	1.3%	3dB	1dB
Philips UC*II	-4.2dB	-57.0dB	1.1%	6dB	4dB
Philips MC*II	-3.2dB	-58.0dB	1.1%	6dB	3dB
Saisho Chrome	-3.8dB	-58.5dB	1.1%	7dB	4dB
Scotch XS II	0dB	-55.0dB	0.85%	4dB	1dB
Sony UX	+0.4dB	-55.0dB	0.85%	4dB	1dB
Sony UX-S	+2.0dB	-53.5dB	0.6%	7dB	1dB
Sony UX-ES	0dB	-55.0dB	0.47%	7dB	3dB
Sony UX-Pro	0dB	-55.0dB	0.5%	7dB	3dB
TDK HXS	+4.4dB	-53.0dB	0.8%	4dB	0dB
TDK SF	-1.0dB	-53.5dB	0.65%	6dB	3dB
TDK SA	+0.2dB	-53.0dB	0.55%	6dB	3dB
TDK SA-X	+0.8dB	-58.5dB	0.7%	4dB	1dB
That's EX	+4.0dB	-52.0dB	0.8%	3dB	0dB
That's EM-X	+3.2dB	-52.0dB	0.9%	3dB	0dB

AGFA SUPERCHROM HDX

In characteristic chrome fashion, noise is very low, but output is also rather low, especially above about 500Hz. The tape overloads rapidly above 0dB. Bias needs to be set slightly high to pull the midband up and cut the extreme HF back a little, but even the Nakamichi auto tape tuning system could not prevent this tape from dulling transients and sounding shut in. Sensitivity is high enough to avoid audible Dolby mistracking.

BASF CR-EII & CR-MII

Like Agfa *Superchrom*, these two chrome tapes have low sensitivity. Very low in the case of CR-EII, this was the only one to give an almost exactly flat frequency response when set up for IEC tape. Noise is low, but severe Dolby mistracking may occur in decks without sensitivity adjustment. CR-MII has a quite sharp extreme HF preceded by a wideband dip centred on 3kHz at IEC bias. Both tapes will accept quite a lot of level, and are extremely quiet. With suitable cassette deck alignment, they sound very clean and quiet. But if your deck has fixed settings for the more widespread Japanese standard tapes, forget these two.

BOOTS SUPER CHROME II

This tape behaves very like BASF CR-EII except that it has even lower sensitivity — the lowest of all Type IIs in fact at -5.5dB! Without a wide sensitivity adjustment, Dolby mistracking is very obvious. With suitable tweaking, the tape sounds very smooth and clean.

FUJI FR-II & FR-II SUPER

These two tapes are practically indistinguishable from each other, the differences being within the normal range of sample variation. Both behave almost exactly like the IEC reference. Output is normal, noise levels are quite low without setting any records, and the frequency responses are ruler flat at the IEC setting, the *Super* version having slightly *less* treble. Good all-rounders; buy whichever is cheaper.

JVC UFII

Another close to IEC standard tape, UFII is within the target range on sensitivity (-1dB), frequency response (there's a mild lift near

20kHz), noise (good) and saturation. It sounds very neutral and unexaggerated.

MAXELL

UDII, XLII & XLII-S

UDII is a low cost and relatively low performance Type II. Noise levels are not especially low and there's a small reduction in HF energy compared to the IEC standard tape. Headroom is quite limited, compression and distortion rising quite rapidly above 0VU.

XLII is more competitive, but sensitivity is a little low (-1.6dB) and headroom is only moderate. XLII-S has a stronger treble and needs a little extra bias to achieve a flat midband. But sensitivity is near normal, headroom is good and noise levels are very low for a super ferric.

MEMOREX CDX II,

CRX II & HBX II

HBX-II is an impressive tape on the test bench and to listen to. There is a mild shelving down in response above 5kHz, but only by about a dB. Noise levels are quite low, and headroom high, whilst sonically it has a clean, refined and detailed quality when used on a deck with standard adjustment.

Neither CDX II nor CRX II are in the same league, but they could hardly be more different from each other. CDX II has a sharply rising extreme HF and high sensitivity. It is inclined to sound a bit coarse and 'loud', where CRX II is flatter at normal bias settings but a little noisy and untidy sounding if driven hard.

OSAWA CR

CR (tested as a C60) is a tape of very limited abilities. On most counts it is just slightly below average, the cumulative effect being fatal. The HF fall is the most obvious characteristic, and CR could therefore suit a deck that sounds bright with most Type II tapes. Any rebiasing (on a suitably equipped deck) will merely emphasise hiss, and that is how it was: CR either sounded soft, or poorly differentiated, or noisy.

