

# The Dawn of a New Recording Era

## The ZX Series

### *Auto Azimuth Alignment*

Undoubtedly the most advanced and sophisticated cassette recorders in the world today, the ZX Series launches a new era in high-fidelity cassette recording. Three revolutionary transports, each featuring exclusive Nakamichi Discrete-Head technology, 4-Motor, Dual-Capstan, Asymmetrical, Diffused-Resonance Transport, Random Access Music Memory, and Auto Azimuth Alignment. For the first time, you can be assured of perfect azimuth alignment—on any cassette—at the touch of a button. Unprecedented frequency response—to 22 kHz at standard speed, to 15 kHz at half speed! The culmination of Nakamichi's commitment to excellence in the fine art of recorded sound.



### 680ZX

The premier Model 680ZX—half-speed response that rivals that of other decks at full speed! And, at standard speed, a full 22 kHz! High-resolution, wide-range FL level indicators and 18 program RAMM. Choose your speed, choose your program. The 680ZX does it all!



### 670ZX

Full off-tape monitoring facilities with Double Dolby and two complete sets of electronics. Single-speed operation to an astounding 22 kHz! Nine program RAMM and wide-range, peak-responding meters. Outstanding performance.



### 660ZX

Performance identical to the 670ZX. Every feature except off-tape monitoring. Exclusive Nakamichi Auto Azimuth Alignment and Discrete-Head design. Master record-level fader too. An extraordinary value!





# Auto Azimuth Alignment

Now, for the first time, there exists a cassette deck so advanced in concept that it literally adjusts itself to the eccentricity of any cassette housing. In fact, there are three such decks—the Nakamichi 680ZX, 670ZX, and 660ZX. Truly, the ZX Series marks *the dawn of a new era in high-fidelity cassette recording.*

## Why Auto Azimuth Alignment?

The real question should be: why is azimuth alignment necessary at all? Put simply, if a magnetic tape is to play back properly, the magnetic pattern that has been recorded on it must line up *precisely* with the gap of the playback head. If the recording is just slightly askew with respect to the playback head, two things happen: high-frequency response is diminished, *and* the two stereo channels are not reproduced at precisely the same time, that is, there is a "phase error" between them. This phase error causes the blurry, unstable stereo imagery that frequently is associated with cassette recordings.

Let's clear up a common misconception. Others have argued that, if the record and playback heads are manufactured and mounted with sufficient accuracy, the two gaps should line up (be parallel), and there would be no phase error or loss of highs. Further, they reason that a combination record/play head would be inherently free from azimuth-alignment problems. While both of these assumptions are partially true, *neither* can be accepted at face value.

Combination record/play heads, while capable of "good" performance when designed properly (as in the Nakamichi 480 and 580M), are still compromise solutions. They cannot provide the *dynamic range, headroom, or low-noise performance* or a three-head system of equivalent precision. And, their maximum frequency response is *limited*—on most decks to something like 15 kHz, although those in the 480 and 580M are uniquely capable of 20-kHz reproduction.

Once we wish to step beyond this barrier—to achieve an unprecedented 22-kHz response at standard cassette speed, to achieve 15-kHz response at half speed (equivalent to 30 kHz at 1½ ips), to achieve the optimum dynamic range, the greatest headroom, the lowest noise and distortion of which tape is capable—*there is no alternative except Nakamichi Discrete Three-Head technology.* And, the head azimuths must be aligned perfectly. A parallelism error of as little as ¼ degree produces a 3-dB loss at 22 kHz at standard speed and a 6-dB loss at 15 kHz at half speed! Across the cassette-tape width, this translates to an accuracy of 0.00026 inch!

## A Bit Of History

Nakamichi invented the three-head cassette format. The legendary Model 1000—introduced in 1972—was the first of its kind in the world—the first deck to exploit the *full* potential of the cassette. The record and play heads in the 1000 were rather far apart; tape-cassette housings were not so precise as they are today. So, the Model 1000 required an azimuth-alignment system—a manually controlled one.

