

OUR "C" OF APPROVAL

NAKAMICHI FIGHT THE TAPE NOISE WAR WITH DOLBY'S NEW "C" SYSTEM, AND EVEN MANAGE TO IMPROVE THE EFFECT OF DOLBY "B". GORDON KING TESTS THREE BRAND NEW CASSETTE DECKS, PLUS A SEPARATE ADD-ON NOISE REDUCTION UNIT

I was pleased to have had this opportunity of being the first review engineer in the UK to scrutinise three of Nakamichi's latest Dolby C cassette decks plus the firm's add-on Dolby B/C noise reduction unit, model NR-200, which can be partnered with almost any tape recorder. The three decks in order of price are the 482Z, 582Z and 682Z.

Production commenced in June and the UK launching is scheduled for the beginning of September, so the machines should just about be in the shops when this review is in print. They lie in the approximate price range of £425 to £695, with the NR-200 coming in somewhere around £185, which makes them some 6% to 20% more expensive than their similar model predecessors owing to updating and the addition of Dolby C with Dolby B noise reduction.

All the review samples were of the

black Nakamichi finish, and right at the outset I must be fair to the distributor by stressing that they were pre-production samples which could well account for any isolated idiosyncrasies or performance shortfalls encountered during the searching lab tests and subsequent auditioning — though, as usual with this highly respected cassette deck name, all the items performed in exemplary fashion, apart from a couple of isolated cases of a seeming fault condition or maladjustment, so neither Nakamichi nor the distributor need get too hot under the collar in this respect! When leaving the shops Nakamichi decks are generally noted for their high state of tune. If you have a genuine grouse, the UK distributor will certainly want to do something to relieve it, the firm's Nakamichi-sensitive technicians being well geared to handle most user problems.

The three decks are equipped with

three heads giving off-tape monitoring with double-Dolby. Each model also boasts Nakamichi's 'low resonance' dual-capstan tape transport system and the neat arrangement whereby the pressure pad is lifted away from the tape in the cassette so that tape/head intimacy is under the control of the deck rather than the cassette, which is a very good point. Another aspect is that the record, replay and erase heads are arranged in a completely discrete configuration. The complete separation of the record and replay heads facilitates the best related optimisation while reducing unwanted coupling between the record and replay channels, and makes possible azimuth adjustment of the record and replay heads separately, leading to a high degree of overall azimuth accuracy. Moreover, a three-head system generally means that both the electrical impedance and the gaps of the record and replay heads can be optimised for the jobs they are called upon to undertake.

The minute replay gap length of Nakamichi decks yields remarkable definition of short wavelength, high-frequency signals recorded on the tape, which means that a very good upper-frequency response is obtained without recourse to excessive record pre-emphasis, which is one quick way of running out of high-frequency headroom. The gap length and magnetic properties of the record head provide a high recording flux without early magnetic saturation, this being dramatically revealed by the relatively high low-frequency maximum output levels (MOLs) that the decks can record on premium tapes. Also astonishing is the high high-frequency MOLs that can be achieved even on 120µs Class I oxides.

I shall be having more to say about the performance later, but for the time being let us have a look at the decks and the noise reduction unit in turn.

BACKGROUND TO DOLBY

At this stage I feel that I should reveal the basics of Dolby noise reduction, especially the latest C as this is a particular feature of the three decks and the noise reduction unit. It is now generally known that Dolby noise reduction works on a level-dependent, sliding-band compander principle, requiring record encoding and replay decoding.

Signals at Dolby reference level (200mWb/m tape flux) or more pass through the encoder without compression (high-frequency level lift) during recording and through the decoder without expansion (high-frequency level cut) during replay. As the signal level falls below the Dolby reference level, however, the middle and high frequency signals are compressed during recording and expanded correspondingly during replay. The amount of compression and expansion (level lift and corresponding cut) increases progressively as the signal level falls — eg, when the noise would not

otherwise be masked by the signal. When the two sections are tracking properly over the dynamic range of the signal, the integrity of the overall record/replay frequency response is accurately maintained.

Dolby B gives a maximum compression around 10dB in the HF region when the signal level is 40dB or more below the Dolby reference and, because of the complementary expansion during replay, the background hiss is reduced subjectively by about the same amount, as commonly measured using CCIR/ARM weighting. The lower compression of higher level signals and the correspondingly smaller amount of noise reduction is of less moment because the stronger signals tend to mask the noise.

Dolby B comes into play around 500Hz and Dolby C around 150Hz, some two octaves lower. Also with Dolby C the compression continues to increase until the level of the signal falls to about 60dB below the Dolby

reference, maximum noise reduction then being around 20dB. Dolby C thus yields 10dB more noise reduction between 2 and 8kHz than Dolby B, and because it starts some two octaves below Dolby B there is also a useful maximum of about 5dB at 150Hz, which increases with frequency. There is also compression treble cut and complementary expander boost which dramatically extends the tape's saturation level and MOLs at high-frequency (see later). The net subjective result is very favourable with respect to Dolby B.

Looking at it in terms of the power of the background noise, Dolby B reduces it by a factor of 10 while Dolby C has the potential to reduce it by a factor of 100. In fact, the noise decrease heard when Dolby C is switched from Dolby B is very impressive.

Dolby C uses two stages in tandem (Dolby B uses one stage), and each stage yields a maximum compres-

sion of 10dB. The two stages, which use separate Dolby ICs, operate at independent levels, one at high-level similar to Dolby B and the other at a lower level. Owing to the series configuration, a noise reduction multiplication effect obtains, so that in decibels the noise reduction of one stage is added to that of the other.

