REPRINT FROM "HIGH FIDELITY" OCTOBER 1973

THE CONSUMER'S GUIDE **new equipment reports** TO HIGH FIDELITY EQUIPMENT

Tandberg's Best Deck Yet

The Equipment: Tandberg 9000X, a three-speed (7½, 3¾, 1⅞ ips), quarter-track stereo open-reel tape deck in metal case with wood side panels. Dimensions: 15¾ by 16¼ by approximately 7 (including feet and controls) inches. Price: $649.50; optional RC-9 remote control, $79.50. Manufacturer: Tandberg, Norway; U.S. distributor: Tandberg of America, Inc., 8 Third Ave., Pelham, N.Y. 10803.

Comment: Tandberg, always a company with its own ideas about tape-recorder design, has done it again: The rethinking of the whole subject of how a tape recorder should best be designed, begun with the 6000X, is carried considerably farther with the 9000X. While its performance is therefore hard to compare directly to that of competing units—and even harder to document within the "normal" framework of tape-equipment tests based on more conventional equipment—it deserves an unusually long, hard look on both our part and yours.

The heart of Tandberg's rethinking is in its approach to metering. The "true" VU meter used in professional equipment (though, advertising aside, in relatively few home units) is a precisely defined device whose characteristics are predictable (to the professional) if hardly ideal (for the layman). Tandberg has scrapped everything about the professional meter in favor of one that really tells the user what is happening to the signals he is putting on the tape. First, it is a peak-reading meter; any peak lasting longer than 50 milliseconds will be registered (within 1 dB of actual value according to Tandberg) and held long enough to be read. (Professional meters require five to ten times this peak duration for accurate readings; most home units register far below true values—or occasionally above, depending on meter ballistics—on such short-duration peaks; few home units have any sort of peak-reading meter system.) Second, it registers the equalized signal actually being fed to the record head, rather than the raw incoming signal. This is important because program material with high-level high-frequency information can be driven into saturation on the tape due to high-frequency equalization boost—particularly at slow transport speeds—before conventional meters will indicate the overload. Since Tandberg's meters read the signal that is actually being recorded, they can dispense with normal safety margins, and a sustained midrange tone at 0 VU on the 9000X's meters will be recorded more than 10 dB higher than one that reads 0 VU on conventional meters. The importance of these facts will emerge as we discuss the measurements on the 9000X.

The metering is by no means the only unconventional aspect of the design, however. Tandberg uses a clever circuit configuration in its mike inputs so that the preamp is, in effect, self-adjusting to the mike's impedance. The input (recording) level control is in the feedback loop in a configuration that will encompass an unusually wide range of signal levels without overload or significant loss in dynamic range. The switching has an unusual range of capabilities that include such niceties as retaining input metering during recording even when you switch to simultaneous monitoring of the playback

signal (in many decks you lose accurate metering if you monitor the playback), the ability to feed both output channels with the same signal in playing mono recordings, the automatic mixing of left and right inputs in making mono recordings, the tape-motion and metering logic (which is, if not the most elaborate, at least the best thought-out logic systems we've yet encountered in a tape deck), and so on. Though it is far from new, the crossfield head in the 9000X is intrinsically part of the rethinking, too, since it permits Tandberg to achieve its high-frequency performance with a minimum of equalization and hence with a maximum of high-frequency headroom even at slow speeds and despite the 9000X's inherently high recording levels.

The unit may be used vertically or horizontally. The reel spindles include captive reel locks—a welcome feature, since there are no removable parts to misplace, and one that is becoming commonplace in current equipment. With the unit standing vertically the head covers are just below the reels. Both are easily removable. The upper one conceals all but the crossfield head. A light-beam sensor stops the transport automatically when the tape runs out, breaks, or includes a length of clear plastic leader. For tape editing there is a lever under the lower cover to defeat the tape lifters and head mute, allowing monitoring ("search") in fast wind and precise cueing of the tape. Cueing also can be accomplished without removing the cover by using the transport's solenoid controls, though old hands familiar with "tape rocking" may prefer to cue manually. The solenoid controls are a series of rectangular buttons to the right of the lower head cover—red for recording, then a group of four green buttons: play, rewind, stop, and wind. The transport logic's time-delay period (needed, for example, in going from a fast-wind mode to play if the tape is not to be damaged) is shorter, and therefore less irksome in hurried work, than that on most decks so equipped. Above the solenoid buttons is a four-digit tape counter. On the left side are the power on/off switch, with a pilot light above it, and the speed control—which can be reset while the unit is running.

At the bottom left are the input level controls; the output level controls are at the bottom right. The meters are just below the head covers. Across the bottom, between the two sets of level-control sliders, are left and right mike inputs (phone jacks), recording selector buttons for left and right channels (either or both must be pressed before the 9000X will record; the play button does not have to be pressed along with the recording button), a headphone jack, the sound-on-sound/echo selector switch (a separate echo position is not needed because of the automatic mono switching described above), and the source/tape buttons for each channel.

