'Music is your experience,
your thoughts, your wisdom.
If you don't live it, it won't
come out of your horn.'
Charlie Parker

Living music

Music is the most powerful of all art forms in its ability to excite the emotions, quicken the heartbeat and inspire the senses. Little wonder, then, that listening to music, and in particular recorded music, has become such an important part of our lives, whatever our musical preferences.

At B&W, music is our very reason for being and our mission, as a company, is to achieve absolute perfection in sound reproduction. We believe that a high fidelity loudspeaker should be to the ear what a flawless pane of glass can be to the eye: the sound image should be able to pass through it undistorted, faithful in every detail to the integrity of the original.

So welcome to the world of B&W: a world where music is our inspiration; where truthful sound is our passion; and where our purpose is to offer lovers of music the chance to experience all the emotions and sensations inspired by a live performance, exactly as recorded, with nothing added and nothing taken away.

Transparent musicality: B&W's Nautilus™ loudspeaker, (pictured left), during a recording session at Decca UK. The Nautilus™ is B&W's state of the art loudspeaker and features a huge three dimensional soundstage, a seamless ultra-wide bandwidth, very high speed, excellent dynamics and ultra-high resolution. Reviewers have described it as 'the best loudspeaker that money can buy'.

Leading the world

Over the past 30 years, the name B&W has become synonymous with high-fidelity loudspeakers of the finest quality, from affordable compact speaker systems to the most sophisticated, hand-crafted collectors' pieces.

We are the world's leading manufacturer of top quality recording studio monitors and our Matrix™ #801 monitor is so highly regarded that it is used in more than eighty per cent of all recordings of classical music – the most demanding sound to reproduce because of its natural, unprocessed nature.

B&W scientists and engineers work closely with teams from recording industry giants such as EMI, Decca and Deutsche-Grammophon and our loudspeakers are installed in famous recording studios throughout the world, including the prestigious Abbey Road Studios in London, England.

Benefiting from this experience B&W engineers are continuing their relentless quest for the truthful reproduction of recorded music, that has been the inspiration ever since John Bowers founded the company in 1966.

The future past

Innovation has always been the hallmark of B&W. The first B&W design, the P1 Professional, featured a new type of crossover unit created by John Bowers in 1966 and the P2, which followed it in 1967, received ecstatic reviews. 'It approaches the ideal that everyone is seeking – perfection,' enthused the music magazine, Gramophone. Two years later, in 1969, B&W launched the DM70 series, made entirely in-house and incorporating B&W's first electrostatic transducers.

The DM70 was described at the time as 'a milestone of development for the next decade.' Five years later, B&W launched the DM6, the UK's first linear phase loudspeaker (which also featured the first B&W Aramid Fibre cone) and in 1979 came the start of the phenomenal #801 monitor, forerunner of B&W's current range of advanced loudspeakers and an important step on the road to our state of the art loudspeaker, the B&W Nautilus™.

B&W's first loudspeaker was the P1 professional, launched in 1966. It was quickly followed by the P2, pictured here, which caused widespread discussion in the audio industry. Its crossover technology became a B&W trademark and, almost overnight, rave reviews ensued. Even at this early stage, every B&W monitor was individually tested for its frequency response and was issued with a calibration certificate – a revolutionary concept in those days. By the time the next model, the P2H, was launched, the B&W marque was already established as the sign of an accomplished loudspeaker manufacturer.

The DM70 was B&W's first loudspeaker made entirely in-house. Hailed as a break-through in speaker design, it featured a moving coil unit for the bass driver, crossing over at 400Hz into an 11-module, electrostatic midrange/high frequency unit. Sound and design were rapturously received: 'a masterwork in the field of modern electro-acoustics and a milestone of development for the next decade', declared Germany's Funk Technik magazine. The DM70 won a special mention from the British Council of Industrial Design and sold to 25 countries worldwide.

The DM6, Britain's first 'linear phase' loudspeaker, was launched by B&W in 1975 and soon became one of the most emulated loudspeaker designs ever produced. Its unique, step-fronted baffle evolved from the linear phase concept, where the acoustic centres of the drive units were placed in the same vertical plane.

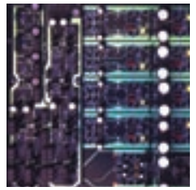
The DM6 also featured a revolutionary crossover network and an exciting new material for the midrange driver cone: woven Aramid Fibre, a man-made fibre invented by DuPont. Hi-Fi News called the DM6 sound 'satisfying, untiring, natural...without any flaw.'

The Matrix™ Esoteric series, launched in 1986, was the first to incorporate B&W's celebrated Matrix™ construction. The B&W #801, launched in 1979, adopted the Matrix™ construction in 1986 – a crucial step in its progress towards becoming the audio industry's studio reference loudspeaker.

The early Matrix™ cabinets were built round a simple structure of interlocking cells, each designed as a perfect anechoic, or echo-free, chamber. The same series also introduced aluminium-domed tweeters and a homopolymer bass driver cone.

The future present

One of the reasons why B&W has been able to set the pace for the world's high fidelity audio industry lies in our belief that excellence in design and engineering is possible only as a result of pioneering research. Some of our inventions have been overtaken by time, but many are still in use today – most notably the B&W Aramid Fibre cone, the separate tweeter housing and the Matrix™ cabinet construction. New ideas coming into play include hollow pole magnets, exponential transmission-line pipes and compliant shock mounts – each a sophisticated advance in the search for pure, undistorted sound.