The design is such that the side-chain of the high-level stage can be altered by a switch to conform to the Dolby B requirements, while the side-chain of the low-level stage is simultaneously switched to operate as a linear amplifier. This provides the Dolby B/C switching.

You can compare the encoding curves of the two modes over 5dB steps from Dolby level (0dB) down to -4dB in Figs. 3 and 4 pen charts. These were plotted from the NR-200. Note the treble cut on Fig. 4 chart.

The NR-200 measures 482 x 71.5 x 268mm (W x H x D) and weighs 5.5kg. It is equipped with provision for standard rack-mounting adaptors.

482Z

£425 - £455



This is the least expensive deck of the trio. Its tape transport uses logic circuitry and a unique motor-driven cam system, the buttons for control being the latching type rather than the non-latching type used on the other models. In common with the other two machines, there are no microphone circuits, but the line ins and outs which connect to the parent amplifier are RCA 'phono' sockets at the rear. A DIN signal socket is not present, but there is a socket for interfacing with an optional remote control unit, MR-100, which comes complete with 5m of cable.

Recording level is under the control of separate left and right channel horizontally-disposed sliders which operate smoothly and are scaled for ease of resetting and balancing. Replay output is fixed, but the headphone output, from a front standard jack socket, can be changed between high and low by a rear switch. Metering range is from -40 to $+10$ dB based on 16 red-glowing LEDs,

the first -40 dB one always being alight. Attack is very fast and decay slower.

The glass-fronted cassette holder lies at the left of the fascia, the front being easily detached for cleaning and for exposing the adjustments for the heads and azimuth. There is a three-digit mechanical tape counter and memory button which, when depressed, ensures that the tape will halt close to counter zero when fast rewinding. Indexing any point of the tape to zero is accomplished by the counter reset button.

Separate press-switches select the required 120 μ s or 70 μ s eq and bias for the tape being used, there being three bias buttons for tape Classes I, II and IV — sadly, not indicated as such but instead carrying the letters EX, SX and ZX respectively. A front control allows the bias to be adjusted either side of the switched nominal value for the best sonic results judged by referring back to the source signal. With a three-head deck, of course, this is relatively easy

since you can monitor the recording while it is actually being made. Another button provides an immediate change between source and tape. It was interesting to see that the instructions state specifically that the deck is not suited for use with ferrochrome (FeCr) Class III tapes.

Dolby noise reduction is activated by a button, while an adjacent button changes between B and C. I shall be having more to say about Dolby B and C later. When recording from FM stereo radio the pilot tone and sub-channel spurious may well need to be suppressed to avoid upsetting the Dolby circuits, and for this you have a rear MPX switch which rolls-off the response sharply to provide a deep cut at 19kHz and onwards. For the widest frequency response, of course, the filter should be switched off when not needed.

The deck is well engineered, metal encased and measures around 450 x 135 x 289mm (W x H x D). Weight approximates 6.4kg.

THE FINDINGS

This pre-production sample was found to have mild Dolby integrity errors on the tapes used for the tests — with Dolby C showing more error than Dolby B; but I must stress that this was a matter of internal adjustment rather than design error. While Dolby B gave a noise improvement of 10.3dB with Maxell MX metal tape, Dolby C achieved an improvement of 18.3dB (CCIR/ARM-weighted) on the same tape, which I regarded as quite acceptable. The improvement at 70 μ s eq relative to 120 μ s, however, was less than I have found on other decks, which is interesting.

I was particularly impressed by the excellent high-frequency MOLs, especially with Dolby C active, which even with Class I XLIIS was as high as

-1.5 dB (for 3% 3rd-order IM distortion). Incredibly good in my book! Metal tape did even better and, curiously, XLIIS less good than XLIIS. LF MOLs were also excellent, particularly with MX metal. Again, as would be expected, XLIIS was less good — XLIIS being better! I was also very happy with the record channel S/N ratio (line input) which would give adequate dB space below the Dolby C noise floor; also with the fine recording headroom and the low distortion of the electronics generally.

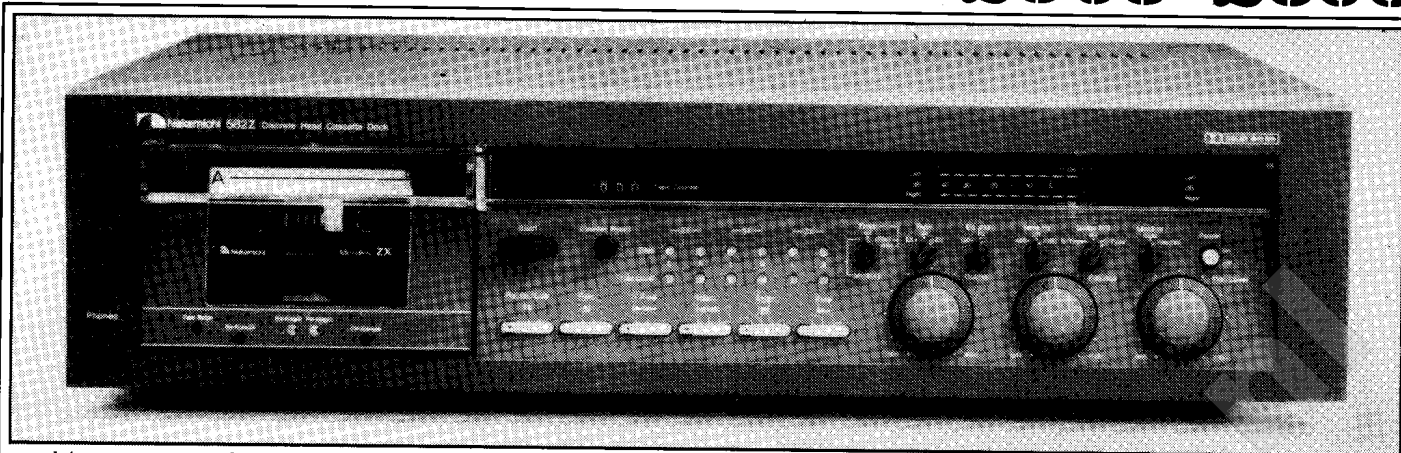
The metering was good to use, though I was rather bothered by the dim red LEDs. Headphone delivery was high and if you want more voltage across low impedance 'phones you only have to switch to the 'high'