On the back panel are standard pin jacks for left and right line inputs and outputs plus a DIN input/output socket. There also is a multipin connector for the RC-9 remote-control unit, which repeats the solenoid controls of the transport. Between the record and play buttons, however, it also has a small recording interlock button; and on one end it has a "timed start" switch: off/play/record. To use this feature, which is endless fun to work with, you plug the 9000X into a standard AC timing unit (for example the kind that is used for automatic nighttime defrosting of non-frostfree refrigerators) and the timer into the wall outlet. When the timer turns on the power, the 9000X will start up in playback or in recording, depending on the position of this switch. You can therefore use it to record broadcasts that are aired while you are away from home.

Now to CBS Labs' measurements of the unit. Since all our measurements are based on NAB 0 VU, while Tandberg's specs for the 9000X are based on the recorder's own 0 VU, they don't match in any particular that relates to level—including frequency response and harmonic distortion for example. Once due allowance has been made for the many differences in measurement techniques, however, the lab findings do confirm Tandberg's data, different though they may at first appear to be. But care must be exercised, too, in comparing the findings with those for other recorders. Signal-to-noise ratios, in particular, are actually better than they look because the 9000X's metering places the signal optimally on the tape—meaning that peak levels are farther above the noise than they normally would be and therefore actual S/N is better than normal. The degree of actual improvement would depend on the way the owner uses his meters in the conventional product; intrepid recordists (or those few who really understand the workings of a conventional meter) will come closer to the 9000X's levels than those who are hesitant to let conventional meters ever go beyond the marked 0 point.

The complexity of this subject is most obvious when we come to compare the 9000X at 1⅞ ips with cassette equipment, using the same transport speed. We measure cassette equipment with respect to DIN 0 VU, open-reel with respect to NAB 0 VU. The DIN standard has no real allowance for headroom built into it (it was written with dictation use in mind, so neither low distortion nor wide frequency response were taken as prime criteria), while NAB includes a hefty headroom allowance at the normal (higher) open-reel speeds. Meter 0-VU levels on most quality cassette decks are at least 3 dB below DIN 0 VU as a result, and therefore effective S/N ratios are (depending on the meters and the way they are used) several dB poorer than the printed figures; S/N ratios in open-reel equipment tend to be better than the printed figures, and in the 9000X they can be some 10 dB better

This discrepancy in reference levels was one reason we abandoned the −10 VU record/play frequency curves for cassettes and adopted −20 VU instead. Even at the lower level the extreme top of the response curves are depressed by tape saturation (the ceiling value of tape response at high frequencies, which follows the rapidly descending curve shown in the "maximum recorded level" graphs of our tape tests). Since the open-reel 9000X is measured at −10 VU (NAB)—instead of −20 VU (DIN)—like all open-reel equipment, its response graph cannot be compared directly to the cassette curves.

Measurement techniques also influence TDH findings. The level at which CBS Labs takes the readings (−10 VU) is a compromise between one so high as to run afoul of saturation at high frequencies and one so low that it is measuring noise rather than true distortion. (THD measurements reflect all output content other than the test-signal frequency and therefore include noise as well as actual harmonics of the test frequency.) Even so, we often find it impossible to get useful figures at high frequencies (that's why TDH curves for cassette equipment frequently stop at 5 kHz), and seldom measure TDH lower than about 1 per cent. (If noise is 50 dB below 0 VU it is therefore 40 dB below −10 VU and would be measured as 1% THD—40 dB representing a ratio of 100:1, or 1 per cent.)

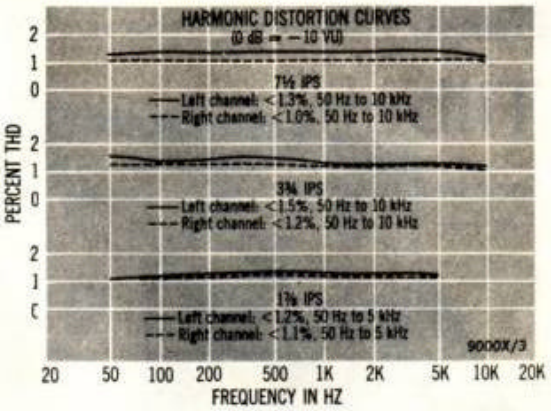
Evaluating the 9000X on the basis of lab data alone is for these and similar reasons problematical at best. Suf-

