YAMAHA NS-5000

Story & interview Jez Ford

LOUDSPEAKERS

The new flagship speaker from Yamaha, the NS-5000, clearly owes its inspiration to the company's classic NS-1000, a home speaker released by Yamaha back in 1974, along with a professional monitor version, the NS-1000M. These came originally as a development of Natural Sound (NS) speakers that had been created for Yamaha's Electone electronic organs of the previous decade, but key among their attributes was the successful development of drivers that used something new – beryllium deposition.

Even today, beryllium metal is, in engineering parlance, a right bugger to work with. Its desirable properties are confounded by its high levels of toxicity, so that the few hi-fi manufacturers that choose to use it, mainly in tweeter domes, all get their work done in a


YAMAHA

△ INSPIRATION BUT NOT IMITATION – THERE ARE REFERENCES IN THE NEW DESIGN TO THESE CLASSIC NS-1000s, BUT ALSO MANY DIFFERENCES.

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very limited number of facilities. Its reputation is not untarnished – over the years there have been minor scandals where beryllium tweeters from certain suppliers were found to contain hardly any beryllium at all, as little as 0.5%, mixed with titanium, copper and a bit of grey paint.

So back in the NS-1000's day, a true beryllium driver was an achievement indeed. Beryllium's properties were well enough known — it had the classic combination of stiffness and lightness desirable in a loudspeaker cone, its 'numbers' were superior to other options such as titanium, aluminium or magnesium. But its resistance to stretching or bending caused it to split when forming it into a shape for use in a loudspeaker.

Yamaha overcame the problems by electro-beam vacuum deposition and a special alloy technology developed in its piano frame building. With an aluminium substrate and a pre-shaped copper former, Yamaha achieved a diaphragm of 99.99% pure beryllium plasma, used not only for the 33mm tweeter in the NS-1000 but also the 88mm midrange driver. The 12-inch bass driver used a more conventional paper cone, nevertheless developed just for the NS-1000.

The 1974 design was not an immediate 'classic'; in the hi-fi market it wasn't helped by being sized smaller than a traditional floorstander yet too large and heavy for bookshelf use — the solid polyurethane-coated ebony finish was no veneer but proper solid wood, so that the speakers pushed 39kg each. And it had to overcome a general bias against 'metallic' drivers, which were widely thought to sound, well, metallic. But the NS-1000 did solicit significant praise from various audio magazines which had, thitherto, not been great believers in Japanese loudspeaker design. And then the pro 'M' model was adopted as the official monitoring speaker of Sweden's state broadcaster, and later Finland's, and the speakers took off, remaining in production, with variations, for 23 years, until beryllium diaphragm production ended in 1997.

BRINGING IT BACK

As you'll read in our interview with Koji Okazaki, Yamaha's audio division has long harboured a desire to revisit the elements that made the NS-1000 and its pro version such a success. But not, we should note immediately, the element of beryllium. Instead Yamaha claims to have matched and possibly gone beyond this awkward substance in "adopting a new development diaphragm with a speed of sound comparable to beryllium in all units" — quite the claim, given that beryllium already has twice the sound propagation velocity of titanium or magnesium. The mystery material is a synthetic polymer called 'Zylon', which is manufactured in two varieties,

THE ZYLON INVASION – THE NS-5000 IS UNUSUAL IN HAVING A SOFT-DOME MIDRANGE AS WELL AS TWEETER, BOTH STRENGTHENED BY THE USE OF ZYLON, A SYNTHETIC POLYMER THAT IS STRONGER THAN KEVLAR OR CARBON FIBRE.

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Zylon-AS and Zylon-HM. It is used by NASA and in Formula One cars, and according to manufacturer Toyobo's spec sheet for Zylon, it is indeed lighter and stronger than beryllium, its density 1.55g/cm^3 compared with 1.8g/cm^3 for beryllium, and its tensile strength 5.8 gigapascals compared with only 0.24 gigapascals for beryllium, and surpassing even carbon fibre at 3.5GPa. Zylon is also amazingly flame resistant, according to Toyobo, hopefully something prospective NS-5000 owners will never need to discover.

The cabinet is again a strong feature of the new speaker, a true three-way with internal reinforcing bars and a cabinet using not ebony but Hokkaido birch-laminated plywood, finished in a true piano black gloss (of which, as an actual piano manufacturer, Yamaha has the best possible knowledge and experience). A newly developed back chamber and resonant port aims to eliminate unwanted resonances and entirely remove any box-like character from the new speaker, leaving only the Natural Sound advertised by the 'NS' model prefix.

At this pre-launch moment of writing we had only skeletal information about the NS-5000 to go on, so to discover the finer details we requested an interview with the design team. As you'll read, they were keen to expand on the reasons and design details behind the new NS-5000, inspired by, but much revised and altered from, Yamaha's great classic speaker of the past.

Koji Okazaki is the NS-5000's Chief Engineer at Yamaha in Japan, playing a key role not only in the NS-5000's development but in past designs including the company's award-winning Soavo loudspeakers. We asked him how the design of the new NS-5000 was developed.

