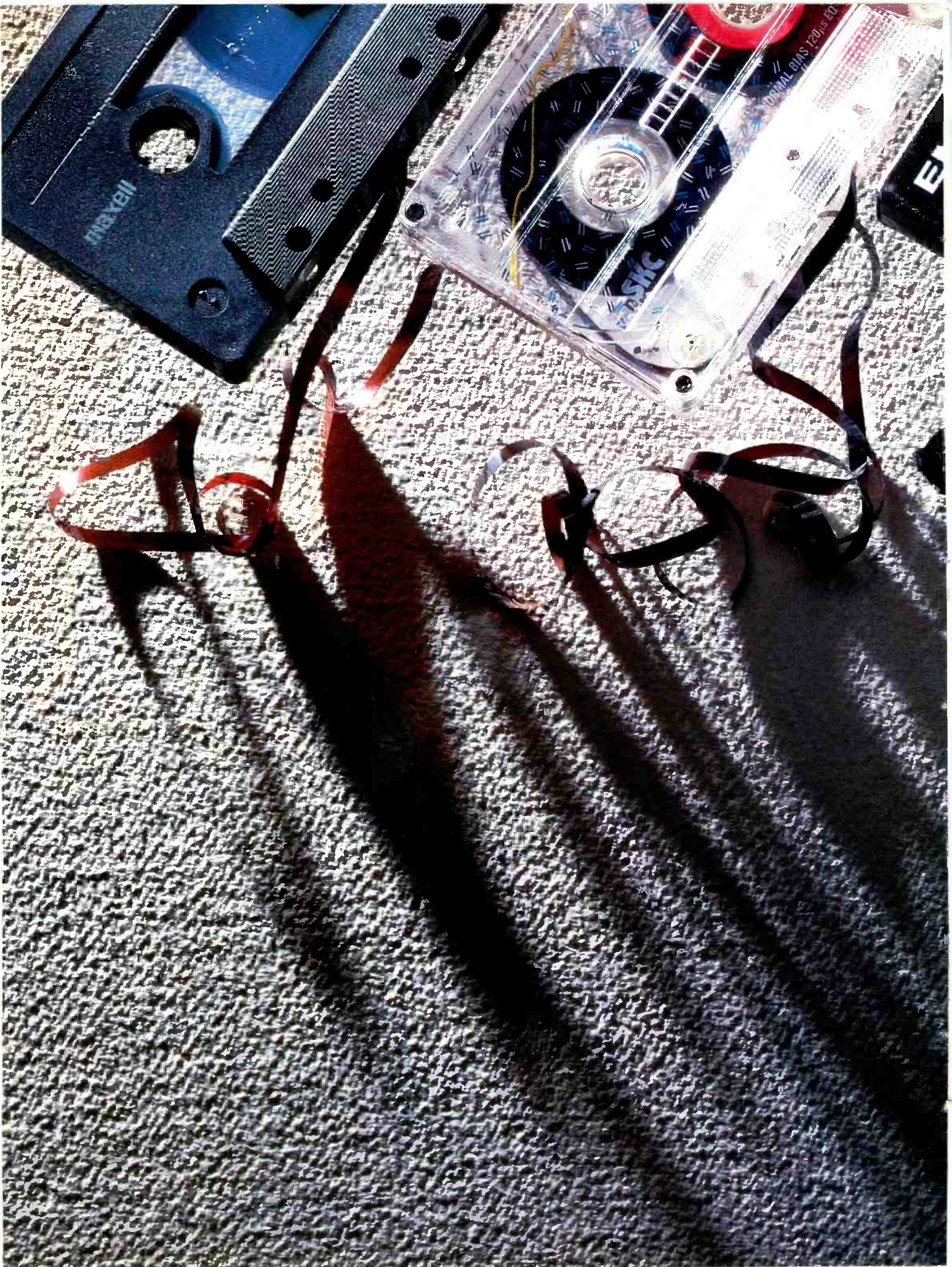

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MASS CASSETTE TEST: WE REVIEW 35 NEW TAPES

HOWARD A. ROBERSON

In June 1986, we published a "Cassette Test Update" covering 49 tapes. This follow-up survey covers 35 new or modified formulations: Seven from Denon, two from Fuji, three from Maxell, five from Memorex (made by Memtek Products), four from SKC, seven from Sony, four from TDK, and three from Triad. The manufacturers' descriptions of their new tapes are quoted or cited below. It is probable that, in a number of cases, tapes were changed in ways that were not mentioned in the limited literature which accompanied the samples I received.

The Denon tapes are DX1, DX3, and DX4 (Type I); HD6, HD7, and HD8 (Type II) and HD-M (Type IV). Their names have remained the same but their formulations have improved, and they have new shells and packaging. The exception is HD-M, which has been updated in minor ways but will be subject to the same major changes in the near future.

The Fuji tapes are FF-I Super (Type I) and FR-II Super (Type II); FR-II remains in the product line. FR-I Super offers Fuji's exclusive coating technology and cobalt-modified Fine Beridox magnetic particles. FR-II Super uses Super-Fine Beridox particles. Fuji states the two formulations have reduced bias and modulation noise.

The Maxell tapes are XLI-S (Type I), XLII-S (Type II), and MX (Type IV)—the same names as before. Maxell states that the new SS-PA (Super-Silent Phase-Accuracy) cassette mechanism "effectively reduces modulation noise, tape running noise and mechanical handling noise." The shell is precision-made out of a resonance-damping material, and it uses S-TA (Silent Tri-Arch) slip sheets with a "special coating treatment." Other features are the BF (Best Fit) pressure pad, two-piece QL (Quin-Lok) hubs for perfect circularity and smooth running, and SS (Super Smoothing) guide rollers to minimize vibration and reduce tension irregularities. The XLI-S and XLII-S formulations use new Superfine Epitaxial particles and new coating technology. The MX tape uses a new SSP (Super Stabilized Pure) particle with unprecedentedly small size and high resistance to oxidation. All of the tapes use a new binding treatment for increased durability and toughness.

The Memorex tapes are dBS and MRX I (Type I) and HB II, HBX II, and CDX II (Type II). Note that there is no

Photograph: Robert Lewis

Many of the latest cassette shells incorporate features designed to reduce resonance, vibration, and modulation noise.

Memorex Type IV tape. The manufacturer's position is that many decks are not really suited to such tapes, delivering high distortion with Type IV because of limited bias current and inadequate head designs. The dBS tape is a new entry, said to offer "performance and value." Its clear plastic shell has a "finely engineered mechanism" for smooth running. MRX I and HB II also have clear shells. The MRX I formulation uses ferric oxide, while HB II uses crystal ferrite. HBX II has "superior sensitivity to deliver greater 'sound presence.' " CDX II is claimed to have better-than-metal performance, but at the Type II bias setting; it is said to push MOL limits to new highs.

The tapes from SKC are GX and AX (Type I), QX (Type II), and ZX (Type IV). These are the first audio tapes from this major South Korean manufacturer to carry their own brand. All of the formulations come in the C-46 length, and the GX is also available as a C-120. GX uses a special ferric oxide for high output and offers "full dynamic range with excellent signal-to-noise ratio." The AX and QX tapes have wide-window, high-precision shells. The AX has an "exclusive particle formulation for superior fidelity," and the QX has a "superior high-bias tape formulation and ultra-high density tape finish" to provide extended high-frequency response. The SKC ZX metal tape has a "precision cassette shell for superior alignment and greater guidance accuracy." It is said to have specially treated pure iron particles for extended frequency response.