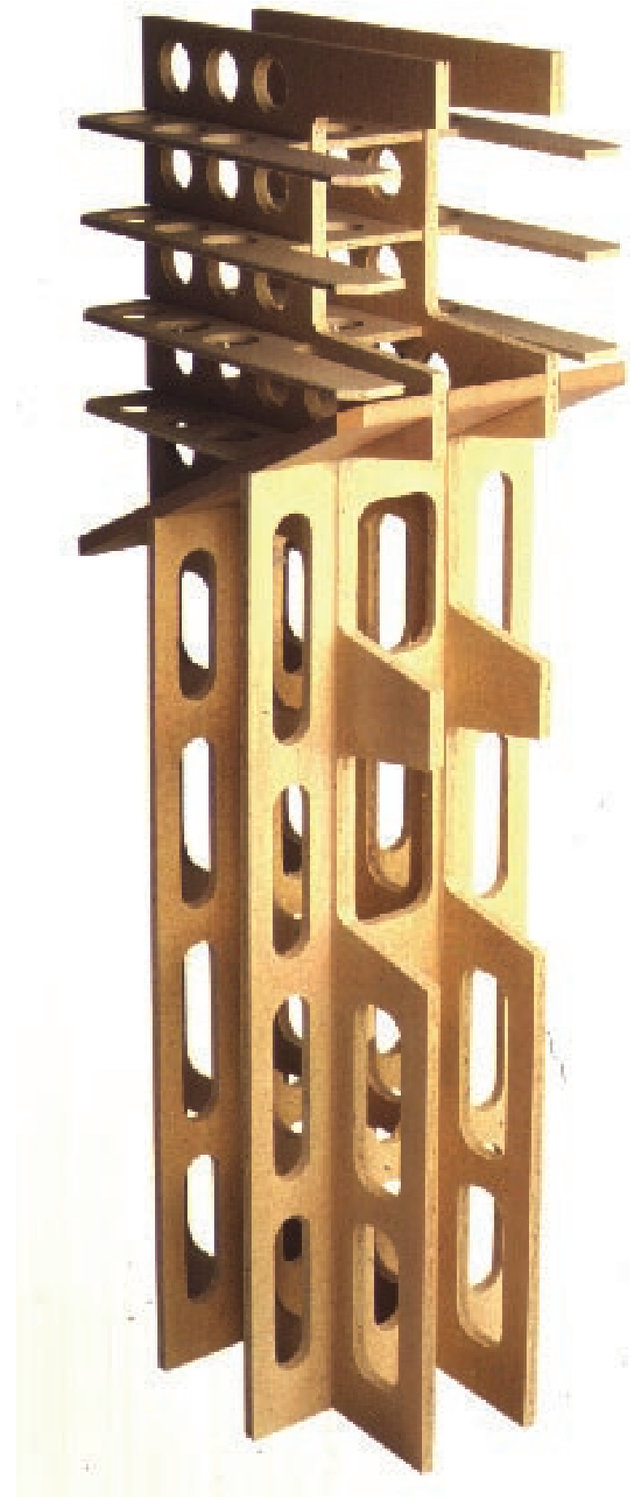


The B&W Nautilus™ uses an external crossover, left, to divide the signal from the preamplifier into four separate bandwidths. External, or 'active', crossover networks are electronically highly accurate.

B&W has pioneered the use of hollow pole magnets to minimse back reflections behind the dome. The magnets are made from neodymium, iron and boron and are extremely powerful for their size.

B&W's patented method of using Aramid Fibre for loudspeaker cones, left, has been a major factor in reducing unwanted standing waves in the diaphragm. Aramid Fibre was created by DuPont as a material for bullet-proof vests. B&W has made it one of the best-sounding materials for hi-fi speaker cones.

The homopolymer Cobex® bass driver cone, above, and the ellipsoidal tweeter housing, left, are both B&W innovations. The bullet-shaped tweeter housing made its first appearance on the acclaimed B&W Silver Signature.



Two famous B&W names: the patented Matrix™ system, left, and the Matrix™ #801 Series 3, above. The cells in the B&W Matrix™ are filled with acoustic material to create a series of anechoic, or echo-free, chambers.

Breaking the mould

In the search for audio excellence, B&W has never shied away from investigating the unusual or the avant-garde. From the original stepped baffle of the DM6 to the cool modernity of the Emphasis, pictured opposite, B&W's policy has been to explore every possible avenue in the pursuit of accurate sound reproduction.

Over the years, the search for transparent, 'uncoloured' sound, has allowed our engineers to follow numerous leads, some ending in disappointment, others opening up further areas of research and all of them gradually adding to our knowledge and expertise.

At one point, for example, our energies were concentrated on developing dipole or backless loudspeakers, where rearward-travelling sound waves could radiate freely away from the drive units. (At high and midrange frequencies, sound tends to travel in a beam, front and back, and rearward-travelling sound waves sometimes rebound off internal cabinet surfaces).

But the backless dipole soon proved unsatisfactory. Despite a variety of inventive baffles, which ranged from medieval sun shapes to Islamic-style screens, listeners could always identify the cone materials used in the drive units.

Then came the breakthrough – the result of an exemplary piece of lateral thinking. While working on prototypes for the Nautilus™ loudspeaker, the engineers decided to experiment with a traditional shape, familiar for centuries: the plain, tapering horn. Only in this case, a horn which is used not to transmit sound but to absorb it.

An inverted horn becomes a cabinet for B&W's inventive Emphasis loudspeaker, shown opposite. The metal-domed tweeter is housed in its own pod, attached to the horn by a short stem. The bass-midrange drive unit benefits from the use of a Aramid Fibre cone.