PHILIPS UC*II & MC*II

These tapes from the inventors of the compact cassette continue to follow the European tradition, along with BASF and others. Both

are pure chromes, moving the dynamic range envelope down a couple of dB, so that hiss levels are low but overload performance equivalently poor; this is useful with a cassette deck with limited headroom. The problem is that sensitivity is very low, especially with *UC*II*, and Dolby mistracking will occur unless the deck is set up for such tapes, or can be readjusted.

Even when this was done, however, both tapes sounded curiously lacking in life and resolution. Differences between the two are marginal. Could *MC*II* simply be quality-controlled *UC*II*?

SAISHO CHROME

Saisho is a brand name associated with Dixons stores. This tape behaves like a typical European chrome — it's made by ICM in Switzerland — and has a chrome coating which compresses strongly when overloaded, but which offers very low noise levels compared to most Type II ferrics. It can sound rather dull and undemonstrative on many cassette decks, where bias, equalisation and sensitivity will all need adjusting.

SCOTCH XS II

This tape has average sensitivity but a smoothly falling response through the midband and treble. Not unnaturally, it is inclined to sound rather warm and rich, but it's also clean and quite detailed, and only moderately hissy. This is one case where reducing bias doesn't really flatten the output. It could benefit from a slightly different equalisation curve, though it's not far from neutral as it stands.

SONY UX, UX-S, UX-ES & UX-PRO

Sony produce a tape for all reasons. *UX* and *UX-S* are the two that correspond to the IEC guidelines. They are both very flat at the normal IEC setting, but differ markedly on sensitivity. Otherwise they are very similar: if the saturation and noise curves are overlaid, both offer almost precisely the same working amplitude response, noise spectrum and dynamic range. Both sound clean and pure; choose the one that suits the Dolby level for your deck.

UX-ES and *UX-Pro* are just as closely paired. Both have a very strongly rising treble, but in this case they both have exactly normal sensi-

tivity and noise levels. They can be driven very hard before overload sets in, and need quite a bit of extra biasing to avoid a sharp 'sting' in the treble. *UX-Pro* is marginally brighter, otherwise only price distinguishes them.

TDK HXS, SF, SA & SA-X

TDK *SA* is of course the *de facto* Type II standard, as used by many deck manufacturers and throughout this project. By definition therefore it has an average sensitivity and flat frequency performance. In fact the sample was very slightly more sensitive and brighter than the reference tape, but noise and overload both press in on the available dynamic range. This year more than ever, *SA* looks decidedly pedestrian. So does the budget *SF* tape, which is about 1dB less sensitive, but otherwise very similar.

HXS is more exciting. It is a Type II metal, with an extremely high sensitivity (which the deck must be equipped to cope with), and the ability to accept almost any amount of treble without overload — if the record head can cope. Without correction, the extreme top has a sharp edge, and the tape can sound rather scratchy and thin, whilst the frequency balance remains neutral. A lively sounding tape, but difficult to work with.

Finally, there's *SA-X*. With a just above average, but IEC compatible sensitivity, *SA-X* is the quietest Type II tested. With its good headroom capability, this tape can be used without noise reduction where other tapes can't, with all the advantages that accrue. The response is a little saucer-shaped, but not severely. It has a super-wide dynamic range and sounds very clear and detailed. Excellent.

THAT'S EX & EM-X

That's two Type II metals have a very specific appeal not based on accuracy. *EM-X* is marginally quieter than *EM* above 1kHz, but the two are otherwise quite similar. Both are quite strongly underbiased at the normal Type II setting, and both offer a similarly muddy, edgy effect on an IEC-tweaked machine. Noise levels look poor, but this at least can be set against the excellent overload performance. Nevertheless, TDK *HXS*, also a Type II metal, has a better dynamic range and a much more accurate frequency response.