The Sony tapes are HF and HF-S (Type I); UX, UX-S, UX-ES, and UX-PRO (Type II), and Metal-ES (Type IV). In this case, the names for the Type I and Type IV tapes remain unchanged, but the Type II formulation names are new, replacing UCX and UCX-S. In their literature, Sony presents the new Type I and IV formulations as having higher sensitivity and greater high-frequency output than the previous versions. The manufacturer describes the particles for UX, UX-S, UX-ES, and UX-PRO as Micro-Fine Uniaxial, Super-Fine Super Uniaxial, Ultra-Fine Power Uniaxial, and Ultra-Fine High-Power Uniaxial, respectively.

Sony states that the rigidity and high precision of its latest shell design help reduce modulation noise and vibration in HF-S and all of its new Type II cassettes. The UX-PRO shell has unique ceramic tape guides for further improvements in this area, to gain "unexcelled sound purity." Metal-ES has a newly designed three-plate, high-precision shell for added rigidity and lowered vibration. This tape has ultra-fine Extralloy particles "in unique double-coating magnetic layers for reduced noise and expanded performance."

The four TDK tapes are AD-S (Type I), SA-XG (Type II), and MA-X and MA-XG (Type IV). AD-S has the same formulation as AD but uses a high-tech, see-through cassette design. The new shell has high rigidity and is made from a vibration-damping plastic to control resonances. SA-XG is said to be engineered to deliver the lowest bias noise and the finest audio performance available from a Type II tape. The MA-X metal-particle tape uses a newly developed two-layer plastic mechanism and an improved Finavinx formulation. The mechanism is constructed with special dual-layer shell halves for reduced resonance and superior tape-to-head contact. The shell halves are designed specifically for best tape transportability, and the plastic used increases the shell's rigidity. The shells have new slipsheets to ensure smooth tape travel and accurate winding while reducing flutter and transport noise. Other features include mono-molded hubs for improved surface smoothness and precise circularity, a new dual-spring pressure pad, and seamless guide rollers.

The new SA-XG and MA-XG tapes are the same magnetically as SA-X (introduced earlier) and MA-X, respectively. They use, however, the new three-layer RS-II cassette-shell mechanism with a die-cast metal-alloy frame. The high-performance mechanism "virtually eliminates sympathetic vibration and provides optimum precision in tape travel." The mechanism uses four ultra-precise guide pins to suppress the generation of modulation noise for "the purest, clearest sound."

The Triad tapes are F-X (Type I), EM-X (Type II), and MG-X (Type IV). All three are housed in Triad's Delta transport mechanism, which features a unique slip pad with a hub-tensioning device. The manufacturer claims that extended headroom, wide dynamic range, and high signal-to-noise ratio make all three formulations "ideal" for the "digital medium." Triad gives credit to the "unique cobalt saturation method" used for F-X, the technologically advanced process making the metal particles for the Type II EM-X, and the "near perfect" uniformity of size and composition of the MG-X particles.

TEST METHODS

The manufacturers supplied three samples of each formulation evaluated. I examined the packaging and unwrapped the samples, noting any pull-tag instructions. Every sample was fast-wound once in each direction before any other tests.

I used a Nakamichi CR-7A deck for the great majority of the record/playback tests; I also used a Nakamichi 582 recorder for some tests. Bias and sensitivity figures were measured relative to the IEC Type I, II, and IV reference tapes. A meter, in its relative-dB mode, measured bias at an internal point in the 582 deck. The 582's calibration tone was the source for measuring sensitivity in dB.

For other tests, the automatic calibration function of the CR-7A set the bias and the alignment of the playback head to the record head. I made swept-sinusoid plots at Dolby level (200 nWb/m at 400 Hz). The −3 dB points at the high-frequency end were measured at the same level. Let me emphasize here that although there are references to Dolby level, no tests were run with any noise reduction.

Maximum output levels (MOLs) were measured at 100 and 400 Hz and at 1, 2.5, 6, 10, and 15 kHz. I have changed the test frequencies I've used in the past. Chiefly, this was done to add 15 kHz, as recent examination of CD output spectra has shown that they can have significant energy up to about this frequency. Some other frequencies were then changed to provide more even spacing up to 15 kHz.

All MOLs were measured with a distortion limit of 3%. For the three lowest frequencies, the limit was 3% HDL_3 (third-harmonic distortion). For the four highest frequencies, the limit was 3% TTIM (twin-tone IM) distortion, using the two tones 400 Hz above and 400 Hz below the stated test frequency. In

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TABLE I—MEASURED DATA

Type	Tape	Maximum Output Level (dB, re: 400-Hz Dolby Level) HDL$_3$ = 3% 100	400	1k	TTIM = 3% 2.5k	10k	15k	S/N Ratio (dBA)	Response At −3 dB For 0-dB Level (kHz)	Mod. Noise (dB)	Bias (dB)	Sens. (dB)
TYPE I	Denon DX1	+4.4	+4.3	+4.3	+0.5	−8.4	−14.8	57.3	9.7	−45.4	+0.3	−1.1
	Denon DX3	+8.0	+7.9	+6.8	+2.4	−7.2	−14.0	59.6	10.3	−45.7	+0.2	+0.8
	Denon DX4	+8.7	+7.9	+6.6	+2.3	−7.0	−13.5	59.1	10.5	−46.3	0.0	+1.0
	Fuji FR-I Super	+7.2	+7.9	+7.4	+1.9	−6.5	−13.4	60.1	10.2	−48.7	+0.9	+0.2
	Maxell XLI-S	+6.6	+6.3	+4.8	−0.5	−9.8	−15.4	59.4	10.0	−45.2	+0.6	+0.9
	Memorex dBS	+4.3	+3.8	+3.1	−0.1	−8.6	−15.4	55.8	10.2	−47.2	−0.2	−0.4
	Memorex MRX I	+5.9	+5.5	+4.7	+0.2	−8.6	−15.0	57.5	10.3	−44.4	0.0	0.0
	SKC GX	+4.8	+5.1	+4.9	+0.2	−8.0	−14.9	55.5	9.9	−48.2	+0.2	−0.3
	SKC AX	+6.1	+5.8	+4.9	+1.7	−8.1	−13.9	56.8	10.5	−45.5	+0.3	−0.2
	Sony HF	+3.5	+3.9	+4.7	+0.7	−8.3	−15.1	54.2	10.3	−48.3	+0.2	−1.0
	Sony HF-S	+6.1	+6.4	+6.4	+1.2	−7.2	−14.4	58.6	11.0	−48.2	+0.4	+0.5
	TDK AD-S	+6.2	+6.4	+6.2	+1.4	−6.8	−14.2	59.9	10.7	−45.0	+0.6	+0.2
	Triad F-X	+7.4	+7.3	+6.8	+1.7	−7.1	−14.0	60.3	10.5	−48.6	+0.9	+0.3
TYPE II	Denon HD6	+4.7	+5.0	+4.2	−2.2	−9.7	−14.6	61.8	9.3	−50.9	+0.7	+1.9
	Denon HD7	+5.1	+5.4	+4.5	−2.3	−9.7	−14.6	62.1	9.0	−50.7	+0.7	+2.0
	Denon HD8	+4.7	+5.0	+4.4	−2.2	−9.6	−14.4	61.8	9.6	−50.3	+0.7	+2.0
	Fuji FR-II Super	+5.5	+5.0	+4.2	−1.7	−8.8	−14.0	61.5	9.9	−50.8	+0.2	+1.6
	Maxell XLII-S	+4.6	+4.4	+2.5	−5.0	−11.5	−15.2	61.7	7.1	−49.4	+1.1	+1.6
	Memorex HB II	+3.0	+3.2	+2.4	−2.7	−9.5	−14.8	59.4	9.6	−42.7	+0.2	+0.8
	Memorex HBX II	+4.1	+4.2	+3.6	−2.2	−9.5	−14.4	59.7	10.1	−47.6	+0.3	+1.9
	Memorex CDX II	+4.2	+4.9	+4.3	−1.2	−8.4	−14.6	58.9	12.1	−45.2	+1.8	+3.5
	SKC QX	+1.6	+1.5	+0.9	−3.9	−10.4	−15.1	56.5	9.2	−51.0	+0.3	+1.2
	Sony UX	+4.0	+4.0	+3.1	−3.1	−10.0	−15.4	59.6	9.4	−48.6	+0.2	+1.5
	Sony UX-S	+4.8	+5.0	+4.1	−2.4	−9.5	−15.2	59.5	9.8	−51.7	+0.8	+1.9
	Sony UX-ES	+6.3	+6.4	+5.9	−1.1	−8.6	−14.8	62.0	10.6	−52.2	+1.2	+1.6
	Sony UX-PRO	+6.4	+6.7	+6.1	−1.0	−8.2	−14.1	62.5	10.5	−52.4	+1.4	+1.4
	TDK SA-XG	+4.5	+4.6	+3.1	−4.4	−11.3	−14.4	62.9	7.1	−49.7	+1.0	+2.6
	Triad EM-X	+4.0	+4.0	+3.0	−1.7	−6.7	−10.2	58.5	12.1	−47.4	+1.6	+2.8
TYPE IV	Denon HD-M	+5.4	+5.3	+4.3	−1.2	−6.8	−9.9	62.2	12.8	−43.8	−0.2	+0.4
	Maxell MX	+6.6	+7.2	+6.4	+0.2	−5.8	−10.3	63.7	13.1	−52.3	+0.7	0.0
	SKC ZX	+8.1	+8.2	+7.6	+1.1	−5.1	−9.7	62.3	13.4	−51.8	+0.4	+1.0
	Sony Metal-ES	+11.3	+11.9	+9.3	+1.6	−5.4	−9.5	68.0	13.7	−53.5	+1.6	+2.3
	TDK MA-X	+8.1	+8.6	+8.2	+1.2	−5.0	−9.9	64.1	13.5	−51.4	+0.8	+0.6
	TDK MA-XG	+8.0	+8.5	+8.3	+1.4	−4.9	−9.9	64.5	13.7	−52.7	+0.9	+0.3
	Triad MG-X	+6.9	+7.0	+6.2	+0.9	−5.5	−9.8	61.0	13.0	−49.2	−0.1	+0.5