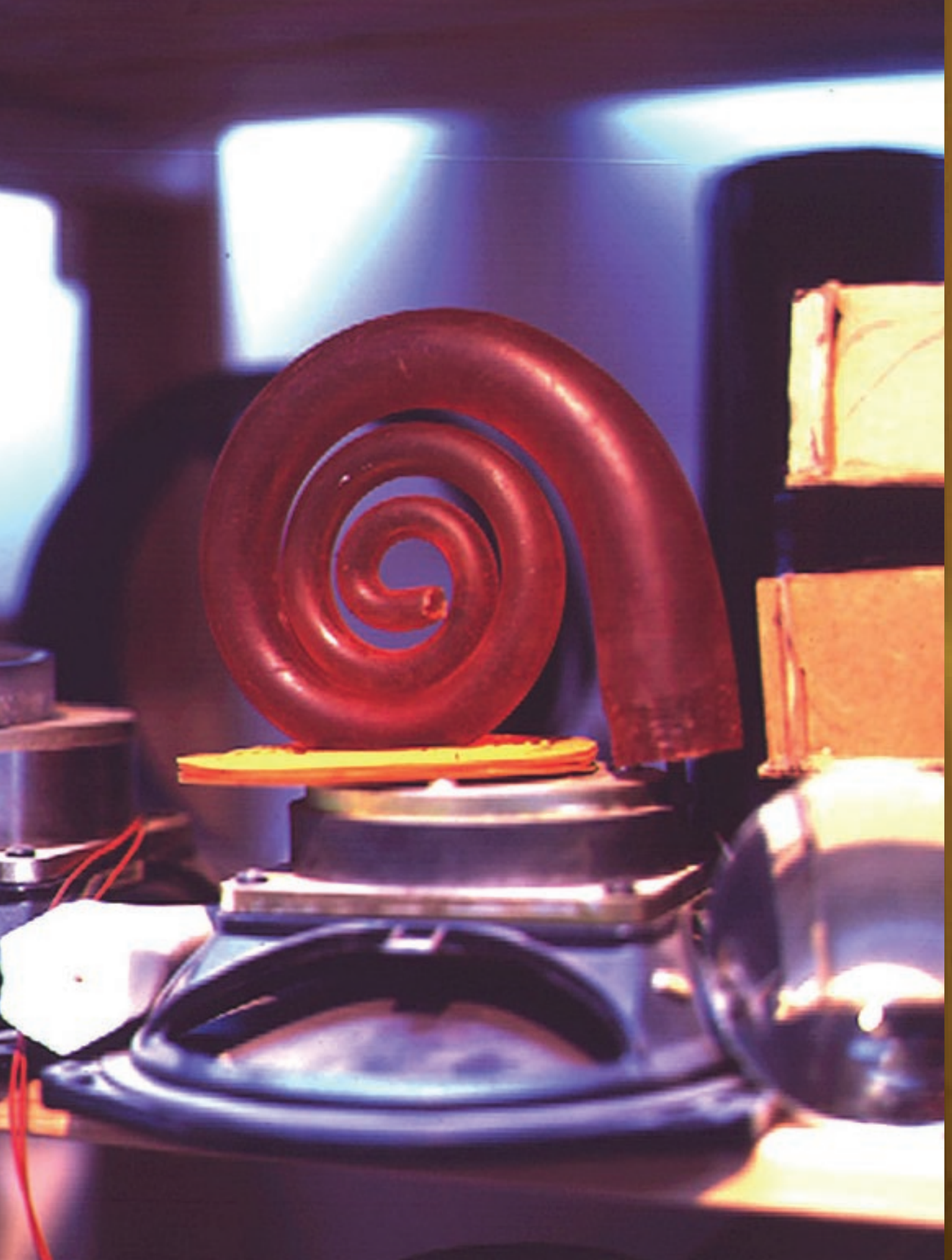
A touch of genius: computer-aided techniques are essential for designing the exact specifications of a modern hi-fi loudspeaker, but traditional model-making is important too – especially in the early stages of developing new prototypes. Pictured here are some of the components which were used, discarded or adapted during the three year process of creating the B&W Nautilus™.

Taking shape: the outcome of original research is beginning to show in this early, small-scale model for the Nautilus™, pictured left. The four drivers – at this stage, a tweeter, two trebles and a bass – are already in place, though the bass is hidden behind the fascia, and the principle of a softened pyramid shape is emerging in the housing for the top three drive units. Early transmission-line pipes flow to the rear.

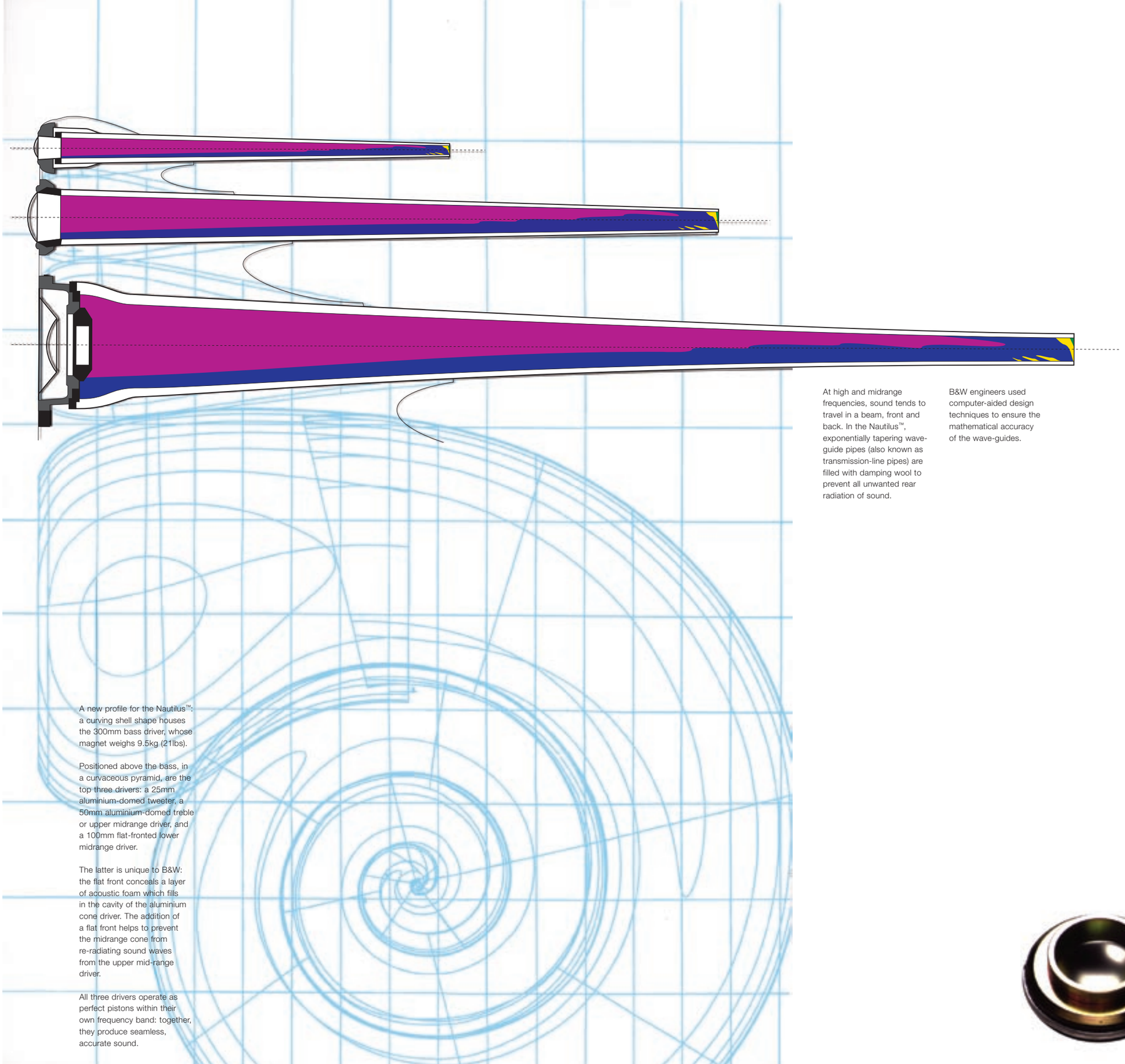
Flowering briefly: the parabolic petal shapes and the massed, screen-mounted driver cones, shown in the top row, were part of early experiments into dipole, or backless, loudspeakers. But dipoles soon proved to be only a partial solution because listeners could identify the specific materials used for the driver cones.