position. The squarewave results were quite sanitary with just a little 'ring' and starting overshoot.

Under audition it was surprising to hear just how much lower the noise went down when switching from Dolby B to Dolby C. There was imperceptible change in quality and neither my listeners nor I experienced any discomfort from breathing effects. On speech, though, a very vague difference was noted when Dolby C was switched on from off. Overall quality was excellent, the delivery being smooth and seemingly well clear of undue tape compression and high distortion, even on music peaks. Very good results were obtained with XLIIS — virtually as good as MX metal, in fact.

582Z

£565-£595



This more sophisticated model sports features in addition to those carried by the 482Z. Certain circuit sections are also improved to provide greater headroom and less distortion on strong signals. Flat rotary controls are used for recording level (left and right channels together), channel balance and replay output, the latter also adjusting the level of the headphone signal.

Bias and recording level for tape classes I, II and IV are separately adjustable on the left and right channels by two rows, each of six presets (twelve in all), on the fascia which are located below screwdriver inserting holes so that once set they are not easily disturbed. The adjustments are aided by switchable 400Hz and 15kHz oscillators, the latter also giving a recording/replay signal for record head azimuth setting. The various head adjusting screws are accessible

through holes at the bottom of the cassette holder.

Tape transport is logic-controlled and is operated by low-pressure non-latching buttons. A small rotary switch, which matches five others performing different functions, allows you to operate the deck for record or replay by an external timer, there also being 'off' and memory (rewind) positions. Eq and nominal biasing for Class I, II and IV are established by two separate switches. A further switch selects Dolby B or C noise reduction, while two others of the same type select 400Hz or 15kHz test tone and source or tape monitoring, the former with an 'off' position, as also the Dolby switch.

The deck provides a useful cueing function, the fast-passing tape signal being audible in either fast spooling mode by simultaneously pressing the pause button, which reduces the fast

spooling speed to one-third of normal. A further reduction to one-fifth can be achieved by retaining pressure on the fast-spooling button.

The metering and tape counter are of the same type as those used on the 482Z. The rear is equipped with RCA 'phono' line sockets for amplifier interfacing (no DIN audio socket) and a MPX filter switch. There are sockets for coupling to an optional RM-200 remote control unit and for powering (by DC $\pm 10V$) an external Nakamichi 'black box' component, such as the MX-100 mike mixer. As already noted, the deck itself has no mike facilities, but there is a standard jack headphone socket with adequate output for most 'phones.

Measuring 500x130x350mm (WxHxD), this model is the physically largest of the group. Weight approximates 8.3kg, and the fascia finish is matt black.

THE FINDINGS

The 'pancake' type of rotary controls were liked better than the 482Z sliders — also the non-latching tape transport buttons. We also found it useful having separate level and bias presets for the different classes of tape with inbuilt 400Hz and 15kHz oscillators to set them by. These adjustments led to improved Dolby B and C integrity but, even so, XLIIS still exhibited ultra-treble lift with Dolby C. It was suggested by the distributor that we try the effect of setting the bias (using the 15kHz oscillator) with Dolby C active. Experiments along these lines proved that the peak could be tamed but with a little more droop just before where the peak would otherwise have been.

This adjustment was also found to be exceedingly sensitive when made with Dolby C active. Anyway, although the measurements shown later were made with the tapes supplied (including XLIIS), using different Class II brews of slightly lower coercivity than XLIIS we were, in fact, able to achieve a 'flat' Dolby C response after the bias was adjusted normally with Dolby off.

I now have the impression that Dolby C integrity might be more critical of level and bias adjustment than Dolby B integrity, though I must admit that these Nakamichi decks were the first that I have had the opportunity of testing in Dolby C detail so, until a greater number of Dolby C machines have passed through my lab and I can get some comparative data, I am keeping an open mind on the practicality of this subject.

Again, I was very impressed by the low noise floor of the record channel measured at line input (essential to achieve the best overall noise reduction from Dolby C); also by the excellent LF and HF MOLs — the former on the same tapes measuring even better than the 482Z. It was again discovered that Dolby C gave an astonishing increase in HF headroom (in real competition with Dolby HX!). This is achieved by special 'spectral skewing' and 'anti-saturation' networks built into the encoder and decoder sections. The first gives encoding treble cut above 8kHz (see Fig. 4 with respect to Fig. 3) and