As others attempted to follow Nakamichi's lead and devise three-head decks, the "sandwich-head" concept—packaging separate record and playback head cores into the same physical housing—was developed. Others reasoned that, if the two sections were made accurately enough and aligned so that the gaps were *mechanically* parallel, there would be no need for azimuth adjustment.

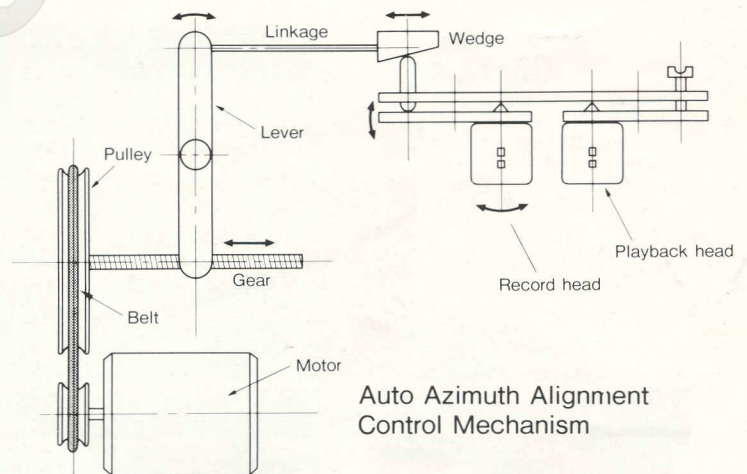
Had they checked with us, we could have told them that such seemingly good logic doesn't work that well in practice. Our research had shown that making the gaps *mechanically* parallel doesn't insure that they are *magnetically* parallel—not to the accuracy that is required! And, once the two heads are sandwiched together, there's no way to adjust them relative to each other. Furthermore, sandwich heads have notoriously high "cross-

feed" (signal feeding directly from the record winding to the playback winding) for there isn't enough room for proper shielding between the sections. The proof of the pudding lies in the testing and, to date, no sandwich-head cassette deck has approached the performance of a Nakamichi Discrete-Head design!

Since 1972, cassette housings have become much better. Moldings are much more precise than they had been, tape is being slit more accurately, guidance has improved. In Nakamichi's newest discrete-head decks—the 481/482 and 581/582—20-kHz response is achieved at standard speed *without* user-adjusted azimuth alignment. Better cassettes are just part of the story. New small heads were developed so that they could be placed close together but still remain magnetically and physically independent, and a tape-pad lifter was devised to remove this cause of mistracking. We are now able to *factory-align* the heads to yield 20-kHz response.

But, 20 kHz seems to be the limit—a sound barrier if you will. To reach beyond 20 kHz—to reach 15 kHz at *half* speed—requires that the azimuth be adjusted for the particular cassette in use to an accuracy of 0.0001 inch! So, when the 680 was introduced, it featured a manual azimuth-alignment system.

Now, Nakamichi announces a revolutionary new system—*Auto Azimuth Alignment*—featured on all models of the ZX series. At the touch of a button, the record head seeks its optimum alignment for that particular cassette and locks into position—all within 2 seconds! For the first time, the audiophile can be assured of *perfect azimuth and phase accuracy on each cassette* he records—*automatically!*



## How It Works

On a theoretical basis, the ZX-Series Auto Azimuth Alignment system works in a fashion similar to the 680 manual system. But, it is faster, simpler to use, and exceedingly accurate. When the auto azimuth is turned on, a 400-Hz calibration tone is recorded on the two stereo channels in precise phase agreement. It is reproduced immediately by each channel of the playback head. A phase-comparator determines the relative phase (error) between the two channels and drives a servo motor to correct the error.

After speed reduction, the motor moves a lever via a rack-and-pinion arrangement. The lever is linked to the record-head mounting base and pivots the record head slightly to bring the channels into perfect phase synchronism. While the adjustment is taking place, the play-button LED blinks; as soon as the adjustment has been completed, the LED glows steadily. Within 2 seconds, perfect phase coherence *for any cassette* has been achieved, and the frequency response extends to an unprecedented 22 kHz!

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