Housing the drivers: pictured in the middle row are an early coiled duct for the Nautilus™ bass drive unit and a variety of discarded speaker components, including some aluminium upper-midrange domes. B&W's aluminium-domed tweeter made its first appearance in the #800 series, but experiments carried out during the development of the Nautilus™ showed that all four drivers could be made with aluminium cones and domes.

An unusual shape: loudspeaker enclosures have always tended to be rectangular in shape, but in developing the Nautilus™, B&W engineers found that curved ducts and rounded surfaces make an important contribution towards eliminating cabinet resonance.



The art of discovery



At high and midrange frequencies, sound tends to travel in a beam, front and back. In the Nautilus™, exponentially tapering wave-guide pipes (also known as transmission-line pipes) are filled with damping wool to prevent all unwanted rear radiation of sound.

B&W engineers used computer-aided design techniques to ensure the mathematical accuracy of the wave-guides.

A new profile for the Nautilus™: a curving shell shape houses the 300mm bass driver, whose magnet weighs 9.5kg (21lbs).

Positioned above the bass, in a curvaceous pyramid, are the top three drivers: a 25mm aluminium-domed tweeter, a 50mm aluminium-domed treble or upper midrange driver, and a 100mm flat-fronted lower midrange driver.

The latter is unique to B&W: the flat front conceals a layer of acoustic foam which fills in the cavity of the aluminium cone driver. The addition of a flat front helps to prevent the midrange cone from re-radiating sound waves from the upper mid-range driver.

All three drivers operate as perfect pistons within their own frequency band: together, they produce seamless, accurate sound.

B&W's reputation for original research is widely revered throughout the audio industry. Our teams of scientists and audio engineers enjoy the freedom to explore new ideas as they arise, often regardless of cost.

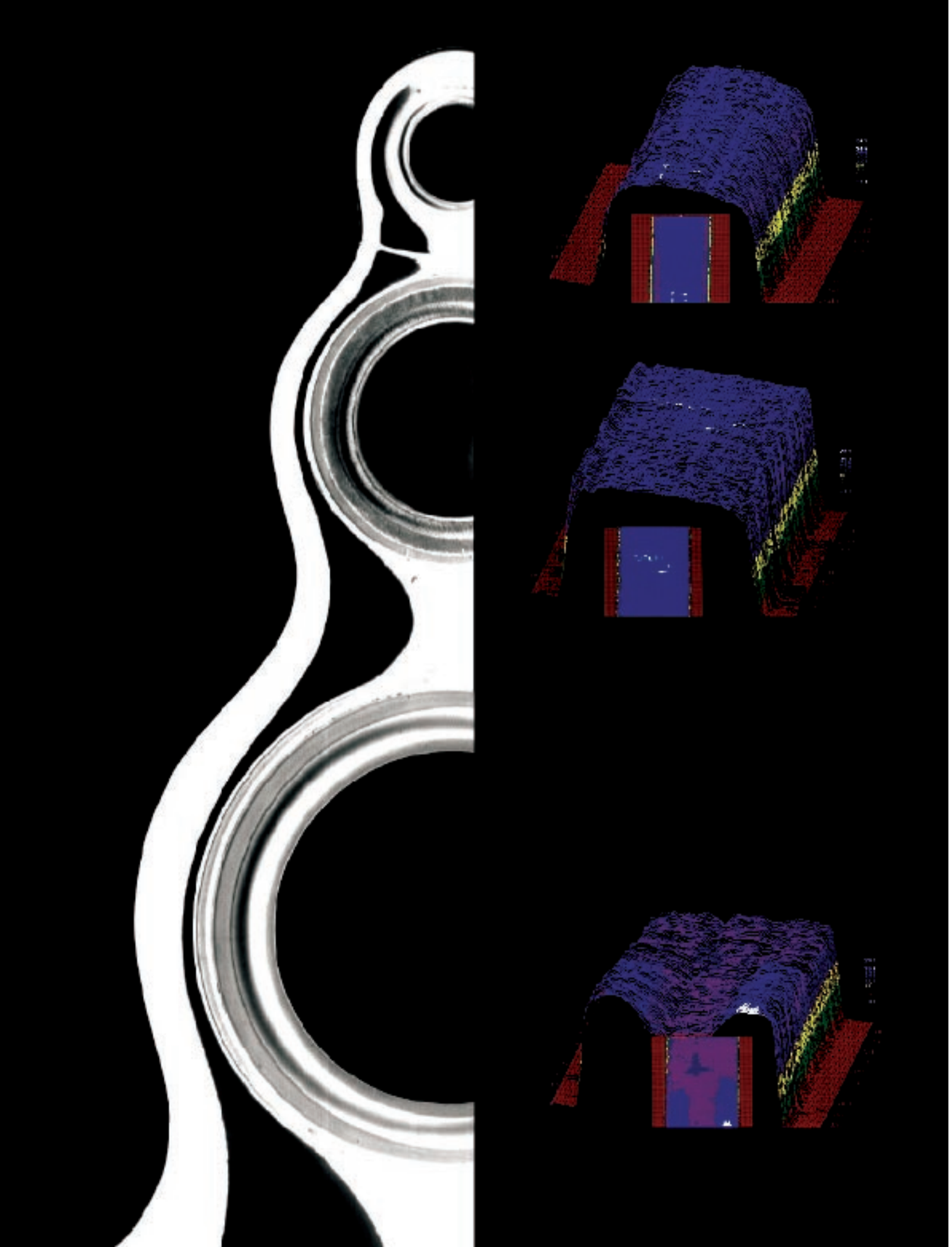
This policy of open-ended research has led to several of the advances now incorporated into the B&W Nautilus™: in particular, the combination of hollow pole, rare earth magnets and the distinctive, horn-shaped transmission-line pipes.