AUDIO ESOTERICA: *It's exciting to have a new loudspeaker inspired by the NS-1000. How did design of the new NS-5000 speaker begin?*

KOJI OKAZAKI: We began by seeking a material for the NS-5000's development that could be used instead of the beryllium used in the NS-1000. We were already paying close attention to the material Zylon, which is comparable to beryllium in acoustic velocity, and we decided to develop the new flagship speaker with this material.

To achieve our ideal sound with this, we came to the conclusion that the best speaker configuration would be a three-way bookshelf design including a 30cm single woofer, 8cm midrange, and 3cm tweeter units — so as a result of this, the NS-5000 came

to feature the same speaker configuration and design as the NS-1000.

AE: *Where was the new speaker developed?*
KO: It was mainly developed at our headquarters in Hamamatsu. The number of the engineers involved in it was only three, but they worked on the development in close cooperation with our Production Engineering and R&D divisions. Regarding the sound tuning, they exchanged opinions with me as well.

AE: *And who do you see as the target market for the new speaker?*
KO: Our target customers are hi-fi users who really love music. We are very pleased to offer them in the NS-5000 a loudspeaker that can embody Yamaha's musicality along with the latest materials, technology and sensitivity. And the aim for the sound tuning of the NS-5000 was to focus not only on reproducing the high-resolution-oriented sound achieved by the NS-1000 at the time, but also on achieving today's levels of musicality with this new flagship speaker. We believed we would be able to enhance the expression of musicality still more with the NS-5000 in this high-resolution era. And this absolutely led us to approach the NS-5000's development in different ways from the NS-1000.

AE: *So what elements of the NS-1000 did you keep, and what did you handle differently?*
KO: One of the elements that stayed was the speaker driver layout, which is asymmetric, exactly as in the NS-1000. The reason for that is to reduce the negative effect caused by the sound interference on the edge of the front baffle, and to avoid large peaks or dips in the frequency response.

But yes, there were many differences. For example, we were very keen to unify the tonal colour of all *three* drivers, and so now the same material is now used on all the diaphragms, for that unified tonal colour. Also different is that we use a soft-dome diaphragm on both midrange and tweeter. And the new speaker uses a bass reflex design, with a new approach to internal-resonance reduction. Finally we have now a full piano finish on the NS-5000.

AE: *So in the final stages, was the new NS-5000 compared in listening sessions with the original NS-1000? How long did the listening process take, and did it result in many changes?*
KO: There would have been no point for that, simply because the product concept has differed so much according to the times. We spent almost two years in developing the new flagship speaker and we can't begin to remember how many times we listened to the sound, changed the parts, and tuned the sound again.

AE: *The NS-1000 was very early in using beryllium, a difficult material. Did you face similar challenges with your new material?*
KO: There are always difficulties with challenging new materials, whether now or in the past. But we always have our philosophy of bringing our possible technology together under in-house development and production.

In the NS-5000 we employ drivers with 100% Zylon diaphragms for the first time, and yes, developing those 100% Zylon diaphragms was certainly challenging for us.

AE: *We understand the Zylon dome of the tweeter is coated in Monel. Is Monel superior to beryllium, and is the coating thickness different to that on the bass and midrange drivers?*
KO: It is hard to compare between the two materials — the Monel is the material for an evaporation while the beryllium was the base material for diaphragms. Each role is totally different. The reason we chose the new material is that it helps to express the small nuances of wind instruments such as a flute and clarinet that fibre materials can't do. In addition, it prevents Zylon from degrading by ultraviolet rays.

The answer to the thickness question is that it's the same on all drivers.

AE: *Can you discuss the tweeter technology? For example, why a ferrite magnet rather than a neodymium magnet? Why copper rather than a lighter material, and why square copper rather than round? Does the tweeter use ferrofluid?*
KO: One of the most important things to design the speaker driver is, generally, the magnetic flux density. And since we achieved enough magnetic flux density with the ferrite magnet this time, we just used it.

In regards to the voice coil material, to put the first priority on the reproduction of unified tone colour, we decided to employ copper wire on all the drivers this time. The square copper helps us to wind more tightly than round copper — that is why we took the square one. And the answer to the ferrofluid is 'yes'.

AE: *What are the crossover points between the three drivers?*
KO: 750Hz and 4.5kHz

AE: *Tell us about the midrange and bass drivers —what is the diameter of the voice coils, and you say they're again all square copper wound? What geometry did you use for the bass driver voice coil/magnet?*
KO: Yes, all voice coils are wound with square copper. The voice coil diameters of midrange and bass drivers are 75mm. The geometry for the bass driver voice coil/magnet is long coil, short gap.

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AE: *Were there special considerations for the cabinets? Is the front baffle Hokkaido birch ply for its entire thickness, or is the birch ply laminated to another material to make the 29.5mm thickness?*
KO: We researched the reinforced construction of the NS-5000 anew by making full use of laser scanning and FEM analysis. All six external surfaces of the enclosure are made of white birch ply. The thickness of the front baffle is 29.5mm while the rest is 20mm.

AE: *Will there be an expansion of the NS-5000 concept into either higher or lower levels?*
KO: We are not ready yet to say if there will be higher or lower levels. But one thing that we can say now is that the NS-5000 is definitely our flagship model, and we put in as much of our knowledge and experience as was possible in its development. And we would like to expand the line-up in the future so we can continue to offer customers this hi-fi experience.