METAL TAPES — TYPE IV

Tape Type	Sens	Noise	Distortion	3% Dist	Compression (ref % Dist)
IEC Reference	0dB	-54.5dB	0.55%	>6dB (2%)	1dB
Fuji FR Metal	+1.5dB	-52.0dB	0.52%	>6dB (1.4%)	0dB
JVC ME P11	+0.5dB	-52.0dB	0.53%	>6dB (1.8%)	1dB
Maxell MX	+0.5dB	-54.5dB	0.48%	>6dB (2%)	1dB
Scotch XSM IV	-1.5dB	-52.5dB	0.68%	>6dB (2.2%)	2dB
Sony Metal-ES	+2.8dB	-56.0dB	0.38%	>7dB (1.3%)	0dB
TDK MA	-0.5dB	-54.5dB	0.55%	>7dB (2%)	3dB
TDK MA-X	+1.2dB	-54.5dB	0.50%	>6dB (1.7%)	1dB
TDK MA-XG	+1.5dB	-54.5dB	0.50%	>6dB (1.7%)	0dB
That's MG-X	-1.0dB	-52.5dB	0.57%	>6dB (2%)	2dB
That's MR-X Pro	+2.0dB	-53.0dB	0.46%	>6dB (1.7%)	0dB

FUJI FR METAL

This is a good all-round metal, but with slightly greater sensitivity than usual, and noticeably higher broadband noise. Sound quality is good but slightly 'fluffy'.

JVC ME P11

This tape is very similar to the Fuji metal, except that sensitivity is a little lower and the extreme HF is a little more muted. Good for decks that sound bright with other metals.

MAXELL MX

An examination of the noise spectrum shows that LF noise is lower than the IEC reference, otherwise MX is similar, notwithstanding the weighted noise figure. Tonally it's just slightly bright, but very smooth and clean, and effectively spot on the IEC guidelines.

SCOTCH XSM IV

Scotch XSM IV has a slightly falling top end and higher than normal noise levels. Sensitivity is very low. Not a state of the art metal.

SONY METAL-ES

This tape has higher output than normal at all frequencies, and the lowest midband noise of all metals tested. The tape is difficult to overload, but is very bright indeed, and

sensitivity is nearly 3dB over the top. Recommended highly, but for decks with adjustable bias and sensitivity only.

TDK MA, TDK MA-X & MA-XG

The importance of metal to TDK can be gauged by the fact that they offer no less than three types, in a choice of conventional plastic or a zinc alloy (reference) core. The latter look magnificent and are practically indestructible, but are functionally inferior to the plastic ones which have internal liners for improved evenness (ie less tape scatter). MA MA-X and MA-XG offer progressively higher sensitivity, but similar noise overload characteristics and response shape. MA-XG sounds a little cleaner than the others, but the main selection criterion should be to choose the one with the right sensitivity for accurate Dolby tracking.

THAT'S MG-X & MR-X PRO

Both That's formulations are a little noisy, MG-X especially. This tape is otherwise almost directly comparable to TDK MA, though it overloads slightly earlier. MR-X Pro, on the other hand, is an excellent product, being very sensitive, with more than usual mid/top combined with a quite smooth extreme top. A recorder with sensitivity adjustment is *de rigueur* to avoid Dolby mistracking.

CONCLUSIONS

The only real answer to 'which is best?' is 'well it all depends . . .' Summarising the results of these tests is not a task amenable to simple one-line judgements, but this doesn't prevent us making some general observations. One, the expected one, is that the higher coercivity, higher bias tapes tended to sound better. This means that Type II chrome-slot tapes sound better than ferrics — usually — and that Type IV metals sound better still.

There are a number of interrelated reasons for this, one being improvement in mid/HF dynamics and freedom from 'squash'. One underlying mechanism here is that the self-biasing contribution of the audio signal itself becomes proportionately smaller with higher energy, bias-hungry tapes. Of course this is the mechanism underlying Dolby *HX Pro*, and on decks so equipped the gap between tape groups is narrowed — but not eliminated.

The other, rather unexpected finding is that, as a general rule, the more sensitive tapes sounded clearer, and more dynamic, often at the expense of smoothness — and this after residual sensitivity and response variations have been taken care of. Obviously part of the reason for this phenomenon (which was confirmed with a number of recorders) must lie in the fact that for less sensitive tapes the amps and heads are being driven harder, and simply sound different under such circumstances. But there may be other factors at play here, including modulation noise.

Despite the earlier comments, the best of the Type I ferrics offer a very good sound, and even better value. Scotch *XS-1* was particularly well liked as an energetic, punchy if not especially IEC compatible formulation. Sony also make two tapes in a similar vein, *HF-S* and *HF-ES* (their popular and compatible *HF* is cheap but unexciting), whilst That's offer *FX*, which is a recommendable squeaky-clean wide dynamic range ferric. TDK and BASF both offer very good tapes with more balanced properties, *AD* (TDK) and *LH-E1* (BASF) being amongst the best here, whilst *AD-X* and *LH-M1* added a

touch of pizzazz — without the strict necessity for a deck with tape alignment facilities. Fuji *FR* is also an excellent compatible tape (*FR-1 Super* is scarcely, if any, better). Maxell *XLI-S* is also recommended, if you want a brighter than average tape. Although BASF make some fine tapes in the Type I category, some of the other European tapes were quite poor. Worst of all in general were the own-brand tapes — the *Saisho* (Dixons) and W.H. Smith types especially.