The two are inextricably linked and arose from a moment of discovery. In an attempt to get rid of unwanted cabinet resonance around the upper midrange drive unit, B&W engineers decided to use a rare earth magnet whose pole piece could be hollowed out to create extra space, freeing the path for rearward-travelling sound waves.

But initial tests showed that the drive unit's pear-shaped enclosure would then produce an unacceptably sharp peak in the response, known as a high 'Q' resonance. By replacing the pear-shape with an inverted horn, the problem disappeared.

The results have proved remarkable. The combination of an acoustically transparent magnet and an exponentially tapered horn absorbs virtually all rearward radiation of sound – creating the nearest thing yet to an infinite baffle.

B&W engineers chose rare earth magnets for the tweeter and midrange drivers on the Nautilus™. The magnets are made from neodymium, iron and boron and the hollowed-out pole piece is unique to our top of the range loudspeakers. Hollowing out the pole piece creates space for rearward-travelling sound waves to pass through the magnet. Another Nautilus™ innovation has been to reinforce the rim of the tweeter dome with carbon fibre: this simple step raises the first break-up mode by a staggering 30 per cent, pushing it up to twice the limit of audibility.



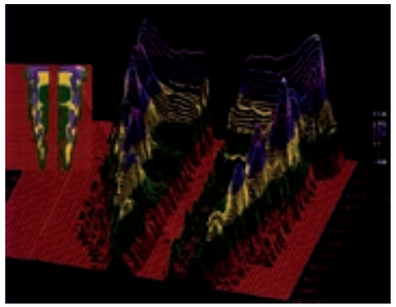
The science of sound

Visitors to B&W's Research Establishment in Steyning, UK, often compare it to a university department, set apart, as it is, from our day-to-day manufacturing operations. Indeed, our 'University of Sound' is widely regarded as one of the most sophisticated audio laboratories in Europe, home to a research and development team of 22 gifted scientists, engineers and technicians. Their work has enabled B&W to develop some of the world's most advanced measurement and forecasting techniques for loudspeaker design.

Our system of laser-doppler velocimetry, for example, allows us to measure, down to 1/3000 of a millimetre, the vibration of a loudspeaker cone or dome (B&W was the first hi-fi company in the world to adopt this technique). We have also developed computer-aided 'finite element analysis' programs, which enable us to build drive units, step by step, based on an accurate prediction of how the component parts of a loudspeaker will perform – separately or together.

Measurement techniques include colour-coded impulse scans, which show how sound waves behave when radiating outwards from a cone or dome; we have developed three-dimensional 'die-away' plots, which analyse patterns of stored energy which continues to radiate after a sound wave has passed. We can even measure sound patterns in the air around loudspeakers; and we have pioneered digital signal processing to analyse crossover performance and 'on-axis' response.

Finally, we call on subjective listening tests. Our team of experts analyse the performance of B&W loudspeakers in a variety of domestic and studio settings, allowing us to fine-tune each new model to create the unique B&W experience.



Colour-coded laser scans reveal the difference in performance between Nautilus™ drive units, illustrated opposite, and a typical bass/mid-range plastic cone, above. Note the perfect distribution of the Nautilus™ sound waves, measured by unbroken bands of colour along the side of the plot, compared with the peaks and troughs of the plastic cone.