the accompanying graphs of performance versus frequency, the MOL measurements were used to plot the dashed curves.

Signal-to-noise ratio was measured as the difference between the signal level that caused 3% distortion at 400 Hz and tape noise measured with IEC A-weighting. A 3-kHz tone was recorded and played back to assess flutter. Once again, I remind readers that the results are just general indications: The deck has a considerable effect on the exact flutter measurement with any tape. The same 3-kHz tone was used to test for dropouts and to determine the degree of level stability at this moderately high frequency. I measured modulation noise with a high-level 1-kHz test tone which was phase-cancelled and filtered out in the playback so that only noise would remain. This noise was then band-limited to the range from 500 to 1,500 Hz and passed to a meter. The meter was referenced to the playback level of the 1-kHz test tone without the filtering and cancellation.

USE TESTS

It was easy to remove the wrap on all samples. As a group, the Sony samples were the easiest to unwrap, followed closely by those from Fuji and TDK, with the Maxell and Triad samples close behind them. The Denon

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Reading the MOL curves for the tape you prefer can help you judge the proper level settings to use when recording.

pull tabs were a little hard to start but worked very well after that. Some of the Memorex tabs were easy to find and pull; some were not. The SKC tabs were not marked, and some were hard to find and pull.

All of the samples were quiet during fast winding, except for a couple of the Memorex HB II and SKC GX samples. Maxell XLII-S and TDK MA-X were the quietest of all, with the Fuji and Triad samples not far behind.

Most of the cassettes offer tactile clues for telling side A from side B. This is very helpful for those with vision problems or for situations in which visual inspection would be difficult, such as while driving a car. Most of the Denon tapes have raised "A" and "B" markings on the appropriate sides, but these letters were not easy to pick out by feel. The "A" and "B" on Denon's HD8 shells, however, are incised rather than raised, in an arty typeface that was easy to feel.

I congratulate Fuji for including "A" and "B" in Braille on their shell halves. (The dot patterns can be decoded by the sighted as well as the blind.) I hope other manufacturers follow Fuji's lead.

The Maxell cassettes have a single raised dot at the left for side A and a double dot in the same place for side B. The Memorex HBX II and CDX II shells have raised letters, but they were difficult to decipher. The other tapes in the line have printed letters, impossible to detect by feel. It was possible to pick out the "A" (raised) or "B" (incised) on the SKC GX cassette, but the other tapes in the SKC line had no tactile clues.

The Sony cassettes have a raised "A" on the left, while the "B," in the same relative position, is slightly incised. This makes for easy selection by touch. Little arrows point to the location of the erase-prevention tabs for the side in use.

TDK's AD-S and MA-X shells use dots on the right side (one dot for "A" and two for "B"). These tapes also have raised letters, "A" and "B," which I could sense correctly with a fingertip. The TDK MA-XG shells offer no tactile clues as to which side is being touched. The snap-out erase-prevention tabs on this tape can be snapped back in again—a handy feature.

Triad tapes have no raised letters to provide tactile clues as to which side is which. However, the triangular view windows, which point in different directions according to which side is up, do make it easy to select the side you want by looking.

All of the cassettes (Denon's DX1 excepted) are supplied with pressure-sensitive labels, but there are some differences. Most of the Denon tapes have fairly wide labels for the two sides, plus narrow labels that can be placed on the long edge of the shell. This certainly is helpful when tapes are stored with their spines showing. The HD8 side labels are fairly narrow, but there are also little "No." labels that fit into an indented square at the right end of each side of the shell. The Fuji labels are reasonably wide, and stick-on numbers are supplied for easy encoding if desired. The Maxell labels are a good size but have many fine lines which might be more confusing than helpful to some users.

The Memorex labels are rather narrow, and their shiny surfaces would be hard to write on except with a ball point pen. Most of the SKC labels are slightly narrow, but it was easy to write on them. Most of the Sony labels are quite narrow, although the labels for HF tape are wide and easy to use.

The TDK labels are wide, which is good, but I needed a ball point to mark the shiny MA-XG labels. Because of the triangular shape of the Triad view windows, their shells do not take full-width labels. The small labels supplied don't leave much room for writing information, and they are gray, which reduces legibility.

MEASUREMENTS

Most of my previous tape surveys have presented data obtained only with a Nakamichi 582 deck and supporting instrumentation. In this survey, as I've said, the majority of the data was secured with a Nakamichi CR-7A deck, using its automatic calibration feature. There was no doubt about the convenience of its automation, but I did wonder how the results obtained with it, particularly the MOL figures, would compare to those I had obtained with the 582 in previous tests. In a detailed comparison, I found that, on the average, 100-Hz MOL readings were 0.7 dB higher with the CR-7A than with the 582, 400-Hz MOL readings were 0.1 dB lower, and 1-kHz MOL readings were 0.8 dB higher. There was, however, little difference between the higher-frequency MOLs (re: 3% TTIM) obtained from the two decks, and relative performance for all tapes was the same regardless of the deck used. However, I got more consistent results in rechecks with the CR-7A, which was therefore used as the source for all MOL data. The 582 was used to check puzzling results.

In my previous surveys, I have presented a table of data to summarize results. Such tables show a lot of detail, but they are difficult to use when making comparisons or absolute judgments. After toying with various forms of bar graphs and pie charts, I have arrived at a combination which I hope meets the goals of accuracy *and* visual effectiveness: The table of Measured Data, graphs of performance versus frequency, and pie charts.