The Type IIs are generally the best value tapes of the lot, and on many machines the best full stop. There was a slightly reduced spread of abilities here; even the own brand tapes did pretty well on the whole. The European manufacturers largely stand by chrome tapes with their reduced noise and lower headroom, for which it should be noted many decks will not be adjusted as standard. But BASF offer the best of both worlds, with the compatible *CR-EII*, and a brighter, more Japanese-like *CR-MII*. Note the sensitivity figures with these tapes.

Amongst the more impressive of this year's crop was Memorex *HEX-II*, a neat IEC standard tape, and TDK *SA-X*, which is amazingly quiet — quieter even than the quietest chromes — and capable of being used without noise reduction where others would sound too noisy. TDK *HX* and the two That's tapes are good in their own terms. They will sink almost infinite quantities of HF, but are bright in balance and don't fit comfortably in any recognised bias slot. Other recommended tapes include Sony *UX* and Sony *UX-ES*, which bridge the gap between the IEC compatible Type IIs on the one hand, and the bright, energetic but sometimes rather grainy Type II metals.

Type IV Metals tend to offer poor value for money, and we know they place extreme demands on the recorder's heads and electronics. But if you want to take the plunge, the various TDK metals, That's *MR-X* and Maxell *MX* mark the middle ground, and work well. Sony *ES*, for which an effective tape alignment system is mandatory, can sound superb. Try the JVC metal if the other metals sound bright. Good listening!

G L O S S A R Y

ACOUSTIC FEEDBACK: If any sound in the room can find its way through the body of the record deck to the cartridge stylus, then that sound will be reproduced from the loudspeakers, along with the wanted programme material. If too much of this sound from the loudspeakers is picked up by the cartridge in this way then a vicious circle of acoustic feedback will be created.

AMPLITUDE: Size or magnitude; hence the amplitude/frequency response, known normally simply as the frequency response, which describes the relative loudness of the system at different frequencies with a constant input voltage.

AZIMUTH: With reference to tape and cassette recorders, the alignment of head gap to tape path.

BALANCE: 1) The overall relative loudness perceived at different frequencies (eg bass, treble); 2) the accuracy of the match between the two channels of a stereo transducer (eg cartridge or pair of loudspeakers).

BANDWIDTH: A range of frequencies with presumed defined upper and lower limits.

BASS: Lower part of the frequency spectrum.

BIAS: (*tape*) This 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 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 is reached when a circuit is overloaded and overdriven, resulting in bad waveform distortion and audibly unpleasant effects.

COLORATION: A general term used to describe the audible effects of distortions, particularly in loudspeakers and record players. These are usually caused by frequency response irregularities and/or resonances.

COMPATIBILITY: The selection of interdependent components to achieve optimum system performance; notably arm/cartridge mass/compliance matching, cartridge electrical loading, or loudspeaker compatibility with amplifiers.

CROSSTALK: The leakage from one channel to the other in a two channel stereo system.

DIN: German standards body, responsible amongst other things for a popular range of standard plugs and socket specifications.

DAMPING: A means of controlling resonances by means of a resistive medium (electrical, mechanical, or acoustic depending on situation).

DECIBEL (dB): A logarithmic unit that is convenient for expressing ratios that span a wide range on a linear scale. For simplicity it can be regarded as a measure of relative loudness.

DISTORTION: Literally this can mean any deviation from the original, but usually refers to harmonic rather than intermodulation distortions when not specified.

DOPING: A technique involving the application of damping to a loudspeaker driver cone in order to assist in controlling resonances.

DOWNFORCE: The weight, measured at the stylus, which holds it down in the groove.

DRIVE UNIT (DRIVER): The term used to distinguish the loudspeaker unit itself, be it bass, mid-range, treble or fullrange in application, from the complete loudspeaker system which combines drive units, cabinet and crossover into a total design.

DROPOUTS: Momentary reductions of programme level due to inadequate head/tape contact caused by oxide particles shedding off the tape onto the head gap, or inadequacies in tape transport or tape.