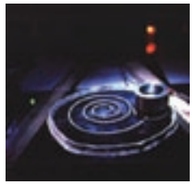
Learning from nature

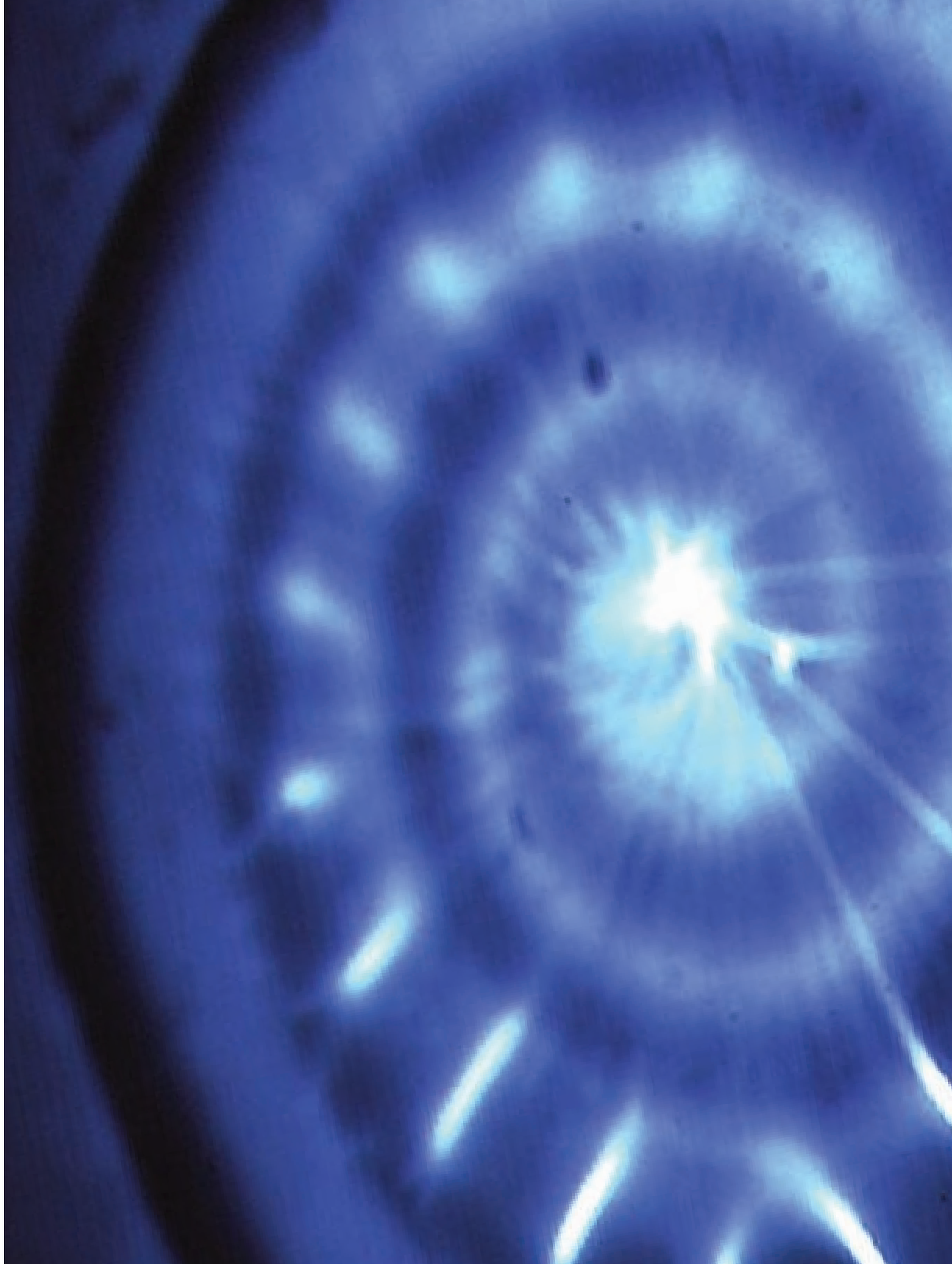
One of the problems which emerged during the long design process for the Nautilus™ was how to handle the bass enclosure. B&W engineers had already discovered the transmission-line principle for the top three drivers but originally thought that a closed box would be fine for the bass.

But listening tests showed a discontinuity between the bass and the other three drive units. To match the sonic purity of the tweeter, the treble and the midrange driver, the bass also needed a wave-guide pipe – and this created a dilemma. The low frequency requirement dictated a non-tapering pipe 300mm in diameter and three metres long (giving a total cubic measurement of 200 litres) – clearly an impractical solution.

So it was back to the drawing board – and, in their relentless pursuit of true sound, the B&W research team came up with another of B&W's great technical advances. Experiments showed that a curled-up horn-shape would perform exactly as required but would occupy a much smaller volume than a straightforward pipe. The 200 litres could be reduced to less than 120 litres, with no loss of performance.

In fact, laboratory tests, illustrated left, show an inherent advantage in a curved shape. A vibrating ball immersed in water produces outward-radiating waves, similar in pattern to sound waves, which vary in reflection according to the shape of an enclosure. The square-shaped enclosure shows a high level of interference, while the curved edge produces no discernible interference at all: the waves propagate outwards along the tube without reflection.





Material perfection

B&W's search for the best possible quality in production means that we devote a great deal of time and care to specifying materials and components – and then to finding suitable specialists to make them.

For example, we use only a particular grade of die-cast aluminium for our chassis components (whereas other companies will sometimes opt for mild steel, which is cheaper); we order a special grade of silver for encasing the wiring in some of our cables; and we find the best specialist manufacturers to make our cabinets and shells.

For the Nautilus™ body, for instance, we have engaged the services of Raceprep, a specialist company which is expert in the formulation of fibre-reinforced composites. (Raceprep is well known in the Formula One racing car industry, where components and materials are life-critical and standards are correspondingly high).

Because of its complex shape, Raceprep engineers make the Nautilus™ shell almost entirely by hand, using a resin which has been identified by computer analysis as perfect for its purpose – ensuring maximum strength and durability.

The same attention to detail has been applied to the finish for the Nautilus™ shell. B&W's paint and lacquer system is imported directly from Germany, where it is supplied only to the leading names in the luxury car industry, such as Porsche and Mercedes Benz. To ensure the best possible result for B&W, advisers from the paint manufacturer formulated a special baking and curing process, unique to the Nautilus™.

Needless to say, perfectionism of this kind means that making a Nautilus™ cabinet is a slow and painstaking process – it takes nine days, including curing time, to make just one shell.

The Nautilus™ shell is all hand-made, except for two parts: the internal spiral which sits inside the shell's gleaming exterior and a dual-purpose bolt, which anchors the shell to its plinth and provides a conduit for wiring from the power amplifiers.

Following pages: a skilled paint finisher applies a final coat of lacquer to the Nautilus™ shell. Twelve different applications containing aluminium and mica particles give the Nautilus™ its stunning finish.

Sound work

B&W's legendary reputation has been created not only by technical excellence and ground-breaking research, but also by the dedication of our workforce and their commitment to achieving the best possible manufacturing standards.

Over the years, B&W has built up a team of highly skilled people, who use a mix of hand-assembly techniques and semi-automatic production processes to make our drive unit components – a combination which gives us speed and flexibility when it comes to producing new prototypes or making complicated parts. It also means that we can achieve world class levels of quality in manufacturing.

For example, all B&W voice coils are wet wound with high temperature resin and then baked in a special oven to ensure enhanced performance and durability. 'Wet-winding' is a time-consuming process and some manufacturers see it as uncommercial and unnecessary. At B&W, we believe it to be an essential step in achieving the kind of quality and reliability for which our loudspeakers are renowned.

Quality in the making: B&W production engineers, pictured left, insert a bass drive unit into the Nautilus™ shell. Chassis for the heavy bass driver are individually sand-cast to achieve the required aerodynamic shape. The 300mm driver incorporates a 9.5kg (21lb) magnet and a 100mm (four inch) voice coil and is capable of handling 500w.

Each Nautilus™ is auditioned before its quality certificate is signed. Listening tests are carried out in a wide varity of domestic settings as part of the B&W design process.