For the pie charts, I have selected six parameters to be shown for each tape: 0-dB response (the −3 dB point at Dolby level), low-frequency MOL (at 400 Hz), modulation noise, "consistency," high-frequency MOL (at 10 kHz), and S/N ratio. All are self-explanatory except for "consistency," a catch-all term covering eight parameters. These are: 10-kHz skew consistency between the tape's two directions of travel, consistency of bias requirements and sensitivity with the IEC Standards, consistency of bias requirements and sensitivity among samples, consistency of playback level at 3 kHz throughout a sample, maximum occasional dropout, and flutter (speed consistency). All are measured in dB, with the exception of flutter; it is ranked as 0 for low, 1 for average, and 2 for high. A perfect "consistency" score would be zero, and I arbitrarily set 20 as the worst possible result.

I have some question whether offset from IEC reference bias and sensitivity should be considered a deviation from perfection. I have therefore weighted my scale so that each 1-dB offset from IEC Standards would reduce a tape's total performance rating by only 1%.

The angles of the pie segments were selected to correspond to the importance of the parameter. I allotted 75° each for 400-Hz MOL and 0-dB re-

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sponse; 60° each for S/N ratio, 10-kHz MOL, and consistency, and 30° for modulation noise. In each segment, the area filled in from the center shows how that formulation's performance compared to the worst (0%) and best (100%) results that I have ever measured. The overall performance figure is the sum of the six percentages, weighted according to their respective contributions and using the same weighting as in the pie-chart diagrams.

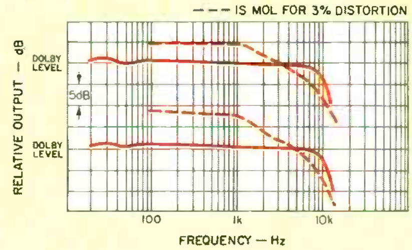
The actual figures for each parameter are indicated on the pie charts. The figures for low-frequency and high-frequency MOL and for modulation noise are in dB. The figures for S/N are in dBA, and those for 0-dB response are in kHz. Consistency, as mentioned before, is just a number ranking between 0 (perfect) and 20 (worst ever).

The MOL curves, shown on the 0-dB swept-frequency plots, can be used to derive MOL figures for the frequencies not covered by the pie charts. There is a good correlation between the 400-Hz MOL and the other low-frequency MOLs shown in Table I, and between the 10-kHz MOL and the other high-frequency MOLs. MOL varies only slightly between tapes of the same type, but greater variations exist between tape types. Note that distortion at the 0-dB level is less than 3% wherever the solid curve is below the dashed curve and is more than 3% wherever the situation is reversed. The MOL curve is of particular help, therefore, in judging the necessary limits in recording levels relative to the high-frequency energy in the music.

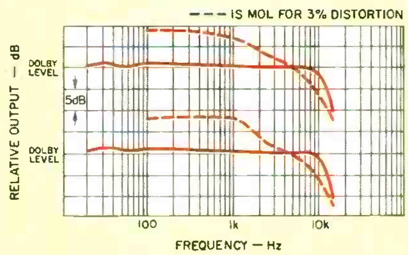
My comments on each of the tapes are arranged alphabetically by manufacturer within each tape type. Most of these tapes showed good consistency, and so no details will be given for this performance category unless something about a given tape is particularly good—or bad.

TYPE I

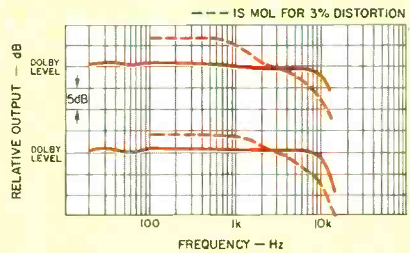
Denon DX1 (top) and DX3



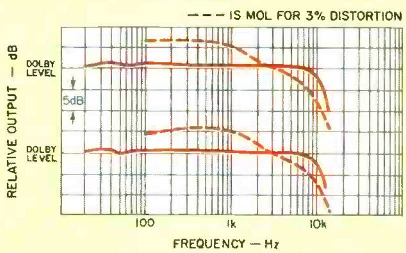
Denon DX4 (top) and Fuji FR-I Super



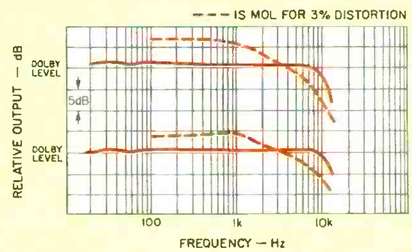
Maxell XLI-S (top) and Memorex dBS



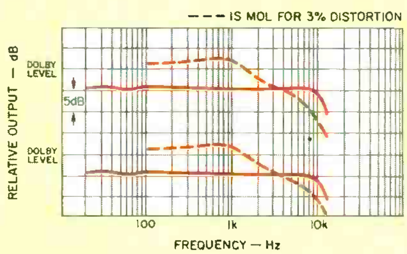
Memorex MRX I (top) and SKC GX



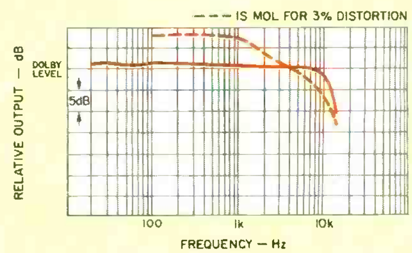
SKC AX (top) and Sony HF



Sony HF-S (top) and TDK AD-S



Triad F-X



TYPE I TAPES

Type I tapes can have fairly high MOLs across the band. However, they have neither high MOLs at the highest frequencies nor really extended response at 0 dB, though they are usually better than Type II tapes in these respects. The best-performing Type I tapes, with 400-Hz MOLs of +6 dB or more, match the S/N ratios of many Type II tapes. The Type I overall ratings do not go much beyond 60% at this time because their performance (except for consistency) cannot match that of Type IV tapes.

Denon DX1: Its overall performance rating (46%) indicates that DX1 would be best used for noncritical purposes.

Denon DX3: This formulation is a considerable improvement over DX1. It is a well-balanced tape, giving good results for all parameters. Its 60% performance rating is one of the best for Type I tapes, equal or superior to that for most of the Type II tapes in this survey.

Denon DX4: This tape's 61% perfor-

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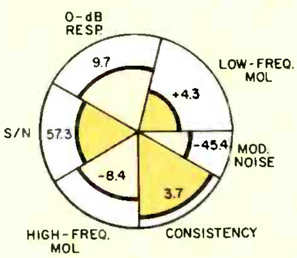
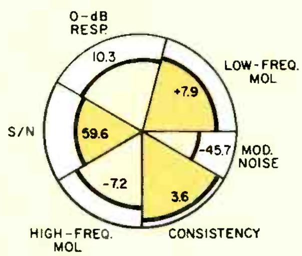
TYPE I