DYNAMIC RANGE: The ratio in dBs between the quietest sound that can be successfully recorded and the loudest which can be accepted without serious distortion on an average programme.

EFFECTIVE MASS: The inertia, or mass-controlled resistance to movement, of a device, particularly important with regard to tonearms.

EFFICIENCY: The amount of acoustic power delivered for a given electrical input power.

ELECTROSTATIC: A principle employed in some loudspeaker transducers using static electricity effects to set up a polarising field within which the modulated transducer medium moves.

ELLIPTICAL STYLUS: A specially shaped stylus profile that makes the 'plan view' radius along the length of the groove smaller than the 'elevation view' contact radius viewed from the front.

EQUALISATION: (*general*) The deliberate modification of frequency response, usually in response to some engineering limitation of deficiency.

EQUALISATION: (*tape*) 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 $70\mu\text{s}$ or $120\mu\text{s}$ (see 'Microseconds').

FM: Frequency modulated; often used to describe radio transmissions of high fidelity potential on the VHF band.

FARAD: Measure of capacitance.

FERRITE ROD: A short rod type aerial used for AM reception; may be fitted internally or externally to tuner or receiver.

FERRO-FLUID: A magnetic fluid which is introduced into the voice-coil gap to provide damping and/or improved cooling.

FILTER: A circuit (normally) used to restrict the bandwidth of a system; may be fixed or switchable.

FREQUENCY RANGE OR SPECTRUM: Can refer to any particular group of frequencies, but commonly applied to the audible band from 20 to 20,000 cycles per second (Hz), extending from the deepest bass to the highest audible harmonics.

FREQUENCY RESPONSE: The variation in output over a frequency range, particularly of a transducer; can be expressed as a range with decibel limits, or depicted graphically.

Hz (HERTZ): 1 Hz = 1 cycle per second and is a measure of frequency which corresponds to musical pitch (the higher the frequency the higher the pitch).

HF: High frequency.

HARMONIC: Harmonics are the whole number multiples of a base frequency called the *fundamental*.

HARMONIC DISTORTION: The addition of unwanted harmonics to a signal.

HUM: A low frequency interfering sound produced by break-through or interference from mains wiring or circuitry.

IHF: American Institute of High Fidelity, an important standards body.

IEC: An international standards body.

IMPEDANCE: Measure of resistance (and reactance) in alternating (ie audio) signals; this is of some importance in the compatibility of both cartridges and headphones with amplifiers. For convenience sake is measured in ohms.

INTEGRATION: Used to describe the success with which the output from two drive units combine to give smooth output through the crossover region.

INTERMODULATION (IM): A form of distortion arising from two or more signals producing non-harmonic signals that correspond to the sum or difference of the two frequencies.

KILO (k): prefix meaning one thousand.

LED: Light Emitting Diode; an indicator light.

LF: Low frequency.

LATERAL FRICTION: The resistance to

movement of an arm and cartridge combination in the horizontal plane (ie across a record), caused by friction in its bearings.

LINEAR: A transducer that produces an output that exactly portrays its input over the required operating range is described as linear, and is hence distortion free. Hence also nonlinearities (distortions).

LINE-CONTACT: A special stylus profile that extends the ellipse, increasing contact length up and down the sides of the groove.

LOAD OR LOADING: The impedance (including resistive and reactive components, ie ohms, mH, pF) seen by one component looking back to its interconnected component; of importance in compatibility of cartridge/amp, and amp/headphone.

'LOUDNESS': An equalisation circuit frequency switchable on amplifiers which is designed to compensate for presumed hearing characteristics at low listening levels by boosting bass and treble.

MOL: Maximum operating level of tape normally referring to 5% distortion of 315Hz or 3.15kHz.

MEDIUM WAVE: An AM transmission band incapable of high fidelity signals.

MICRO- (μ): Prefix for units meaning one millionth of.

MICROSECONDS (μs): The time constant of a resistor capacitor combination involving a frequency response change (equalisation).

MIDRANGE, MIDBAND: The central part of the audible frequency range where the ear is most sensitive.

MILLI- (m): Prefix for units meaning one thousandth of.

MODULATION: The audio signal is 'stored' by means of modulations within a medium, eg the 'wiggles' in the groove of a plastic disc, or the magnetic coding on a tape.

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 (causatory tone).

MOVING-COIL: A transducer (eg cartridge or headphone) where the signal is generated by the movement of a coil within a magnetic field.