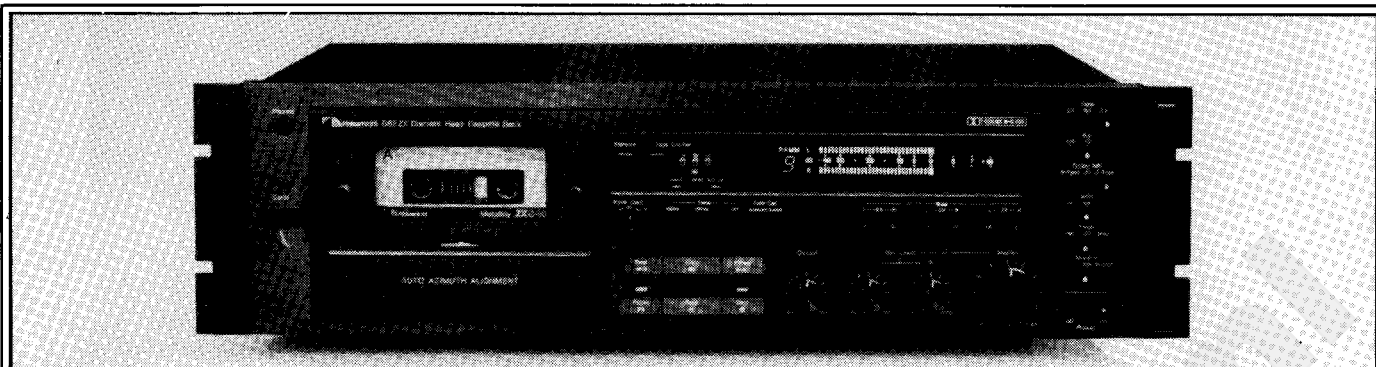
compensating decoding boost, while the second serves to raise the tape saturation level. Nakamichi also take great pains over Dolby IC selection for low noise and matching by colour coding. The decks and the NR-200 use type 7300 ICs.

Over 10dB of Dolby B noise improvement was measured, and on this deck with MX metal the improvement with Dolby C was as high as 19.5dB, which I feel will take some beating. Metering results were as with the 482Z, wow and flutter a shade higher but still very good and C90 fast-spooling time very quick as cassette decks go.

Auditioning was not too dissimilar from that of the 482Z, and with Dolby C the background hiss just vanished to zero! Results using metal tape were better than I have heard from some direct-reel decks at fast tape speeds. There was plenty of urge to drive almost all headphone types, and I would say that the quality of the programme signal being recorded would be the limiting factor of auditioning.

682ZX

£670-£695



In appearance, this model is more like the 482Z than the 582Z. It can also be adapted for rack-mounting, the standard 19in (EIA) adaptors being present on the test sample. However, the layout and ergonomics do differ. Recording level is controlled by separate left and right channel knobs of fairly conventional protruding style, along with a master control which adjusts the left and right channels together and whose knob is larger. You also have control over the replay level at line output and headphone monitoring.

The metering is brightly-glowing fluorescent rather than the relatively dull, red-glowing LEDs of the other two models. Dynamic range is the same, however, going from -40 to $+10$ dB (first LED always lit), and the attack very much peak responding. Eq and nominal bias demands of Class I, II and IV tapes are set by two small lever switches which lie in a vertical column of switches at the right-hand side of the fascia along with matching switches for Dolby B/C, MPX filter, external timer record/play start, source/tape monitoring and mains on/off.

A particular feature of this deck is its auto level calibration and record azimuth adjustment which optimises with the least trouble on whatever tape is being used. The primary operations required to start the auto process are merely to place the deck in recording pause mode and then to start the tape

rolling by pressing the play button after pressing a small button labelled 'auto calibration'. This sets the inbuilt 400Hz oscillator going, balances the recording level (essential for correct operation of the Dolby circuits for different tapes) and sets the azimuth of the record head for optimum relative to the replay head. If you zero the tape counter before you start, the tape will automatically rewind to zero when the adjustments are finished.

LEDs also tell you that the process is happening and when it is completed. If something is amiss with the eq or bias settings for the tape, or if the tape is too poor for level balancing, you are warned of this by flashing LEDs.

You can also operate the 400Hz oscillator or a 15kHz oscillator by button pressing, the latter being used for setting the bias on the particular tape you are using. There are three pairs of adjustments set below holes on the fascia for separate left and right channel bias setting of tape Classes I, II and IV. When the tape is being recorded by this signal and monitored directly, the appropriate adjustment is set for zero dB indication on the level meter. That is all there is to it, really! What happens is that the 15kHz signal is recorded at -20 dB and the meter sensitivity increased by the same amount so that 0dB is indicated when the bias is set for equal tape sensitivities at 400Hz and 15kHz.

The deck is also equipped with a

pitch control which adjusts the replay tape speed over about $\pm 6\%$ of nominal, with rear sockets for connecting a remote control and for powering a Nakamichi mike mixer, and with RCA 'phono' line sockets for amplifier interfacing.

With this deck you also get Nakamichi's Random Access Music Memory (RAMM) which allows you to locate recorded programme sections fairly quickly provided that at least five seconds of 'silence' prevails between them. It works in conjunction with a nine-count electronic digital indicator. Operation is reasonably simple. When the pause button is pressed at the start of a fast-forward operation the digital indicator lights and shows a number (up to nine) related to the number of times the pause button is pressed. The tape then continues to spool until the electronics have counted the number of entered pauses. The spooling then stops and the deck goes into play mode to reproduce the recorded section which directly follows the pause. It can also be used in the rewind mode to count down the number of pauses. The RAMM functions can also be operated by an optional remote control unit RM-200, which has a record mute button so that you can put deliberate pauses into your own recordings.

Dimensions approximate $482 \times 143 \times 340$ mm (W x D x H) and the weight 9kg.