Denon DX1



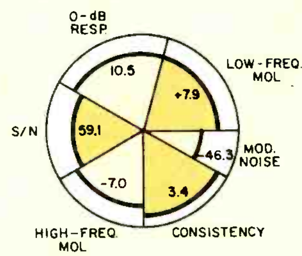
OVERALL PERFORMANCE: 46%

Denon DX3



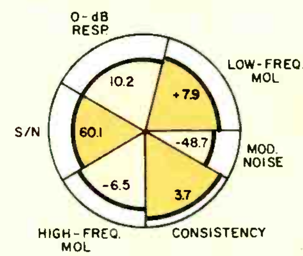
OVERALL PERFORMANCE: 60%

Denon DX4



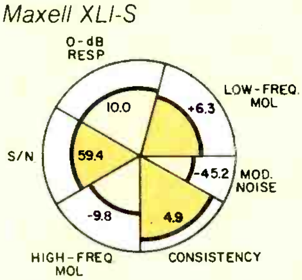
OVERALL PERFORMANCE: 61%

Fuji FR-I Super



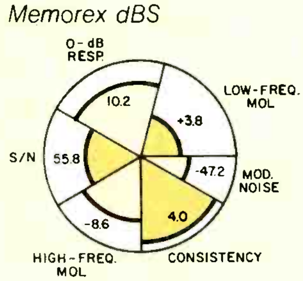
OVERALL PERFORMANCE: 62%

Maxell XLI-S



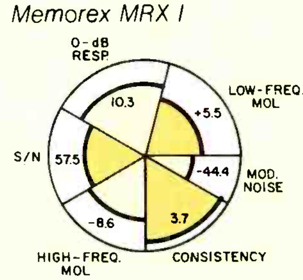
OVERALL PERFORMANCE: 50%

Memorex dBS



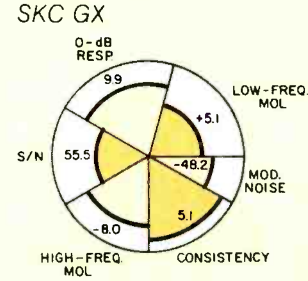
OVERALL PERFORMANCE: 45%

Memorex MRX I



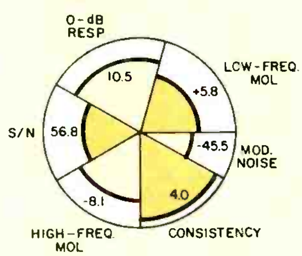
OVERALL PERFORMANCE: 50%

SKC GX



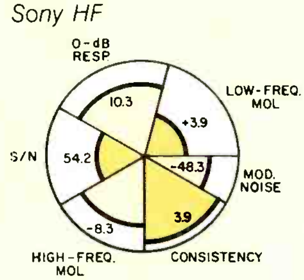
OVERALL PERFORMANCE: 48%

SKC AX



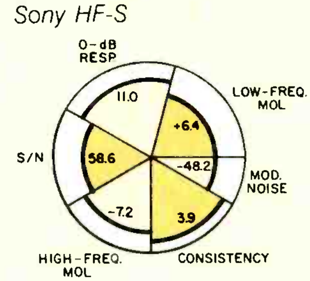
OVERALL PERFORMANCE: 51%

Sony HF



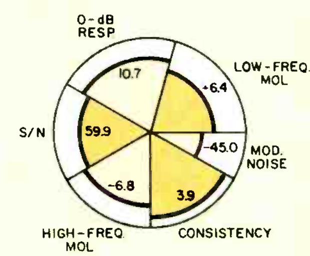
OVERALL PERFORMANCE: 46%

Sony HF-S



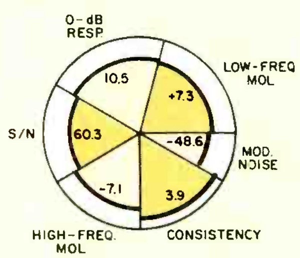
OVERALL PERFORMANCE: 58%

TDK AD-S



OVERALL PERFORMANCE: 58%

Triad F-X



OVERALL PERFORMANCE: 61%

mance rating earns it a tie for second place among the Type I formulations and puts it just above the best Type II. It is little different from DX3, as shown by its 1% performance advantage.

Fuji FR-I Super: Low modulation noise, a high S/N ratio, and a good 10-kHz MOL combine to give this formulation the highest rating of any Type I tape: 62%. This figure is better than that for any of the Type IIs and close to one of the Type IV tapes.

Maxell XLI-S: This formulation was a bit of a disappointment, with low MOLs and high modulation noise. Consistency was poorer than for most tapes because of high bias and sensitivity, measurable skew, 3-kHz level wandering, and dropouts. Overall: 50%.

Memorex dBS: Poor performance in most parameters gave this tape the lowest Type I rating (45%) in this survey. It was, however, still superior to a number of Type IIs.

Memorex MRX I: With the exception of modulation noise, this formulation is a worthwhile improvement over dBS. Its 50% rating is not *that* impressive, but it is better than a number of Type IIs.

SKC GX: This tape had low modulation

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Most Type II tapes have higher S/N ratios than Type I formulations, but they also have poorer 0-dB responses.

noise, but its signal-to-noise ratio was poor. Irregular sensitivity and high skew contributed to poor consistency. Overall: 48%.

SKC AX: Except for its modulation noise and 10-kHz MOL, AX *is* better than GX. Overall: 51%.

Sony HF: This is actually one of the lower scoring Type I tapes in the survey, mostly because of poor 400-Hz MOL and a low signal-to-noise ratio. The modulation noise is fairly low, but the overall rating is just 46%.

Sony HF-S: A considerable improvement over HF, it has a well-balanced collection of performances in each parameter. This is one of the better Type I tapes and is superior to most Type IIs. Overall: 58%.

TDK AD-S: This formulation has good balance in performance among all of the test parameters, except that its modulation noise is on the high side. Its overall rating of 58% makes it one of the better Type I tapes and superior to most Type IIs.

Triad F-X: Offering good, well-matched results for all the parameters, it achieved an overall rating of 61%. It tied for second among Type I tapes and is just above the best Type II in the survey.

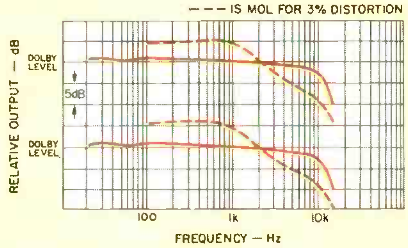
TYPE II TAPES

Most Type II tapes have low MOLs at the higher frequencies, but they usually have higher S/N ratios than Type I formulations. Most Type II tapes also have poorer 0-dB responses than do Type I tapes. The fundamental reasons for all three characteristics are these: The greater record equalization used with Type II tapes increases the high-frequency saturation, and the complementary equalization used in playback results in greater reduction of tape noise than with Type I tapes. The Type II overall ratings go no higher than 60% at this time, mostly because of low MOLs.

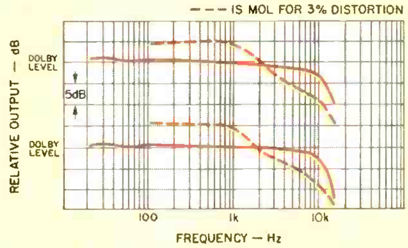
Denon HD6: This formulation is average, as Type II tapes go. The modulation noise was low and the S/N ratio high. Consistency was poor because of high bias and sensitivity offsets and higher-than-average skew and drop-outs. Overall: 49%.