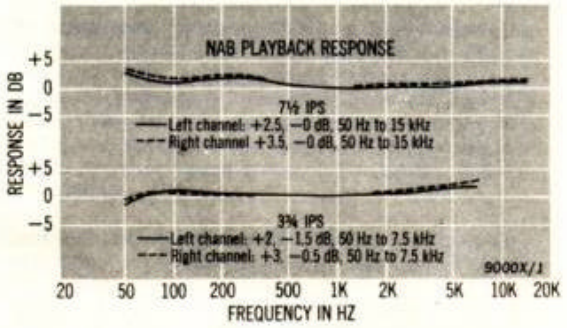
fice it to say that all the data help to document it as an excellent unit; when understood in the light of Tandberg's unique metering, the data indicate that it is one of the best on the market. Using Maxell UD-35 tape (which the lab used too), the ear confirms the measurements. We were hard put to find any difference between original and copy on the unit even at 3¾ ips and with excellent program sources. At 1⅞ the quality still is excellent—audibly a bit superior to that from a good cassette deck (without Dolby of course), though a truism of tape has been that since cassette tapes are formulated with 1⅞ ips in mind and open-reel tapes are not, the cassette deck should do better. The reason for the apparent anomaly seems to be, again, Tandberg's crossfield

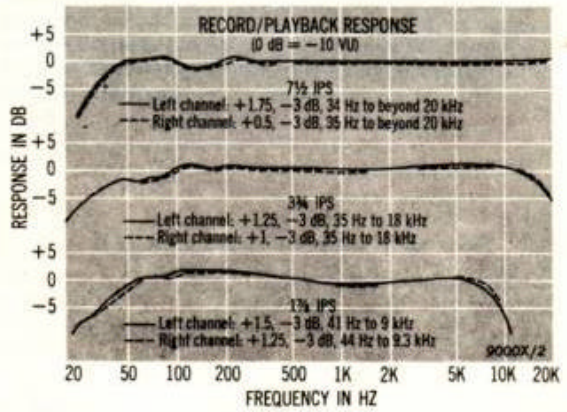
Dolby units can be used with the 9000X of course. Again because of the metering you'll find the Dolby reference level works out to something like –10 VU on the Tandberg meters. This suggests that signal levels on the tape already are some 10 dB higher than you would expect with cautiously read conventional meters and that—all other things being equal—the Tandberg already gives you the extra 10 dB of S/N claimed by the Dolby-B process. And in essence this is true. The performance of the 9000X *without* Dolby is similar to that of most decks *with* Dolby.

Mechanically and functionally the 9000X proved enjoyable to work with. Though there is no pause control as such, for example, the solenoid action is so quick and the signal sequencing so pop-free that we found we could stop and restart our recording with results comparable to those from an efficient pause—that is, without audible clicks or wowing even where timing is relatively tight. In complex copying operations the remote control proved a big advantage since it can be positioned near other controls and the 9000X itself moved out of the way (even out of sight, once you have set levels). All told, it's an exceptional unit.

CIRCLE 143 ON READER-SERVICE CARD







Tandberg 9000X Additional Data

Speed accuracy		
7½ ips	0.3% fast at 105, 120, & 127 VAC	
3¾ ips	exact at 105, 120, & 127 VAC	
1⅞ ips	0.5% slow at 105, 120, & 127 VAC	
Wow and flutter (ANSI weighted)		
7½ ips	playback: 0.02%	
	record/play: 0.02%	
3¾ ips	playback: 0.03%	
	record/play: 0.04%	
1⅞ ips	record/play: 0.11%	
Rewind time, 7-in. 1,800 ft. reel		1 min. 0 sec.
Fast-forward time, same reel		1 min. 0 sec.
S/N ratio (re NAB 0 VU*)		
playback	L ch: 56.5 dB	R ch: 58 dB
record/playback	L ch: 51 dB	R ch: 53 dB
Erasure (400 Hz at normal level)		63 dB
Crosstalk (at 400 Hz)		
record left, play right		51.5 dB
record right, play left		57.5 dB
Sensitivity (re NAB 0 VU)		
line input	L ch: 25 mV	R ch: 24 mV
mike input	L ch: 6.5 μV	R ch: 7 μV
Sensitivity (re meter 0 VU)		
line input	L ch: 92 mV	R ch: 95 mV
mike input	L ch: 16.5 μV	R ch: 18 μV
Meter action (at 700 Hz, re NAB 0 VU)*		
	L ch: –12 dB	R ch: –11.5 dB
IM distortion (record/playback, –10 VU)		
7½ ips	L ch: 1.8%	R ch: 1.8%
3¾ ips	L ch: 4.5%	R ch: 2.0%
1⅞ ips	L ch: 5%	R ch: 4%
Maximum output (line)		
re NAB 0 VU	L ch: 0.62 V	R ch: 0.58 V
re meter 0 VU	L ch: 2.1 V	R ch: 2.1 V

*See text.

*Tandberg comment to interpret signal-to-noise ratio.

*Add S/N figure to meter action figure to obtain S/N ratio (L ch 63dB - R ch 64.5) measured at 0dB on Tandberg meters. Bear in mind that 0dB corresponds to far below 3% THD from tape.