THE FINDINGS

I found the auto level and azimuth adjusting facility on this deck particularly useful. During the trials I had less call for the RAMM feature but it worked okay and would be useful to many people changing from disc to cassette tape for programme sourcing. This model had the lowest wow and flutter of all, being no more than 0.06% using the TDK AC-342 test tape. It was good having a master recording level control, but rather than the addition of separate left and right channel knobs I prefer the balance control of the 582Z. It is just what you like personally, really.

Results across the board were well up with those of the other two models,

but I was much happier with the fluorescent metering than the red LEDs. Very acceptable small-flux frequency responses were penned with only minimal lack of Dolby integrity, the worse case again being with XLIIS — different Class II tapes coming out better. You might have noted that all the decks had a -20 dB response up to at least 20kHz from 20Hz on all tapes.

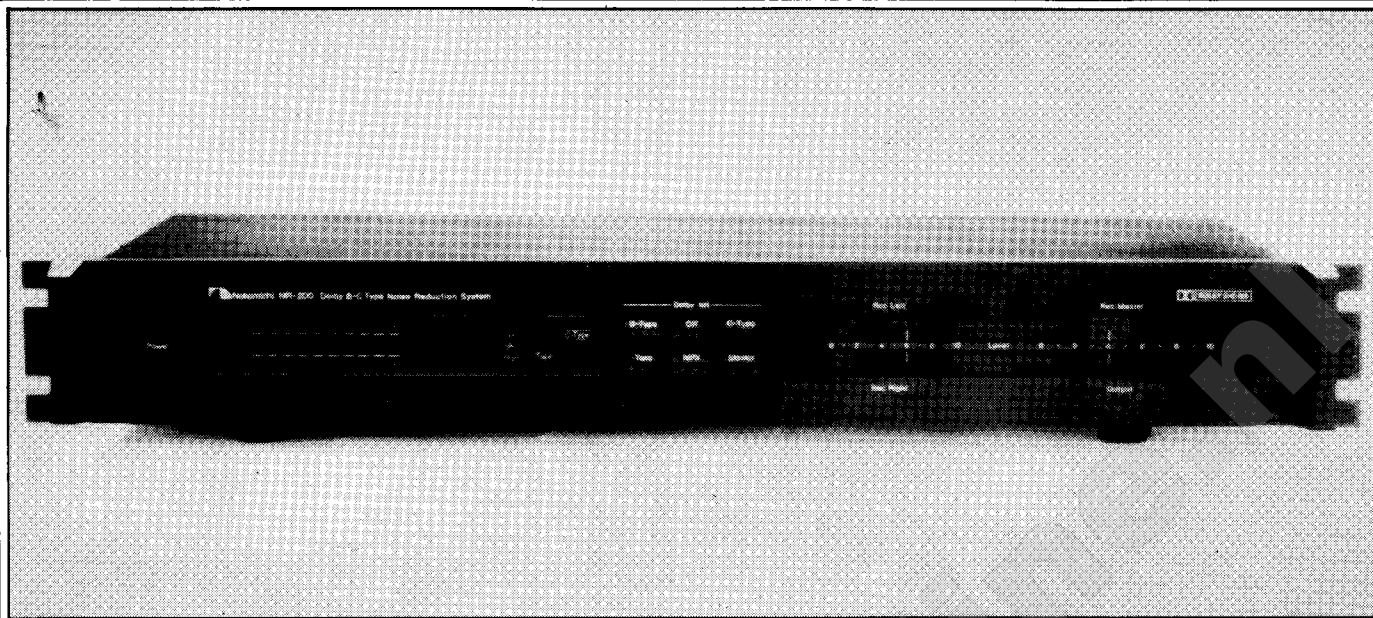
With Dolby B and without Dolby the auditioning of this deck was on par with the others, but I'm sorry to say that Dolby C auditioning was poor. The noise floor was well down, though, being a measured 18.4dB improvement with Maxell MX metal,

but on speech in particular sharp changes in level were marred by a kind of 'puffing' or clicking noise. This effect could also be detected on certain music rich in transient content, especially when the level changes occurred at low-level on the meters.

Further investigations revealed that the trouble was present essentially on the right channel, and I am inclined to agree with the distributor after protracted telephonic discussion that the fault was caused by an IC being out of tolerance or in some other way defective. It was certainly not caused by a shortfall of the Dolby C system, the desirability of which was proved by the other models and NR-200.

NR-200

£185



This unit is designed to be connected between the left and right tape recorder output and input sockets of the parent amplifier and the corresponding sockets on the tape deck. Because the unit adopts separate encode and decode channels it is possible to monitor either the source signal before encoding or the decoded signal from the tape with a three-head deck while the recording is taking place.

It is easy to install and not too difficult to adjust to achieve the correct level balances, these important subjects being clearly and adequately dealt

with in the owner's manual. The rear is equipped with amplifier and tape deck RCA 'phono' interfacing sockets and separate left and right channel record and play level calibration controls.

It is a 'slim-line' unit whose fascia is equipped with the red-glowing LED-type of meters used on the 482Z and 582Z decks. The adjusting involves setting the deck's record and play level controls to maximum and then controlling the recording and play levels by the unit's sliders, ignoring the deck's meters and using those of the unit. There are separate record

level sliders for the left and right channels which run in parallel and facilitate making both adjustments in step. However, you are also given a record level master slider and a slider for replay level adjustment. Press-buttons select Dolby B or C (or off), source/tape monitoring, MPX filtering and a 400Hz Dolby reference level tone oscillator which is used for level setting adjustments. Illuminated indicators show which Dolby mode is selected and whether you are monitoring from tape or source. Calibration marks and numbers against the controls aid resetting.