MOVING-MAGNET: The most common form of cartridge transduction, where the magnet moves while the coils are held relatively stationary.

MULTIPLEX FILTER (MPX): A circuit which introduces severe attenuation at supersonic frequencies to decrease interference encountered with the output from some stereo FM tuners.

NANO (n): Prefix meaning a thousandth of a millionth of.

NOISE: Random unwanted low level signals.

NOISE MODULATION: An unwelcome breathing effect that can be heard on some programme material, produced by poor noise reduction systems, or circuits.

OCTAVE: Two-to-one ratio of pitch or frequency.

OFFSET ANGLE: The angle measured between the centre line of the pickup cartridge and the line which joins stylus and arm pivot point.

OHM: Unit of electrical impedance (including reactance) or resistance; also kohm, where 1 kohm = 1,000 ohms.

OVERHANG: The extent to which the cartridge stylus extends beyond the centre of the platter is critical, and controlled by fore and aft adjustment of the cartridge on the arm.

PASSIVE: The most common type of system, where drivers and crossover are driven from a single power amplifier.

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: The most commonly used plug/socket combination in audio components.

PICO (p): Prefix meaning one millionth of a millionth of.

PORT: An opening in a cabinet which is tuned to characteristics of the bass driver and the enclosure volume to provide reflex type bass-loading.

POWER AMPLIFIER: The part of an amplifier that provides power to drive the loudspeakers: usually integrated, it is sometimes a separate component.

PRE-AMPLIFIER: The part of an amplifier that accepts the input signals, sorts them, applies any necessary equalisation, and then passes the signal to the (normally integral) power amplifiers.

PRESENCE: A quality of forwardness or immediacy in a sound balance, generally related to an upper-middle frequency response boost.

PRINTTHROUGH: A pre- or post-echo of a loud signal created by magnetisation occurring from one layer to an adjacent layer after the tape has spooled or been recorded.

Q: A measure of the magnitude and shape of a resonance; the higher the Q, the sharper and more severe in amplitude the resonance.

REFLEX: A system of bass loading (using port or ABR) which offers improved efficiency and bass power handling at the expense of subsonic control compared to a sealed box.

RUMBLE: The low or medium frequency sound produced mechanically by any moving parts in a turntable, mainly the motor and platter bearings.

SENSITIVITY: The volume of sound output for

a specific electrical voltage input.

SEPARATION: As between the two channels of a stereo pickup; see *crosstalk*.

SHIBATA: A special stylus extending the elliptical to a 'line-contact' type of profile.

SIDE-THRUST: A force acting on cartridges in pivoted (ie not parallel tracking) arms, due to the stylus/vinyl 'friction' acting along the line of the offset angle; hence bias or side-thrust compensation.

SIGNAL-TO-NOISE, SIGNAL/NOISE, S/N: The difference in total output when an applied signal is removed.

STYLUS: The specially shaped piece of diamond in contact with the groove and connected to the cantilever.

SUBSONIC: Below the audible range, ie below 20Hz.

SQUARE WAVE: A signal which consists of a fundamental plus a (theoretically infinite) series of odd (3rd, 5th etc) harmonics in a precise phase and amplitude relationship. It is useful for examining transient performance, symmetry, resonance control and 'ringing'.

THD: Total harmonic distortion.

TRACING: The following of the groove modulations by the stylus; hence for example tracing distortion, caused by the inability of a spherical stylus to trace the high frequency inner grooves on a disc.

TRACKABILITY: The ability of the cartridge to cope with large amplitude modulations (or of the arm and cartridge to follow the groove itself properly).

TRACKING ERROR: The discrepancy between the truly tangential angle at which a record is cut and the slightly off-tangential angle at which it is tracked by a stylus on a pivoted arm during some parts of the arm's travel.

TRANSIENT: Signal of very short duration.

TREBLE: Upper part of frequency spectrum, typically above about 3kHz.

TWEETER: A small drive unit designed to operate over the high frequency range.

ULTRASONIC: Frequencies above audibility, ie greater than 20kHz; also *supersonic*.

VERTICAL TRACKING ANGLE (VTA): The angle at which the plane of motion of the stylus is set with respect to the vertical when viewed from a side elevation of the cartridge. Should match the 20° cutter standard.

WEIGHTING: A factor or function that is applied to a measurement to increase its relevance and usefulness.

WOOFER: A drive unit that operates over the bass portion of the audio range.

WOW AND FLUTTER: Low and high frequency pitch variations (from poor tape transport of turntable platters with speed drift).

Example No. 62

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