A drive unit for the Nautilus™ is auditioned mid-way through the manufacturing process. Details of the test are included in the literature which accompanies each finished B&W loudspeaker.

A final audition

Our commitment to the best means that quality procedures are built in to all stages of production of a B&W loudspeaker, from individual testing of each bought-in component to rigorous checks at every stage of our own production line and a final test of every finished assembly.

In the case of the Nautilus™, each loudspeaker is then auditioned before it receives its final seal of approval.

By the end of the process, everyone who has contributed towards making, testing and checking our loudspeakers is named on the B&W quality certificate – an important element in recognising the dedication of our production teams.

We also believe in publishing our measurements. B&W's top of the range loudspeakers are delivered with a comprehensive range of documents, giving precise details of each speaker's overall performance and the time and date of testing.

Documents accompanying the Nautilus™ include performance plots for all four drive units, showing their near-field response and their deviation in sound pressure levels from the laboratory standard. The overall acoustic deviation for the Nautilus™ is less than half a decibel and this is corrected by the electronic crossover.

Redefining audio

The B&W Nautilus™ has been greeted worldwide as an outstanding loudspeaker which will shape the direction of the audio industry well into the next millennium.

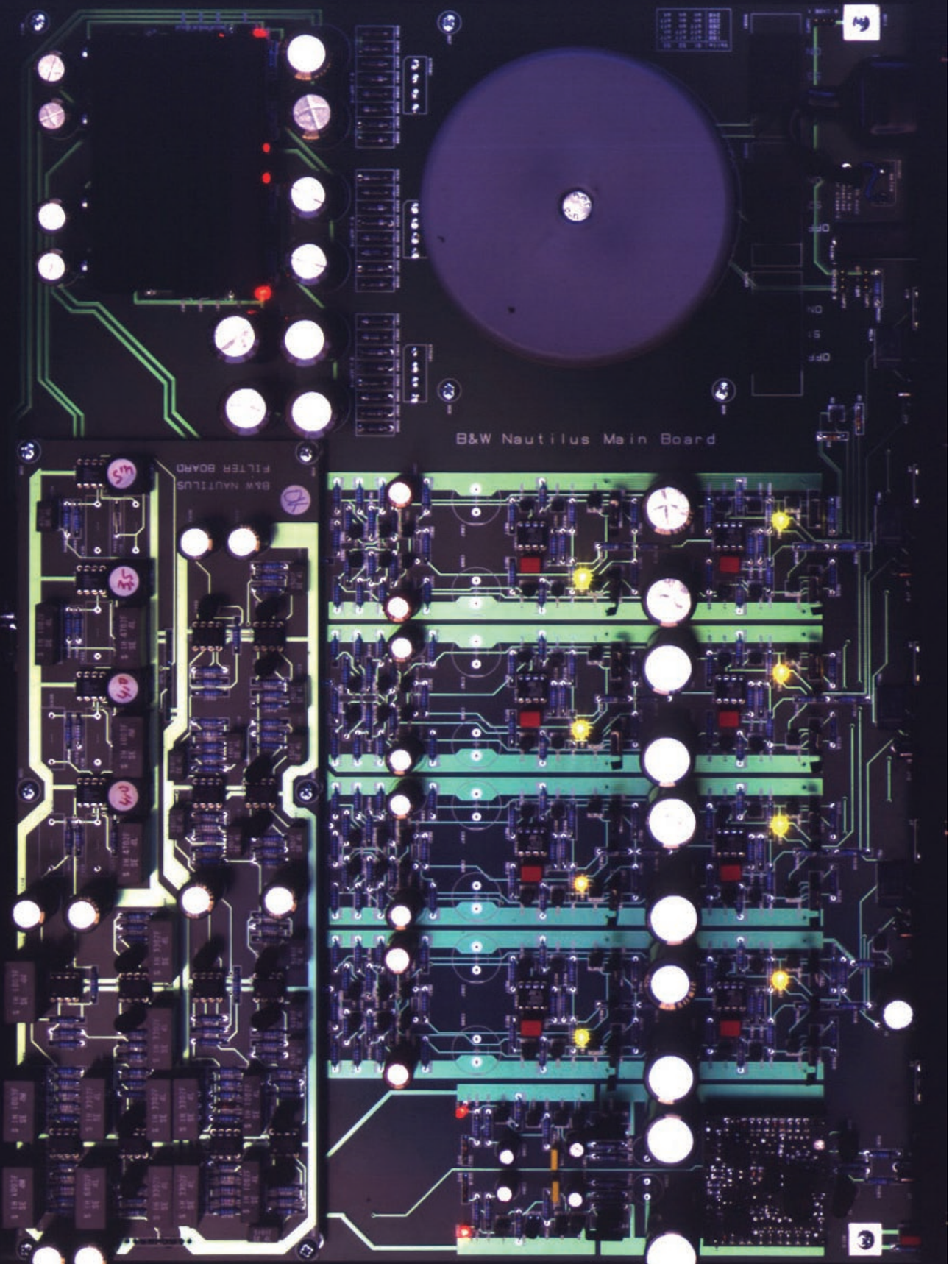
Already sought after by cognoscente, it has been been unashamedly designed with the serious audiophile in mind, not only because of its size and shape but also because of its 'active' design – the crossover network is positioned between the pre and power amplifiers.

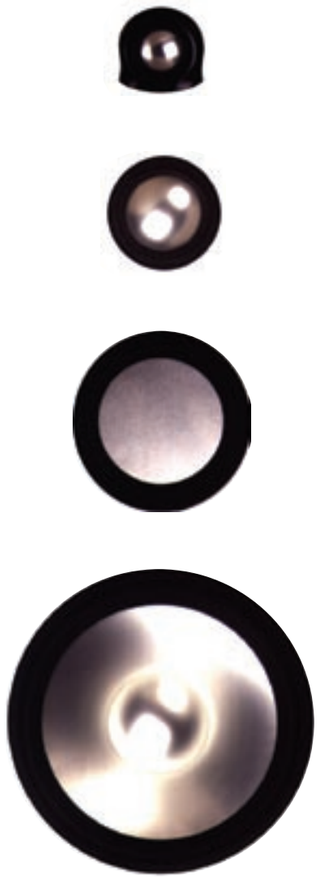
This means that a full Nautilus™ system needs one stereo pre-amplifier and eight monobloc (or four stereo) power amplifiers per pair (amplifiers of 100w upwards are recommended, with 500w being optimum for the low frequency drive unit).