THE FINDINGS

Although the owner's manual clarifies the setting-up procedure, careful attention to level balancing is essential for the maintenance of good tracking and hence response integrity. The procedure can be somewhat protracted to secure the very best results, but it is certainly worth concentrating on — and once done is set for good unless you inadvertently knock the rear controls. Recessed screwdriver presets I think would have been better.

The meters of both the tape machine and the NR-200 need to be used to establish the Dolby reference levels in conjunction with the inbuilt 400Hz tone oscillator. Despite the readout definition of the NR-200 metering increasing to ± 1 dB (which is the DL datum), when the 400Hz oscillator is switched on I still had a little difficulty in knowing whether I was spot-on or almost 1dB off since it required almost 1dB change in level to get the adjacent LED to indicate. Several attempts gave slightly different overall (encode/decode) response characteristics, especially on Dolby C.

Anyway, I think you will agree that the results shown in the pen charts are very good. The absolute response integrity is also a function of the ICs themselves, so you can imagine the accurate selection that must have been subjected to the NR-200 ICs.

The unit had a very low distortion yield and excellent headroom, with the output clipping being up to the 7V mark! The intrinsic S/N ratio improved by 10.3dB in Dolby B mode and by 13.6dB in Dolby C mode, yet coupled to a cassette deck the Dolby C improvement was as high as 18.9dB with Maxell MX metal tape, comparable to the values obtained from the decks themselves. The B and C improvements with different tapes are listed at the bottom of the NR-200 lab chart.

I also checked the 1kHz squarewave performance with Dolby off, MPX on and Dolby off, and with Dolby B and C on with MPX off, the results being given in Fig. 7 oscillogram.

Coupled to a cassette deck the results were equally as good as from the Dolby B and C circuits in the decks themselves (excluding, of course, the

right channel Dolby C fault of the 682ZX!). Breathing effects were very minimal and it would be nit-picking to dwell on them. Indeed, the differences between Dolby off and Dolby C seemed to be stemming more from the dramatic lowering of the background hiss and the clearer lower-middle, especially noticeable at high reproducing levels and on top-grade programme material and partnering equipment, conditions which normally emphasise the noise limitations of the cassette medium. The improved treble performance and HF headroom of Class I tapes with Dolby C were also apparent on certain music.

Another thing I noticed consistently with the three decks and the noise reduction unit was that the Dolby B noise improvement was better than 10dB — a value generally superior to that achieved by the average Dolby B-only deck. This would appear to be the result of Nakamichi's use of the specially selected low noise Dolby ICs. It is understood that many ICs are rejected during assembly, only the best few passing into the units.

VERDICT

Based on my detailed measurements and listening experiences I have no hesitation in proclaiming that these new Nakamichi decks equally match; if not surpass, the performance of the models which have gone before. Excluding the one

or two curios exposed in the pre-production samples and the obvious right channel fault of the 682ZX, I would say that the designs, including the NR-200, accommodate both Dolby B and C in the way that Dolby Labs and Ray Dolby originally envisaged. It is early days yet to know how well other decks will cater for Dolby C and how close they will come to the realisation

of its full noise-reducing potential (I have no comparative data at all at the moment), but judging from the results of the Nakamichi equipment I think a very high standard has now been set. Dolby C is so much better subjectively than B.

It is impossible to give a 'best buy' verdict. The decks each have their own features and characteristics and

THE EVIDENCE

This is presented in my usual form of lab charts, pen charts and oscillograms which are explained in the captions. I have already referred to some aspects of the technical results so there is no point in going over these again. Points of particular note are the remarkably wide small-flux frequency responses which are all intrinsically 'flat' from 20Hz to 20kHz at least. The undulations on some of the noisereduction curves are due to mild level errors which I have

already explained. The replay-only responses might show less upper-treble droop based on a different test tape, but I am satisfied that the eq of all models was accurately set.

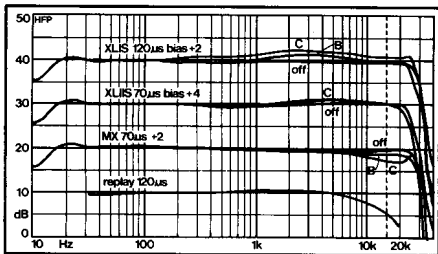
Notice, too, the excellent LF MOLs and how the HF MOLs are improved by the action of Dolby C. This makes it possible to achieve remarkably good results even with Class I tapes. The ultimate in performance, though, is provided by metal in all the decks — this kind of tape being exploited virtually to its maximum.

You will see that I have given the S/N ratios of all the tapes with Dolby off, B and C on, so you can see just how much improvement there is with the two types of noise reduction.

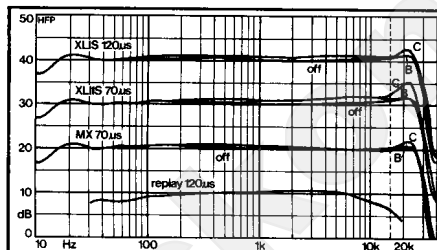
For metal tapes I have indicated the Dolby C noise improvement separately for each deck, the 582Z coming out best on this measurement. I have also given the isolation between the record and replay channels at 20kHz. This is rather important with three-head decks giving off-tape monitoring. The

average was 36.5dB, which is pretty good at this high frequency. All models provided adequate erasure.