TYPE II

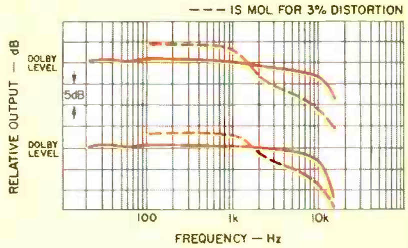
Denon HD6 (top) and HD7



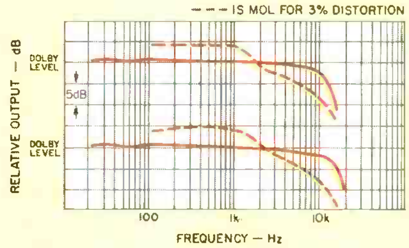
Denon HD8 (top) and Fuji FR-II Super



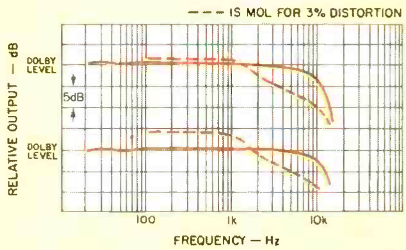
Maxell XLII-S (top) and Memorex HB II



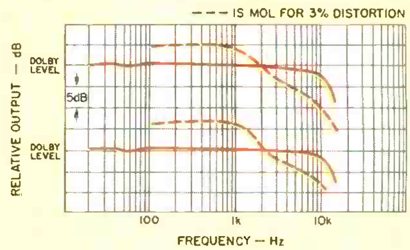
Memorex HBX II (top) and CDX II



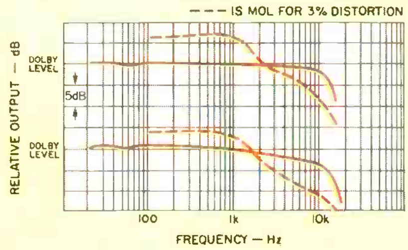
SKC QX (top) and Sony UX



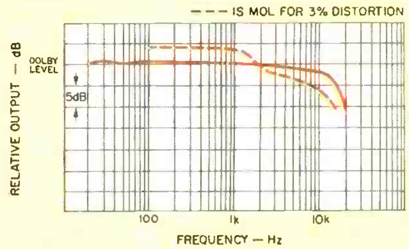
Sony UX-S (top) and UX-ES



Sony UX-PRO (top) and TDK SA-XG



Triad EM-X



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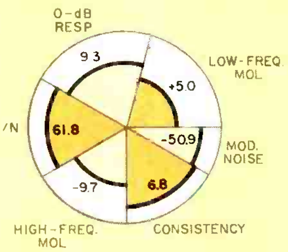
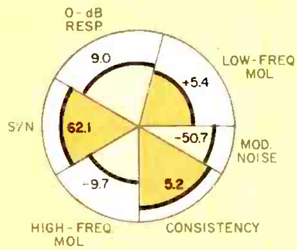
TYPE II

Denon HD6



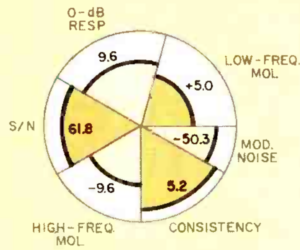
OVERALL PERFORMANCE: 49%

Denon HD7



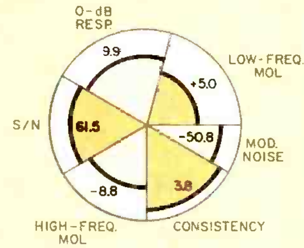
OVERALL PERFORMANCE: 50%

Denon HD8



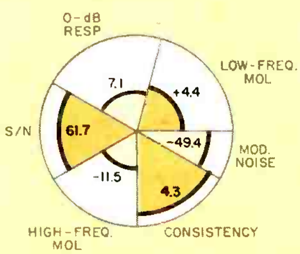
OVERALL PERFORMANCE: 51%

Fuji FR-II Super



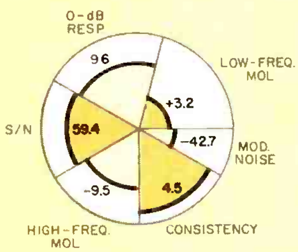
OVERALL PERFORMANCE: 54%

Maxell XLII-S



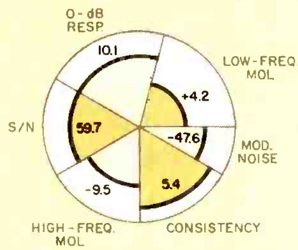
OVERALL PERFORMANCE: 40%

Memorex HB II



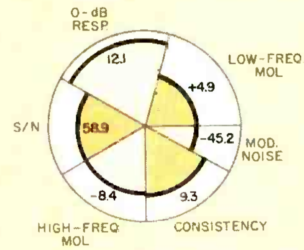
OVERALL PERFORMANCE: 42%

Memorex HBX II



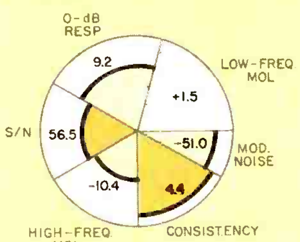
OVERALL PERFORMANCE: 47%

Memorex CDX II



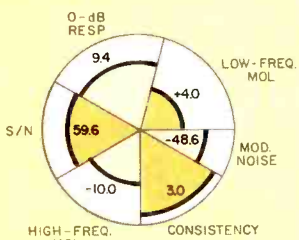
OVERALL PERFORMANCE: 51%

SKC QX



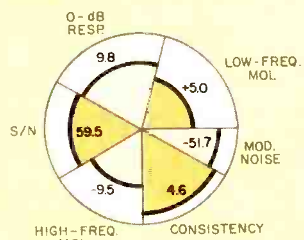
OVERALL PERFORMANCE: 38%

Sony UX



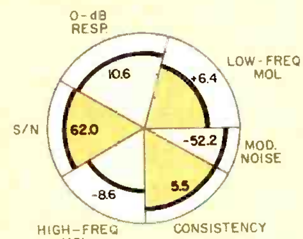
OVERALL PERFORMANCE: 46%

Sony UX-S



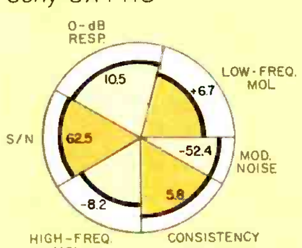
OVERALL PERFORMANCE: 51%

Sony UX-ES



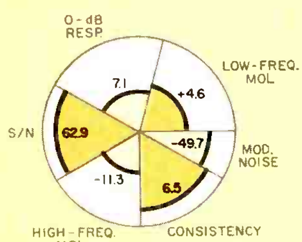
OVERALL PERFORMANCE: 59%

Sony UX-PRO



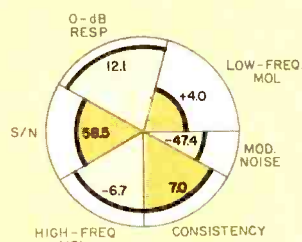
OVERALL PERFORMANCE: 60%

TDK SA-XG



OVERALL PERFORMANCE: 41%

Triad EM-X



OVERALL PERFORMANCE: 54%

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The best overall performers were Type IV tapes, with advantages that are especially useful when taping from CDs.

Denon HD7: This tape's performance is quite similar to that of HD6. In three parameters it is slightly better, and in two others it is a bit worse. Up slightly overall from HD6, to 50%.

Denon HD8: This formulation is very much like the other two Denon Type II tapes. It is a bit above the Type II average, with an overall rating of 51%.

Fuji FR-II Super: Each parameter measured higher than the Type II average, winning it one of the better ratings in this survey, 54%.

Maxell XLII-S: The results for this tape were puzzling, in that it did not demonstrate expected improvements over earlier versions. Even after rechecking, however, its low 400-Hz and 10-kHz MOLs and its restricted 0-dB response could not be denied. With an overall rating of 40%, it is next to last in performance among the Type II tapes.

Memorex HB II: This formulation's poor 400-Hz MOL and its high modulation noise were balanced out, to some extent, by a reasonable 0-dB response. Overall: 42%.

Memorex HBX II: Improvements over HB II in four parameters were most welcome. The poorer consistency of HBX II was primarily due to greater offsets from IEC bias and sensitivity. Overall: 47%.