With all four drivers acting as perfect pistons within their allotted frequency bands, the Nautilus™ is able to create a truly seamless, three-dimensional sound stage, accurately reproducing all the fundamental frequencies and a full spectrum of overtones right across the audio band, together with all the spatial and time differences picked up in a live performance.

The Nautilus™ is named after the sea-creature and shares its shell-shaped structure. But unlike its namesake, which measures only 22cm or less, the B&W Nautilus™ stands more than a metre high and weighs a mighty 110kg (242 lbs), including the plinth. The curved, retro styling of the enclosure was created by designer Alison Risby. The plinth is made of terrazzo-style material, polished to a gleaming finish.

Active performance





As an active loudspeaker, the Nautilus™ relies on an external crossover network, illustrated opposite, to filter the signal from the pre-amplifier to the power amplifiers and then to the drive units. This means that the Nautilus™ network, because it handles 'low level' signals, can be engineered from components which are capable of a higher degree of accuracy than those used in a passive system.

It also means that B&W is able to achieve linear phase filtering at each of the three crossover points: the low-pass filter gives a fourth-order Bessel acoustic response which is then subtracted from the all-pass filter to provide the high pass filter. This allows the Nautilus™ to achieve an almost perfect time-alignment of the various driver signals and a 'maximally flat' frequency response of plus or minus half a decibel through the crossover.

Nautilus™ crossover networks include components which have been hand-made. The networks are individually fine-tuned to modify driver performance to suit listening room requirements; and because B&W crossovers are carefully matched to each drive unit, both driver and network can be updated to keep pace with new refinements.

The four Nautilus™ drive units have been designed to operate effortlessly within their own frequency bands. The voice coils are wound on polymide formers to eliminate eddy-current losses and all four drive units are 'decoupled' from the cabinet walls by compliant washers and O-rings. A unique rear shock mount holds the massive bass driver securely in place, whilst still allowing desirable movement of the chassis.

Shaping the future

The B&W Nautilus™ is available in three different colours, blue, silver and black. The paintwork contains aluminium and mica particles, giving the Nautilus™ its distinctive pearlescent effect. Twelve different applications are involved and the final finish contains an ultra-violet light screen to protect the Nautilus™ colour.

As with a concept car, some of the developments featured in the Nautilus™ are already beginning to filter down to other speakers in the B&W product range.

Yet there remain some interesting avenues still to be explored. Our scientists are already working on ways to develop the performance of the Nautilus™ drive units to reduce their number from four to three or less. Our cabinet designers are examining how to develop the transmission-line principle into a more conventional, high-fidelity furniture format – Traditional, rectangular enclosures will remain the choice of many, not only for ease of positioning within the home but also because they cost less.

In fact, research has already shown that Nautilus™ wave-guide pipes do not necessarily need to be straight. A development which opens up the possibility of all four waveguide pipes being curled up to fit within a box, without loss of performance or increase in distortion.

But for afficionados, the Nautilus™ will be treasured for what it is – a remarkable piece of audio sculpture whose form, like all great designs, has been dictated by its function. Hand-made and produced in a limited edition, the Nautilus™ is destined to become a true collector's item.

Listen and you'll see

In the search for transparency of sound, the Nautilus™ represents a true audio miracle. It can only be limited or coloured by the source, amplifiers and cables, without any colouration of its own.

It symbolises all the qualities of innovation, dedication and love of music which have inspired B&W engineers, designers and production teams ever since our company was established over 30 years ago.

Already hailed as the most musical transducer in the world, the Nautilus™ enables the listener to hear nuances and subtle dynamics hitherto unattainable, offering a level of sonic accuracy unmatched by any other speaker.

Available, on order, from B&W-approved dealers worldwide, the Nautilus™ offers a unique chance to hear music exactly as recorded – detailed, vibrantly alive, full of power and unhindered by speaker distortion or cabinet diffraction.

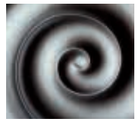
Listen and you'll see!

Nautilus™

Nautilus™ is our touchstone: the result of a groundbreaking, five-year research and development mission to achieve, as near as possible, the perfect loudspeaker. The things we learnt by developing something so new, so different and so uncompromised have become our own rules for speaker design, and have informed every range we've created since. That's down to advances in materials, crossover components and cabling, and to its pioneering use of tapering tubes in place of the conventional box cabinet.

Midnight Blue

Black



Silver

What you hear from Nautilus™ is as different from ordinary speakers as what you see. Its shape and sound were created by straight and spiralling tapered tubes filled with absorbent wadding, designed to soak up wayward sound waves from the back of each drive unit and allow the sound from the front to reach you in as pure a state as you're ever likely to hear. In form and performance, Nautilus™ was and still is revolutionary.

Specifications

Nautilus™

Model	Nautilus™
Features	Nautilus™ tube loading Active crossover
Description	4-way tube-loaded loudspeaker system
Drive units	1x 300mm (12 in) aluminium cone bass 1x 100mm (4 in) aluminium/polymer sandwich cone lower midrange 1x 50mm (2 in) aluminium dome upper midrange 1x 25mm (1 in) aluminium dome high-frequency
Frequency range	-6dB at 10Hz and 25kHz
Dispersion	Within 2dB of response on reference axis Horizontal: over 60° arc Vertical: over 10° arc
Crossover frequency	220Hz, 880Hz, 3.5kHz
Power amplifier requirements	4 channels per speaker, rated 100W-300W continous into 8Ω on unclipped programme (each channel to have identical gain and phase)
Dimensions	Height: 1210mm (47.6 in) Width: 430mm (16.9 in) Depth: 1105mm (43.5 in)
Net weight	Speaker: 44.5kg (98 lb) Plinth: 42kg (92 lb) Total: 86.5kg (190 lb)
Standard finishes	Midnight Blue, Black, Silver