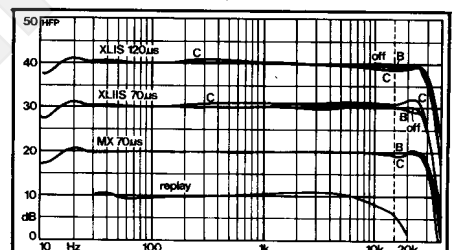
Line input S/N ratios were all high, necessarily so to ensure that Dolby C can be fully exploited, and the meters of all models had no under-reading at all on 20ms bursts, so they can be regarded as true peak-responding. In all cases the W&F was very low, the best results obtaining from the 682ZX. Headphone yield was sufficiently high even across 8ohms.



482Z

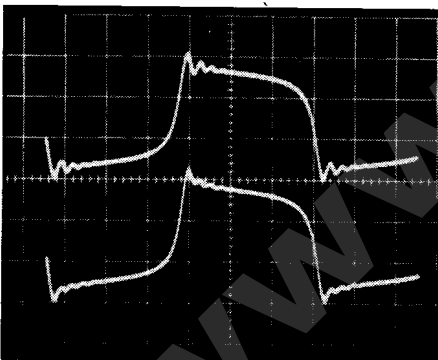


582Z

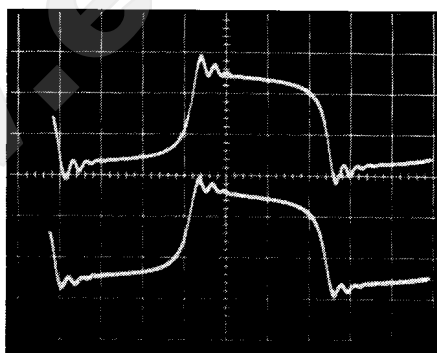


682Z

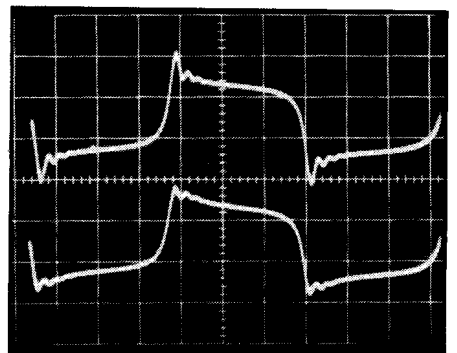
Fig. 1. Overall frequency responses at -20dB recorded level with Class I, II and IV tapes indicated over 10Hz-40kHz showing Dolby integrity. Lower curve replay response at $120\mu\text{s}$ using BASF test tape.



482Z



582Z



682Z

Fig. 2. Squarewaves 1kHz overall, with MX tape. Upper without noise reduction and lower with Dolby.

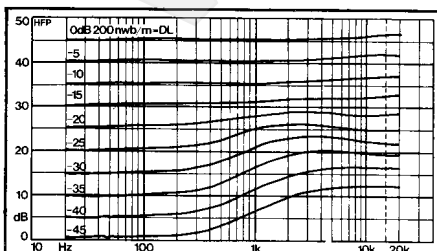


Fig. 3. NR-200 Dolby B encoding responses over 20Hz-20kHz at 5dB input level steps from 0dB to -45dB .

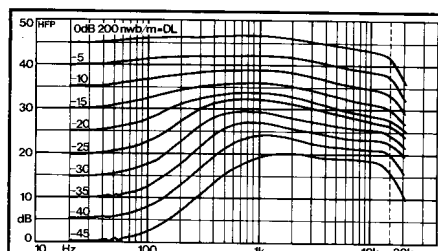


Fig. 4. NR-200 Dolby C encoding responses over 20Hz-20kHz at 5dB input level steps from 0dB to -45dB

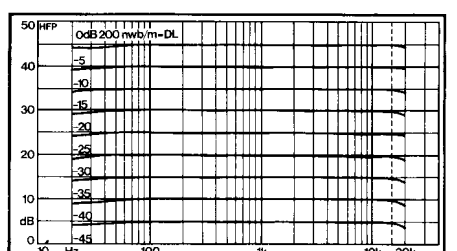


Fig. 5. NR-200 Dolby B overall encoding/decoding responses over 20Hz-20kHz at 5dB input level steps from 0dB to -45dB .

they range fairly widely in price. All models are more expensive than the 'average' class of deck — but the performance of these Nakamichis is well above average. The 582Z has a good bit going for it and it is more of a 'domestic looking' deck than the others. My preference veers more towards the 682ZX with its auto azimuth and level setting, but I don't think

personally I would have all that much call for the RAMM. I liked the fluorescent metering more than the LEDs of the other models.

With the 482Z, the choice of tapes for the best Dolby integrity might be more critical owing to the lack of user Dolby reference level setting; but, once you have selected the tapes of your liking and optimised the adjustments on

these, this limitation won't bother you. The NR-200 is undoubtedly a high class noise reduction unit and is reasonably priced. It will link to most decks, so if you have a recent deck of good design and performance the unit would bring you right up to date with Dolby C and possibly give you better Dolby B performance to boot, (if you ever use B again after C!).

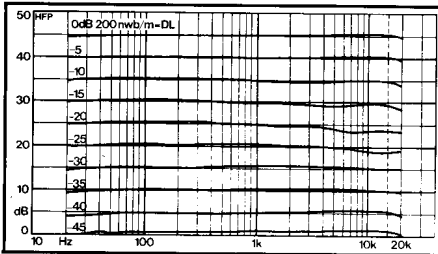


Fig. 6. NR-200 Dolby C encoding/decoding responses over 20Hz-20kHz at 5dB input level steps from 0dB to -45dB. Response accuracy is very critical of level setting (see text).