Memorex CDX II: A further improvement in performance is achieved by this Memorex formulation: There is a worthwhile extension in 0-dB response along with desirable increases in the MOLs. On the negative side, its consistency rating is the poorest among all the tapes in this survey (primarily because of high bias and sensitivity), and its modulation noise is among the highest. Overall: 51%.

SKC QX: This formulation had bottom-limit 400-Hz MOL and a poor signal-to-noise ratio. Relatively low modulation noise wasn't worth much in this case. Overall it rated 38%, the lowest figure in this survey.

Sony UX: As Sony's bottom-position Type II tape, UX is a bit weak in its 400-Hz and 10-kHz MOLs, but it is balanced quite well otherwise. The consistency was one of the best, with low flutter, excellent 3-kHz output stability, and very little in the way of dropouts. Overall: 46%.

Sony UX-S: This formulation was not all that different from UX, but the higher MOLs of UX-S are of definite value, and its more extended 0-dB response and lower modulation noise don't hurt. Consistency was poorer because of increased bias and sensitivity. Overall, it rated 51%.

Sony UX-ES: In moving up one more position in this manufacturer's Type II tapes, all parameters were improved with the exception of consistency, which was slightly poorer. Once again, higher bias and sensitivity were the culprits. The overall rating is 59%, making this the second-best Type II tape.

Sony UX-PRO: In general, this tape was similar in performance to UX-ES, but the PRO version had a slightly greater S/N ratio, and its MOLs were a bit higher. UX-PRO also provided outstanding 3-kHz stability, but the consistency rating was poorer because of the slightly higher bias and skew. Overall: 60%, the best of the Type IIs.

TDK SA-XG: The signal-to-noise ratio of this tape is the best of the Type IIs, but this cannot compensate for the low MOLs and the restricted 0-dB response. Overall: 41%, one of the poorer Type II tapes.

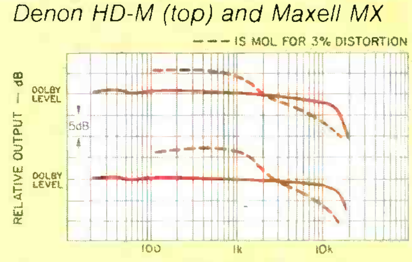
Triad EM-X: The 400-Hz MOL and the S/N ratio of this formulation are disappointing, but its 0-dB response is tied for best among Type IIs, and its 10-kHz MOL *is* the best. Overall: 54%, one of the better Type II tapes.

TYPE IV TAPES

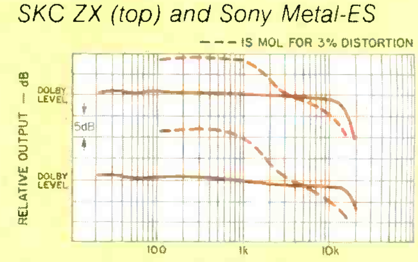
The better metal-particle Type IV tapes stand as the best performers overall, primarily because of their very high MOLs and reduced high-frequency saturation (which yields greater response extension at 0 dB). There has also been a general and slow reduction in the tape noise of Type IV cassettes since they first appeared. With the proliferation of CDs as sources, both at home and via broadcast, the performance at the high-frequency end has become even more signifi-

TYPE IV

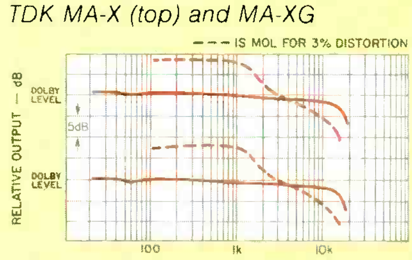
Denon HD-M (top) and Maxell MX



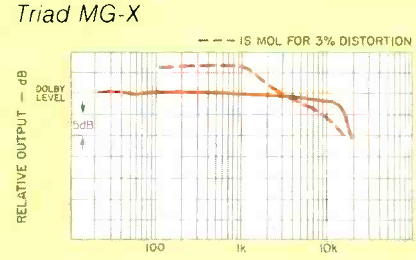
SKC ZX (top) and Sony Metal-ES



TDK MA-X (top) and MA-XG



Triad MG-X



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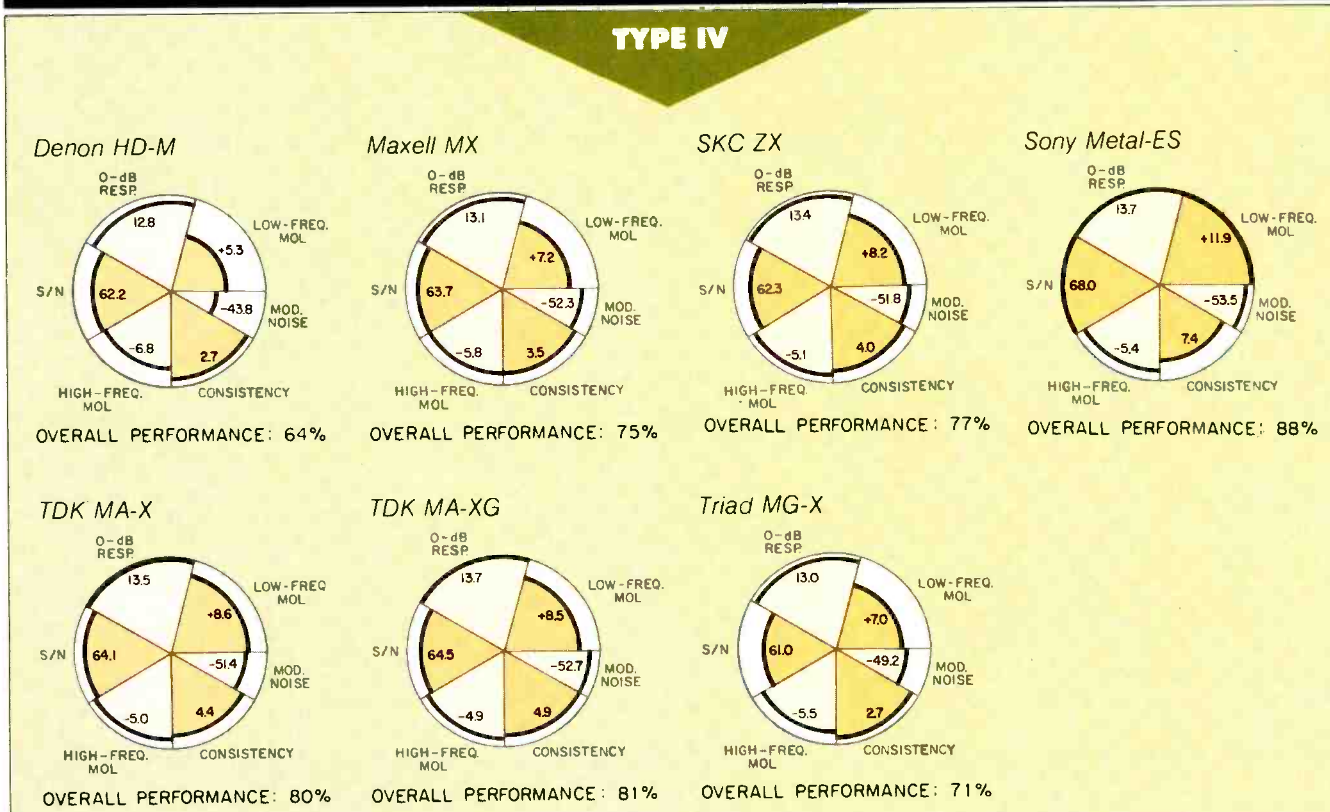

cant. Thus, metal-particle tapes have become even more interesting to the serious recordist. The Type IV tapes approach 90% overall performance.