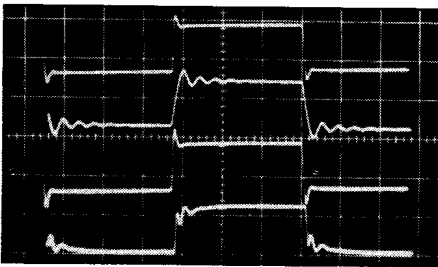


Fig. 7. NR-200 overall squarewave performance at 1kHz. Upper Dolby off, 2nd Dolby off MPX filter on, 3rd Dolby B on MPX filter off and 4th Dolby C on MPX filter off.

NAKAMICHI NR-200 DOLBY B/C NOISE REDUCTION UNIT

Distortion 1kHz overall	0.005% 2nd harmonic only
0dB Dolby level	0.05% 2nd and 0.007% 3rd harmonic
+10dB	
Input for 500mV output	
1kHz overall	48mV level control maximum
Output clipping level 1kHz	7V
Calibration tone frequency	406Hz
Calibration tone output at DL	568mV
MPX filter -3dB frequency	16,722Hz (very fast roll-off)
Replay S/N ratios ref. DL (CCIR/ARM)	
Dolby off	64.7dB
Dolby B	75.0dB
Dolby C	78.3dB
Meters	16 red LEDs -40 to +10dB (first always lit); no under-reading of 20ms bursts

NOISE IMPROVEMENT WITH NR-200 LINKED TO 482Z

Tape	Dolby B	Dolby C
XLIS	10.4dB	18dB
XLIS	10.3dB	18.1dB
MX	10.4dB	18.9dB
Scotch Master II	10.4dB	18.2dB

PERFORMANCE COMPARISON

	482Z	582Z	682Z
Output 0dB high-Z (mV):	670	zero to 1,200 variable	0 to 1,000 (variable)
Meters at 0dB read:	+3dB	0dB	0dB
Input for 0dB record control max line (mV):	60	55	50
microphone (mV):	no mike i/p	no mike i/p	no mike i/p
Headroom at 400Hz			
line i/p for 1% distortion (dB):	>46	>46	>46
microphone ditto (dB):	no mike i/p	no mike i/p	no mike i/p
replay distortion (%):	0.035 + 10dB o/p monitor mode	<0.01 + 10dB monitor mode	0.018 + 10dB o/p monitor mode
Signal/noise ratios ref 0dB			
line i/p ref 500mV (loaded) (dB):	83.6/68.6uw (level 1/2 on)	81.5/69.5uw (level 1/2 on)	82.5/62.7uw (level 1/2 on master maximum)
mic i/p ref 5mV (loaded) (dB):	no mike i/p	no mike i/p	no mike i/p
replay (dB)/unweighted (dB):	58/53	56.7	58.4/50.5
70µs improvement (dB):	2.5	2.6	3
noise reduction improvement (dB):	Dolby B 10.4/Dolby C 16	10.6 Dolby B/17.5 Dolby C	10.4 Dolby B/16.3 Dolby C
overall with XLIS (dB):	49.4 (B 59.9; C 68.1)	48 (58.5 B; 67.5 C)	47.8 (B 58.3; C 66.5)
overall with MX (dB):	50.3 (B 60.6; C 68.6)	59.5 (60.2 B; 69 C)	50.2 (B 59.6; C 68.6)
overall with Scotch Master II (dB):	55.4 (B 65.5; C 71.8)	54.5 (64.6 B; 71.3 C)	55.8 (B 66.0; C 73.0)
Distortion 400Hz 0dB			
overall with XLIS (%):	0.45	0.4	0.34
overall with XLIS (%):	0.85 (All with Dolby B on)	0.8 (All with Dolby B on)	0.75 (All with Dolby B on)
overall with MX (%):	0.3	0.27	0.25
LF MOL 400Hz for 3% distortion			
with XLIS (dB):	+7. XLIS: +4dB	+7.5. XLIS: +4.5	+8. XLIS: +5
with MX (dB):	+9.5	+10	+10
HF MOL 10 + 11kHz for 3% 3rd-order IMD			
with XLIS (peak dB):	-6 (-1.5 C)	-5 (-1.5 C)	-5 (-1 C)
with XLIS (peak dB):	-9 (-5 C)	-7 (-4 C)	-7 (-3.5 C)
with MX (peak dB):	-3 (+1 C)	-2.5 (+1 C)	-2.5 (+1 C)
Wow & flutter replay (%):/speed error (%):	0.07/+0.3	0.08/-0.4	0.06/-0.3 with pitch zero
Erase ratio (dB)	below noise floor	below noise	below noise
Stereo separation 1kHz (dB):	44	53	54
Headphone o/p 600/200/8ohms (mV): (at 0dB):	low: 640/580/112	zero to 1,000/900/160	zero to 950/810/143
	high: 690/670/300	variable	(variable)
	0 (slow decay) 16 LEDs 1st always lit	0 (slow decay) 16 LEDs -40 to +10 1st always lit	0 (slow decay) (-40 to +10 dB)
Meters under-read on 20ms bursts by (dB):			
Fast rewind time (sec for C90):	71	77	72
Dolby C noise improvement with MX:	18.3dB	18.4dB	19.5dB
Record/play isolation 20kHz, 120µs, Dolby & MPX off:	37dB	38dB	34.5dB
0dB references correspond to 200nWb/m recorded flux at 400Hz			



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