Denon HD-M: As the pie chart for this tape illustrates so clearly, an increase in the 400-Hz MOL and a reduction in modulation noise would bring the scores for these parameters closer to this formulation's other very good scores. Overall: 64%.

Maxell MX: This tape demonstrates further that the Type IV formulations are the source of the highest performance ratings. The 400-Hz MOL is just slightly low compared to a number of other metal tapes. Overall: 75%.

SKC ZX: With its first metal tape, SKC has hit the mark quite well. All of the results are very good, with no weak areas. The excellent 10-kHz MOL is certainly worthy of note. Overall: 77%.

Sony Metal-ES: This tape had the highest 400-Hz MOL and the highest signal-to-noise ratio, both by sizable margins. It also had the lowest modulation noise, and the 0-dB response was tied for best. Bias and sensitivity offsets were the most significant factors contributing to its relatively poor consistency rating. This formulation, with an overall rating of 88%, stands as the best-performing of any type evaluated to date.

TDK MA-X: With high MOLs, extended 0-dB response, high signal-to-noise ratio, and good consistency, this is certainly a very good metal tape. Overall: 80%, third best of all tapes tested.

TDK MA-XG: As this tape uses the same actual formulation as MA-X, I should have found the same performance—and I did, pretty much. The XG version's slightly better 0-dB response, S/N ratio, and modulation noise outweighed its slightly poorer 400-Hz MOL and consistency. The discrepancies all fall well within meter-reading error limits. Overall: 81%, making it second best of all these tapes.

Triad MG-X: This is a very good performer, in general. However, its 400-Hz MOL was low for a Type IV tape, and its S/N ratio was the lowest for the metal tapes in this survey. Consistency was among the best, with zero skew and low flutter both worthy of mention. Overall: 71%.

FURTHER CHECKS

When I selected the six parameters and chose all of the various modifying factors, I expected that the Type IV tapes would show the highest ratings. I did think that the Tape II tapes might edge out the Type I tapes, primarily because of their higher signal-to-noise ratios. The fact of the matter is that the average overall performance figure was 53% for Type I and 49% for Type II. This is not a big difference, to be sure, particularly when we think about the 76% average for Type IV tapes. The Type I tapes were superior to the Type IIs in 400-Hz MOL, 0-dB response, 10-kHz MOL, and consistency. The Type IIs were superior to the Type I tapes in signal-to-noise ratio and modulation noise. As noted above, many of these differences are due to the different equalization curves used with the two types. The Type IVs were superior to both in all parameters, with the exception that Type I tapes were very slightly more consistent. For the next survey, perhaps I will have to change the weighting of the various

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I had expected Type II to edge out Type I because of higher S/Ns. In fact, the average Type I performance was a bit better.

parameters or add another parameter, but I will have to learn more before doing so.

I decided that a broad-band pink-noise record/playback compression test would have value in proving the importance of some of the parameters. The pink noise was band-limited to the range from 20 Hz to 20 kHz, and a negative shelf of about 5 dB was put in from 5 to 20 kHz to make it more music-like. For a flat display on the ⅓-octave RTA, a complementary positive shelf was put in after playback. I call this modified pink noise "PN/Music III." For my tests, I used a dual attenuator whose second section had been wired backwards so that attenuation would decrease in one section while increasing in the other. The noise was fed through the first attenuator section into the recorder, and playback was fed to the RTA via the second section. Because of the reverse connection, the total attenuation of both sections remained constant for all settings, so the signal level to the RTA remained the same at all times *except* for the effects of any compression. Buffering amplifiers were used to maintain required impedance matches for exact and equal steps of the two sections.

Figure 1 shows the results of the compression test. The level of the noise was adjusted for a 0-dB indication on an rms meter that had been calibrated to 400-Hz Dolby-level playback. The attenuator was operated in 1-dB steps over the range from −15 to +5 dB. Because of the differences between peak and rms indications, the CR-7A's peak-responding meters indicated close to "+10" at the noise level which corresponded to 0 dB on the rms meter, and the CR-7A's meters went off-scale at the +5 dB maximum level.

Three formulations were tried, one of each tape type. As is shown in the figure, the Type I and II tapes had some roll-off at the highest frequencies, even at −15 dB. The vertical spread of each trace shows the compression in each ⅓-octave band. There is normally some spread in the lowest bands because of the statistical character of the random noise. It is easy to see that the Type I tape has less compression than the Type II across the entire band, and that they both show more compression at the higher frequencies. The Type IV tape is quite superior to the other two tapes across the entire band, with relatively little additional spreading at the highest frequencies.

One thing this exercise demonstrates clearly is that maximum recording or meter levels are different for one tape than for another. The limits are lower for Type II tapes than they are for Type I tapes, in general, but the question of which tape to use for what music is more complex than is suggested by this relatively simple test. In my next survey, I will do more testing of how tapes perform in the recording of music. The desirability of the IEC bias and sensitivity references for the consistency rating will also be reviewed.

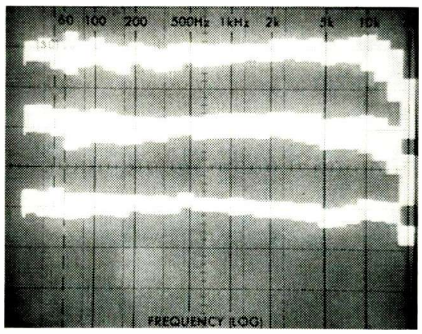

Fig. 1—Compression vs. level and frequency for high-quality Type I (top), Type II (middle), and Type IV (bottom) cassettes, over the range from −15 to +5 dB rms re: Dolby level. Thickness of traces in each ⅓-octave band shows the degree of compression (except in the bass, where statistical noise increases the spread); the trace for a perfect tape would be a thin, straight line (see text). Input signal was PN/Music III, band-limited from 20 Hz to 20 kHz. Vertical scale: 5 dB/div.

FINAL THOUGHTS

Since my previous survey, Sony Metal-ES has become even better. A caveat here, however, is that with the relatively high bias and sensitivity (re: IEC) of this formulation, it will not perform at its best unless the recordist adjusts his deck to match it.

This is also true of the other tapes whose bias and sensitivity figures are offset from the IEC Standards, especially when this discrepancy is large enough to adversely affect the consistency rating. The rule applies to tapes with extra-low or extra-high bias and/or sensitivity ratings; however, high-performance tapes are usually on the high side of the IEC bias or sensitivity specifications.

This facet is particularly important, of course, when the user employs Dolby noise reduction. Dolby NR can track accurately only when levels are matched exactly to the Dolby encoder and decoder. Level errors cause deviations in playback frequency response because the decoder makes the wrong "correction." Frequency response errors caused by poor bias matching generate level errors, which usually cause further response deviations. As a general rule, the recordist should not use a tape having extra-high bias and/or sensitivity (re: IEC) with Dolby NR *unless* the deck can be matched to it.

Digital audio tape is no longer a distant possibility. R-DAT decks have appeared in Japan, and their pricing history is expected to follow that of CD players. They have also been announced in Europe. Many factors, as yet unpredictable, will affect what happens to DAT in the United States market. Among them, of course, are the questions as to whether R-DAT decks will be required by law to include anti-copy chips and whether record companies will carve a notch from their products' frequency response to trigger such chips into action. My own studies of many CDs' spectra have shown that there is as much music energy in the area of the anti-copy notch as in the equivalent areas around it. Is this energy not, then, just as important as the energy that the notch would not affect? Let us all hope that no foolish decision is made to remove some of the music that we have been trying so hard to capture and reproduce accurately.

In the meantime, the recordist has many formulations to choose from for whatever purpose and for whatever form of cassette recorder. I hope that the pie charts presented here—as well as the text discussions—will facilitate making rapid comparisons when selecting a tape. *A*

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